WTCS Summit
June 16-17, 2023
Houston, TX

PreK to 2nd Grade Teachers Noticing, Naming, & Connecting Computational Thinking to Literacy Learning

Sean Justice & Lori Czop Assaf
Texas State University
Friday, June 16 • 1:15 pm

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This presentation describes early elementary lesson plans that integrate CS/CT with reading, writing, and storytelling. In our CS education research we've found that PreK to 2nd grade teachers gravitate to ELA content when exploring computational thinking with their students. This presentation shares cross-curricular learning activities designed by teachers to combine CS/CT with literacy. Our goal is to share and unpack learning activities that expand PreK-2nd grade ELA content with computational tools and materials, where students design, write, and perform stories with ScratchJR, Scratch, and various robotics platforms.

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EPK-2

Exploring preK-2nd grade teachers' abilities to
NOTICE, NAME, and CONNECT
computational thinking to the curriculum.

Art • Science • Storytelling

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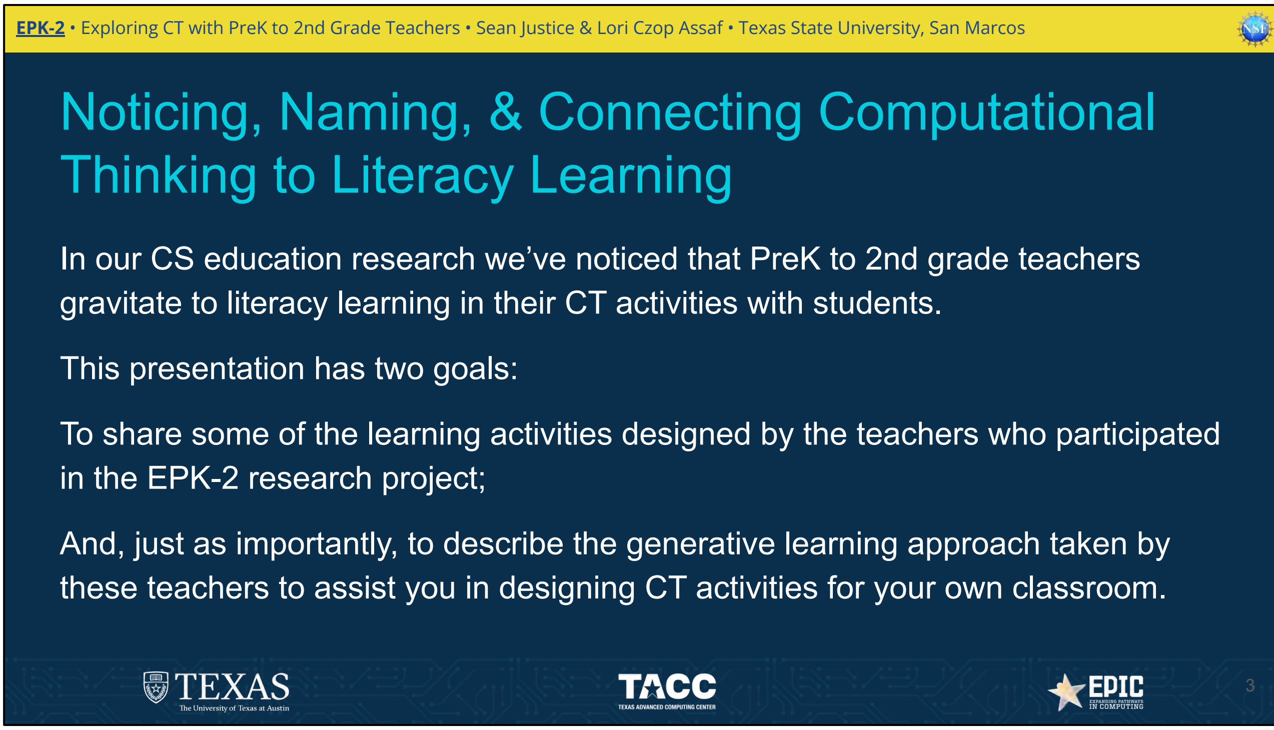

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EPK-2 • Exploring CT with PreK to 2nd Grade Teachers • Sean Justice & Lori Czop Assaf • Texas State University, San Marcos

Research Context: Exploring CT with PreK to 2nd Grade Teachers

A year-long professional learning program to facilitate teachers' CT learning.

First, teachers explored CT by making art, doing science, and telling stories within a professional learning community.

Then, teachers designed and implemented CT learning activities in their classrooms.

Kindergarten teacher prompting students to make a hide-and-seek game on ScratchJr.

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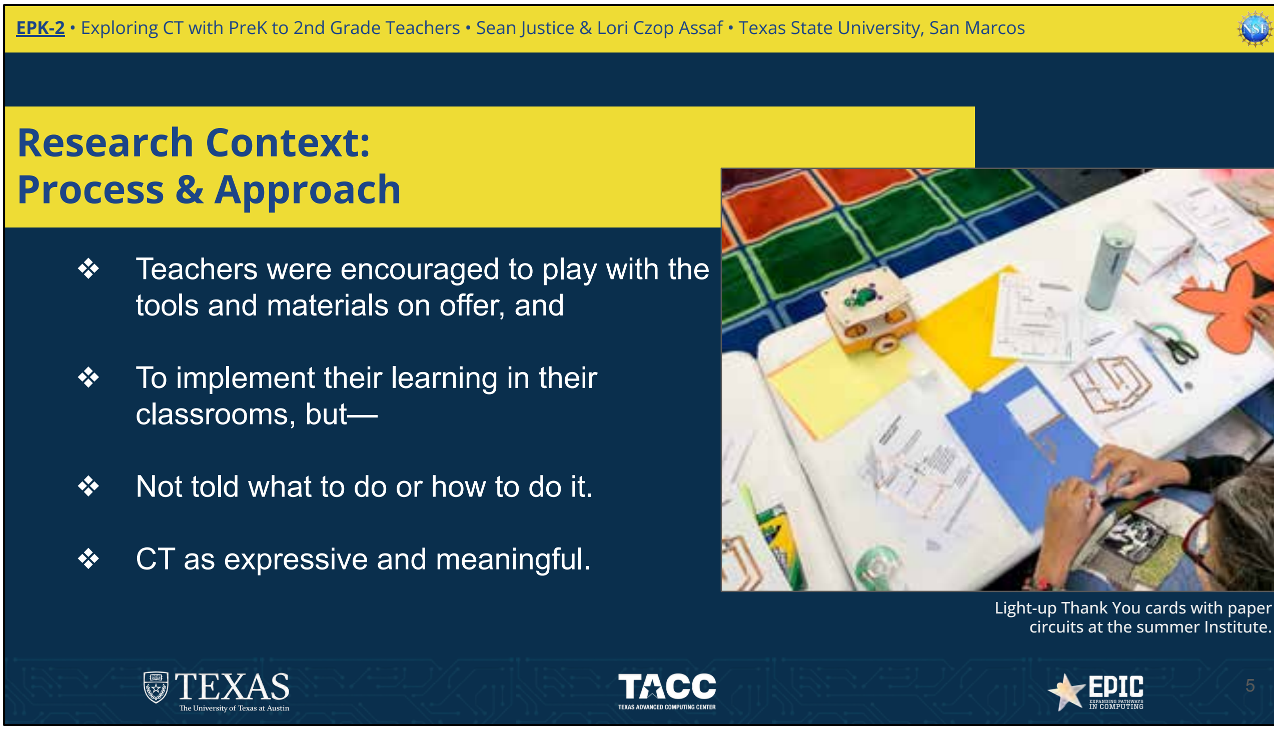

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Phase 1: Computational Making & Inquiry Institute (Summer)

- Pre-Institute Meeting (3 hrs).
- 2-week Institute June 2021 & 2022.

Data

1. Pre/Post Survey on CT.
2. Field notes and teacher-produced artifacts.
3. Post-Institute interview.

Phase 2: Meetups and Teacher Observations (School Year)

- Scheduled classroom observations.
- Group Meet-Ups (Virtual & F2F).
- Individual Coaching (as requested).

Data

1. Classroom observations with videos.
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3. Post Observation interviews and video recall.

Phase 3: Learning Conference (End of School Year)

- Teachers present their CT learning.
- Hands-on demonstrations.
- Poster sessions.

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1. Teacher implementation artifacts.
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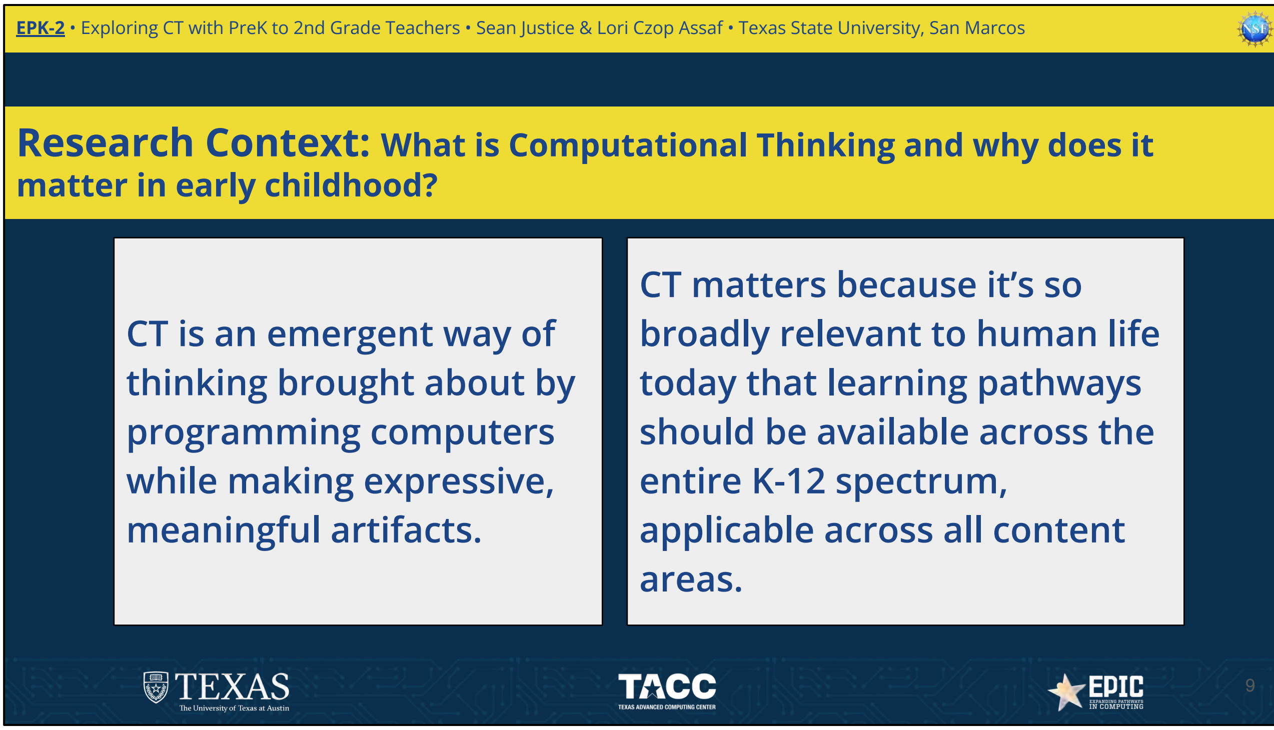

CT is:

A way of solving problems, and of finding problems worth solving; a mindset; a human way of thinking about and with computers.

The thinking routines and practices that shape and are shaped by computer programming symbol systems.

A participatory literacy, where participation creates and sustains communities of practice that include people working with computers.

A thought process involved in formulating problems and their solutions (Wing, 2017).

An expressive and creative process that includes dispositions, habits, and approaches while developing technological fluency. (Bers, 2021; Resnick 2017)

Concepts, practices, and perspectives applied by humans to express themselves by designing and constructing computation (Brennan & Resnick, 2012).

An interdependent mindset or way of thinking that emerges in the relationship between people and computational tools and materials (Resnick, 2017; Stephens & Edwards, 2018).

CT is important because:

Computational technologies are **transforming** modern work and life (Arnott, 2017; Stephen & Edwards, 2018)

Students learn to be **good digital citizens**, recognize misinformation, and create better lives for themselves and those around them (Pinder, 2022)

We need to **transform gender and economic inequities** that exist in computer science (Digital Promise Foundation, 2022).

Lack of research on the **relationships** between computational thinking, computer science, and literacies in early childhood education (Kafai & Proctor, 2022)

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Precursors are non-computational thinking practices that might become computational thinking in the appropriate context, with time and with nurturing.

In this study we wanted to identify professional learning activities that would help early childhood teachers notice, name and connect CT with what they already do in classrooms. That is, teachers pay attention to emergent learning in core areas such as reading, writing, and science. Teachers notice students on the threshold of new learning and then implement activities to help them cross those thresholds. Here we followed a hunch that similar relationships of learning and teaching might apply with CT, even though it is a brand-new learning area for many teachers. The goal therefore was to identify and articulate those relationships in ways that made sense to our participants.

For example, we are reluctant to identify Simon Says, or Red Rover, or making peanut butter and jelly sandwiches, as "unplugged" CT activities. Our skepticism comes from two directions. First, the word "unplugged" implies a condition of participation that highlights or even depends on a specific kind of (electronic) tool—i.e., it's a tool-first distinction. Secondly, and perhaps more importantly, foregrounding a tool-first dependence accentuates a deficit perspective, especially with early childhood teachers who are encountering CT perhaps for the first time—i.e., because the focus shifts to what they do not have (computational tools) and what they do not know (how to work with those tools).

Instead, to keep the focus on relationships of learning, e.g., how and with whom we learn to work *with* tools to build and sustain communities of participation, we propose the word “precursor” — because teachers already understand that children’s early capacities for knowing and doing will later constitute mature capacities.

That is, as with reading, writing, and mathematics, among other content domains, what children already know how to do can be thought of as *precursors* to practices that teachers care about—e.g., as letter recognition in the world at large (“Look mom, that’s an ‘M’ on that sign!”).

Importantly, as teachers already understand, learning precursors are *always already* present in students’ lives, because learning itself, as a human phenomenon, is rooted in social participation.

Photo Credit: Royalty-free photos by Pexels https://www.pexels.com/search/children/

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Context of Learning: EPK-2 Summer Institute

- ➢ Teachers explored CT as expressive meaning-making practices by making art, doing science, and telling stories for themselves and each other.
- ➢ Teachers built interdependent understandings of CT as a learning community and began noticing, naming, and connecting CT to classroom learning activities.
- ➢ Teachers considered how and where CT might extend or support what they were already teaching (e.g., literacy, math, science, social studies).
- ➢ Teachers approached CT as an open-ended encounter with new tools and materials.
- ➢ Teachers' responses were not prescribed nor mandated. Teachers designed and implemented CT learning activities of their choice.

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Teachers were not asked to teach computer programming as a separate domain.

Teachers designed and implemented lessons of their choice.

Teachers were encouraged to consider not teaching computer programming as a separate domain but to integrate coding into the expressive practices at the core of the teaching they were already doing.

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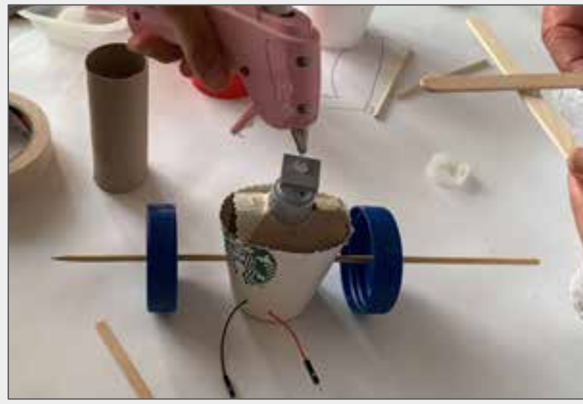
Context of Learning: Summer Institute Activities

Greet the Day Circle.
Tower of Hanoi puzzles. Bottle cap sorting.
Storytelling with ScratchJR, Scratch, and KIBO.
Make the cat move!
Animated Name Dance in Scratch and ScratchJr.
Makey Makey narratives with KIBO and Scratch.
Interpretative mark making.
Mapping the way home. Retelling the map.
Mapping with Ozobot, KIBO, Edison.
Thank you circuits.
Art machines with motors & recycled materials.
Classroom games with Scratch.
On-site at Play & Inquiry preK summer school.
Collaborative reading: Bers'; Resnick; others.
Daily multimodal journaling.
Action plans for teaching with students.
Computing in the World Circle: artists, designers, scientists.
Show and Share presentations.



Making art machines at the summer institute (click for a video).

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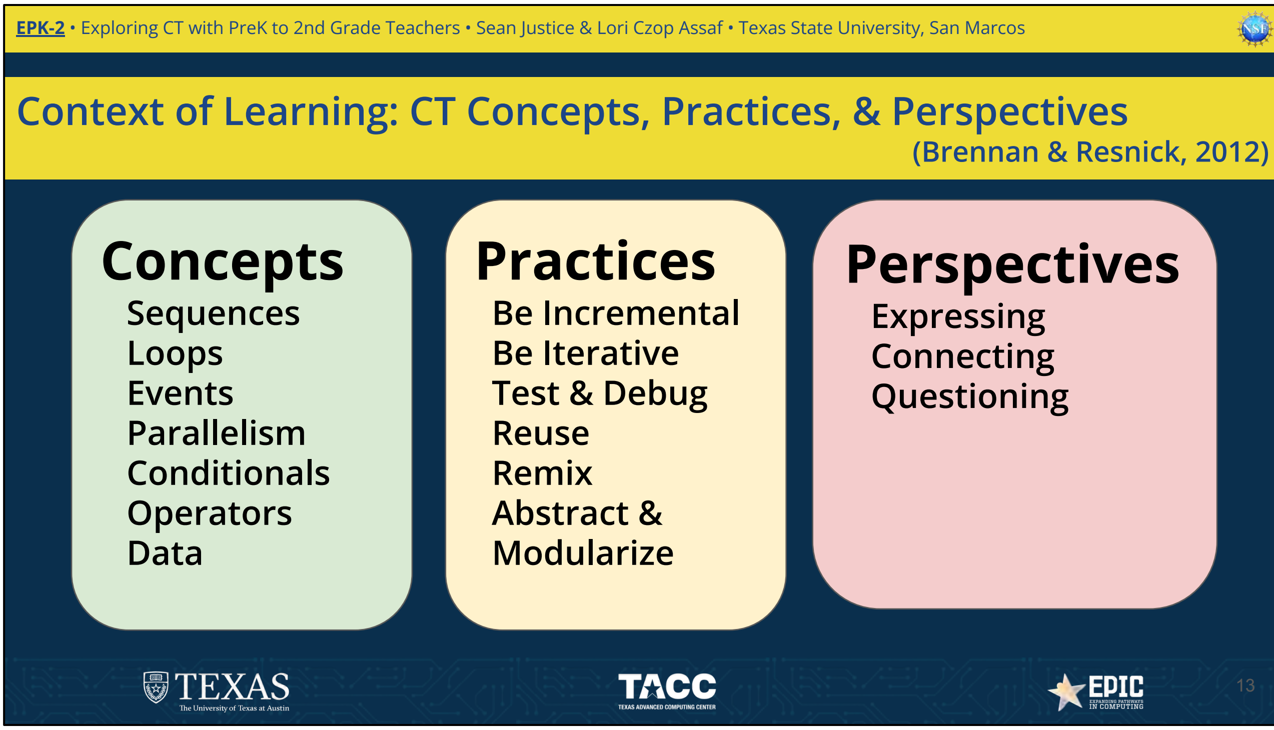

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Context of Learning: CT Powerful Ideas (Bers, 2021)

Powerful Idea	Related Early Childhood Concepts and Skills
Algorithms	* Sequencing/order (foundational math and literacy skill) * Logical organization
Modularity	* Breaking up a large job into smaller steps * Writing instructions * Grouping a list of instructions into a given category or module to complete a larger project
Control Structures	* Recognizing patterns and repetition * Cause and effect
Representation	* Symbolic representation (i.e., letters represent sounds) * Models
Hardware/Software	* Understanding that "smart" objects don't work by magic (i.e., cars, computers, tablets, etc.) * Recognizing objects that are human-engineered
Design Process	* Problem-solving * Perseverance * Editing/revision (i.e., in writing)
Debugging	* Identifying problems (checking your work) * Problem-solving * Perseverance

Figure 8.2 The steps of a simplified design process that can be used with young children.

from Bers (2021) *Coding as a Playground*. Routledge.

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Bers, M. U. (2021). *Coding as a playground: Programming and computational thinking in the early childhood classroom* (2nd ed.). Routledge.

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PreK to 2nd Grade CT Learning Activities

Multimodal Literacies
Reading & Writing
Story responses
Storymaking
Phonics
ELAR practices

Science
Habitat
Life cycles

Tools
ScratchJR
KIBO
Scratch

KIBO Exploration:
Dual-language girls exploring the KIBO microphone and invented a greeting card for their robot. One girl was Spanish dominant and learning to speak English. She wanted KIBO to greet the other KIBOS around the room. She started a dialog with the other robots. The other dual language students responded with greetings in English.

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PreK to 2nd Grade CT Learning Activities: Story Response

"In the fables and folktales unit, my group was working on retelling *The Boy Who Cried Wolf!* — beginning, middle, end.

Whenever I can tie in ScratchJr., I definitely want to do that.

With the fables and folktales, it just naturally felt like it worked really well for retelling."

1st Grade Teacher

1st grade story response: *The Boy Who Cried Wolf.*

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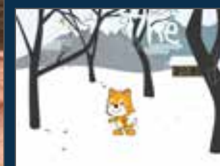
PreK to 2nd Grade CT Learning Activities: Phonics

"We always read a story and have some type of a response that can go in many different ways. I remember thinking to myself that I wanted to tie in sight words, but I wanted to do it in a way that was not just writing your sight words on a piece of paper. I was thinking about the symbolic representation of the code blocks and how they represent the actions of the sight words."
Kindergarten Teacher



Kindergarten Phonics—camouflaging sight words on ScratchJr.

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After reading How to *Hide a Butterfly & Other Insects*, by Ruth Heller (1992), Bridget asked her kindergartners to respond with ScratchJr., a block-based computer programming platform designed for early readers. Since the book focused on camouflage, Bridget invited the children to code a computational hide and seek animation with words that are difficult for young readers to decode, commonly known as sight words.

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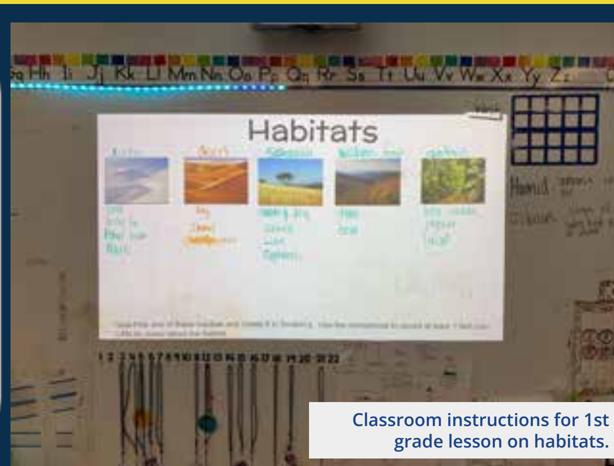
PreK to 2nd Grade CT Learning Activities: Science (Habitats)

CT Precursor Activity Plan, 1st Grade

Reading: Students will explain what a habitat is. TEKS 1.6.G; TEKS 1.9.D.ii
Speaking & Listening: Students will identify characteristics of a particular habitat. TEKS 1.1.C; TEKS 1.7.B; TEKS 1.7.E
Science: Gather evidence of interdependence among living organisms such as energy transfer through food chains or animals using plants for shelter. TEKS 1.9C
Precursor(s) or Powerful Idea(s): Representation; Design process; Modularity, possibly Debugging.
Materials: Amplify curriculum/pre-learning of habitats, iPads with ScratchJr.
Activity description: Students will build a habitat that we have learned about in ScratchJr. Students will record themselves recording 1 fact about that habitat.



Classroom instructions for 1st grade lesson on habitats.

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In the teacher's voice:

"Yeah, well it was at, towards the end of our habitat unit where we had spent, I don't know how many days, it was probably 14 days learning about habitats and comparing them, learning about the animals and how to describe them, the environmental parts of the habitat adaptations, all of that. ...

We actually only did one other thing ... a research project about an animal. And so, it didn't have to be the same animal that they did their ScratchJr project on, but a lot of them did have the same animal. They had to read books about it, write down facts, record their information, and then turn that into a paragraph.

And got the idea because last year we were really focused on project based learning, and I wrote a unit for 2nd grade that was similar—it was using habitats and they had to plan out a zoo. With that one it was a lot of making using recyclable materials. They created the habitat and had to think about like oh, we don't want an African safari habitat next to, or an African savannah next to an arctic habitat, because there's such a degree difference in the temperatures, and they had to take that into consideration.

So, I kind of had that project in mind, but taking more technology driven piece instead of the recyclable materials and hot gluing. And part of that was because that project took like, two weeks. It took a long time for them to do it. And it was also tough to do in groups because everybody's like, "Well, who takes it home? I wanna take it home." "No, I wanna take it home." So, with ScratchJr, everybody got to have that ownership of their own project."

[Interview excerpts.]

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In the teacher’s voice:

Life cycle of insects ... 2nd grade science ... it was the start of a new unit and we finished it last week with the life cycle of a butterfly. So the week you were here was the life cycle of a ladybug. It's ladybug, grasshopper, butterfly, or other insects. My teammate and I both plan science. We decided on the ladybug for the first week and then the butterfly for the second week.

I thought the lesson overall was good, and after seeing your comment about you know, taking it maybe slower next time, I think that project maybe could have been broken up into like three days, maybe downloading images the first day, uploading them the second, and then starting the script on the third day. I know you can tell they're all different levels of understanding of Scratch. I paired them up based on who was here and who wasn't the day prior. Thursday we did a very small lesson over how to upload and download pictures, but we didn't upload them onto Scratch itself.

I felt confident because I created an example. So I went through it myself because, like even (a teacher who’s not in the cohort) and I talk and we're like if we don't do it ourselves, how are they going to understand? So I think I mentioned to you that day, the night before and I created an example, a project myself of the actual end product.

[Interview Excerpt]

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In the teacher's voice:

I started off with KIBO the way that we were introduced with KIBO where we had the smaller box. So, there's was a couple of blocks. It was the forward, backward, turn left, turn right, and then the parts just of the KIBO like the two wheels. And so, I started just with that. And really, I just gave them KIBO. We separated around the floor, and I just wanted them to figure out if they could find out how to make it move really. And so, I let them push buttons.

And then I started giving them some tasks. Okay. Well, can we make it move from this side to this side in a straight line, or can we make it move from left to right? And then there was another task. Can we make it shake? We got some shaking blocks and some light up – with the light bulbs. And so, there was just different – and gradually, more and more I had them add more pieces to it.

And so, in the beginning, I feel like students were very frustrated. I even had a new kid come in after students have already had opportunities and time with the robot that that student was frustrated even at the end because he didn't necessarily have the same time span as everybody else to explore with KIBO.

And so, he was frustrated and still is frustrated with ScratchJr because that's new to him as well. But for the majority of them, whether you were a low student, whether you were a speech student, whether you were a high student, they were all engaged and working together as a team to get their farmer to visit all of the animals. So, everybody had a piece. There was collaboration, working together.

My goal for this semester is that I want whatever it is that we're working in ScratchJr I want it to tie into Amplify. And so, today, for example, we were able to successfully do that with ScratchJr.

And the principal came in and was just so excited that we were able to get all the concepts that we've been working on, all of the – so, for example, it was like the little red hen last week. And then we started reading a book about ox and men. And so, they created the characters as sprites and they've just been taking off with it, and kids have just been engaged and just happy to be able to explore with ScratchJr.

And then I'm excited because it also ties into our reading curriculum.

[Interview Excerpt.]

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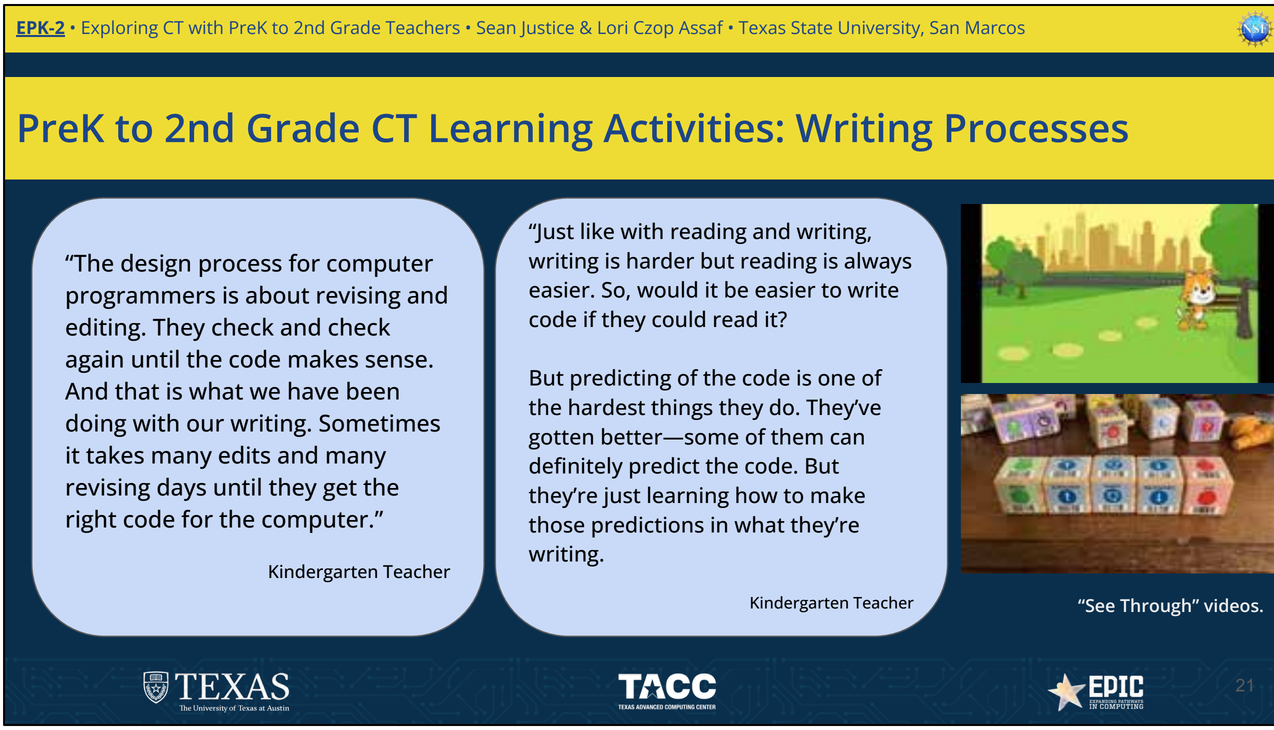

In the teacher's voice:

(re: "revising and editing"):

I noticed first things like collaboration, because this is a year, where I've seen like way more collaboration than any other years. Engagement and I've also seen two were even like these students that struggle academically, like they are so engaged. And they want to try to do this, or they go in, with their friends because they want to do it- because there are so engaged.

So I have a student. I know this is recording so I won't tell you his name. But let's say his name is Pete. So, my student Pete struggles academically. There's so much going on at home and stuff and so he's struggling so much academically. But when ScratchJr. or crafts or any open ended material activities come in.. but like reading, man, he struggles to be engaged, like he's just—he doesn't stay on task at all, like at all. But during these activities like ScratchJr. and any open-ended material activity, he's so engaged. And he does not move until he finishes. So like I've seen that, like that student for sure. For sure he is so engaged.

(re: "predicting the code")

When we're working in ScratchJr, I feel like it's more open to your own interpretation of what you want your product to look like, so there's not really a that's not how you're supposed to do it, that's not right, it doesn't go there, why did you put it there, you know? And then just hearing the kids talk amongst each other, like their conversations during ScratchJr are always – not always but most of the time seem to stay on topic versus with the worksheet, they get distracted with anything that's happening, and a lot of times they're not talking about what the worksheet's about or what they're supposed to be doing.

But with ScratchJr, when that's happening in here, they're talking about what they're doing, they're asking for help about on-topic, they're engaged in what they're doing, they're having fun, they're giggling, they're laughing, they're sharing, they're up and moving around to show people versus with another type of response, it's more of like they're getting up and laughing and talking because they're off topic, not because they're actually working. So, I do feel like the environment definitely changes a little bit when we do an exit ticket on ScratchJr versus on a sticky Go Draw picture of the character. It is very different.

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Awareness of Student Learning: Engagement

When we work with ScratchJr....

“I noticed collaboration, way more collaboration than any other year. Engagement. I’ve also seen where even students that struggle academically, they are so engaged. And they want to try to do this,they are so engaged.

Pete struggles academically. There's so much going on at home and he's struggling so much. Reading, man, he struggles to be engaged—he doesn’t stay on task at all. But during ScratchJr. activities, he's so engaged. He does not move until he finishes. He is so engaged.”

Kindergarten teacher interview.

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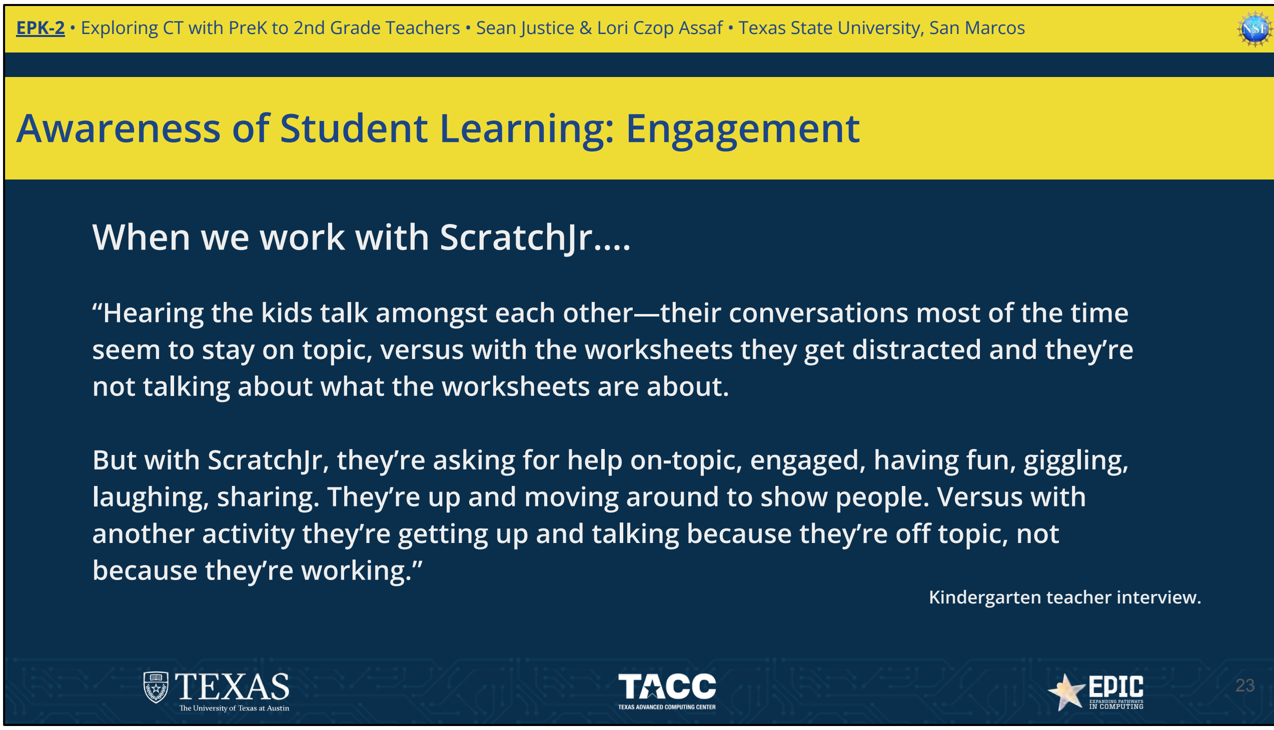

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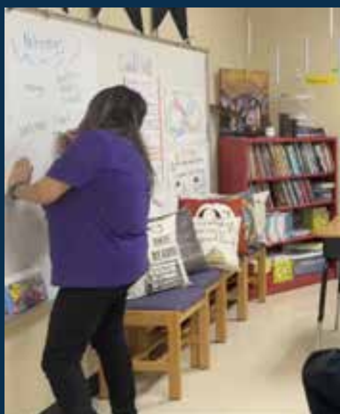
Awareness of Student Learning: Expertise



Naming student experts on the white board.

Cultivating Community Expertise

"The summer Institute helped me open my mind to try new things."

"In years past, I felt like if I'm not the expert, then maybe I shouldn't be using it in my classroom, but that's really not the case anymore, which is really cool."

"These students were the experts, which was so powerful, because two of them are normally the ones that need the most help. They're the ones that always say, 'I don't get it.'"

GT Teacher

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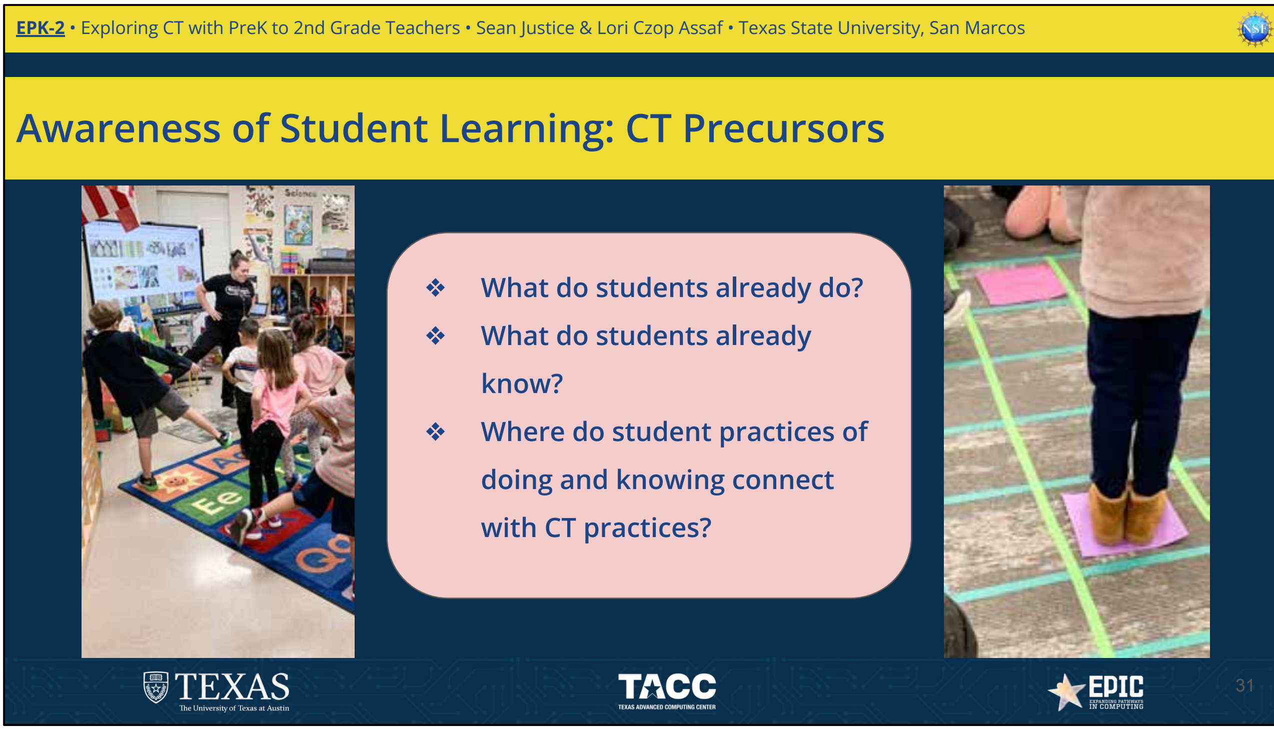

The concept of *CT precursors* helps us construct and articulate an additive perspective of students and their social, cognitive, and affective capacities (i.e., *precursors* don't come from a deficit perspective).

Noticing CT precursors helped teachers recognize students' agency as interdependent with the world of their peers, family, and community. Teachers realized they didn't have to work so hard to integrate CT in their classroom because it's already there—always already present in their students' lives. In response, teachers critically reflected on their teaching practice and learned to embrace exploratory inquiry designs, for instance, by adopting the role of non-expert so their students could shine.

- Precursors are non-computational thinking routines and practices that will become computational thinking with time, nurturing, and opportunities for tool/material exploration.
- The concept of *precursors* assumes that capacities for knowing and doing are rooted in social participation and therefore always already present in learners' lives.
- Foregrounding instructional design on precursors centers teachers attention on community building around socially valued content.
- 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 on what needs to be in place (in their classrooms, for themselves, for their students, for their school community) for young learners to refine the social, cognitive, and affective tools they need to sustain and expand communities of computational participation.

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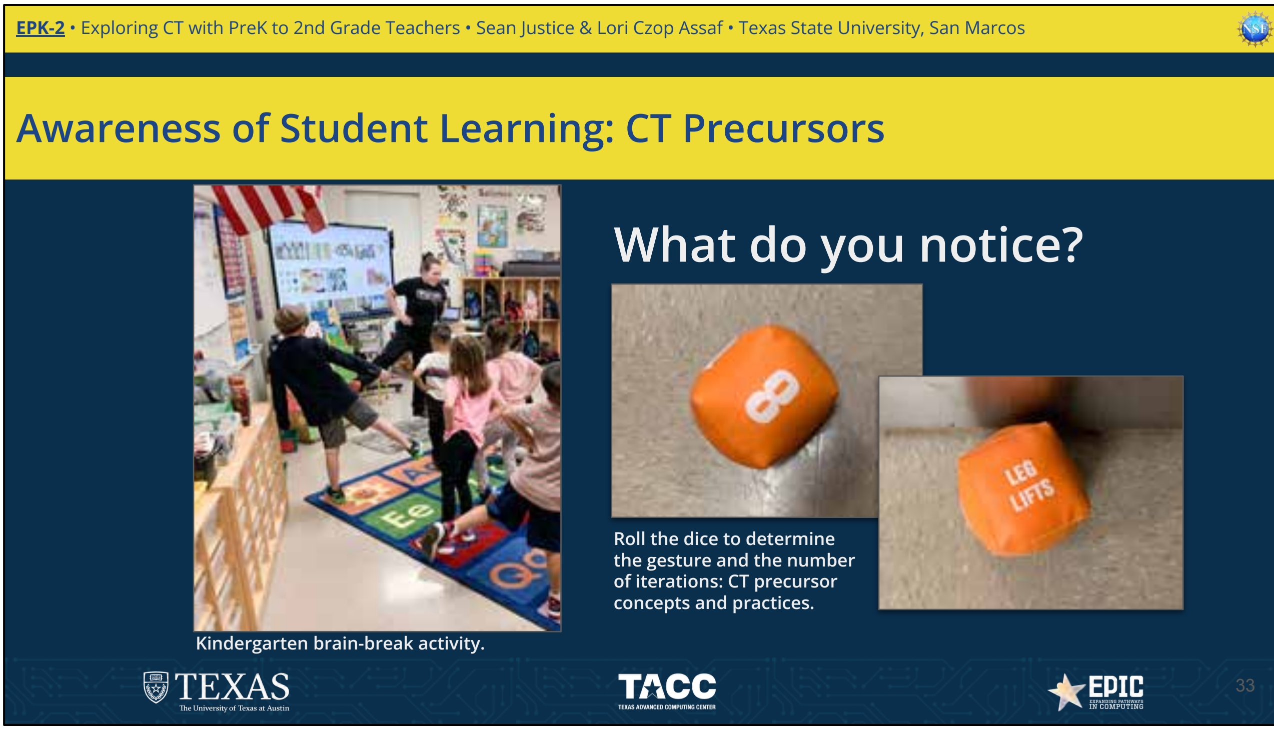

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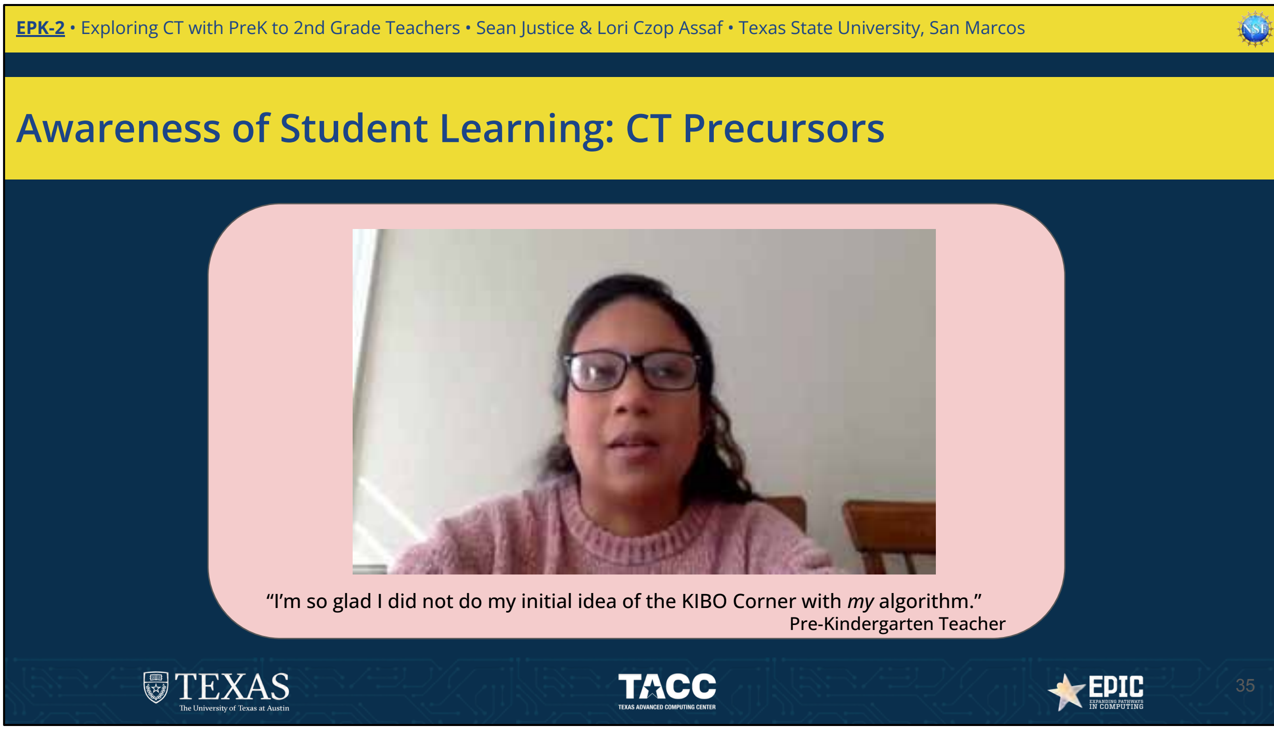

Excerpts from teacher interview:

I feel like I learned that – I mean, I think there's two perspectives. I'm thinking of it in two different ways, because there's the way that I remember teaching it, and then there's watching the video that you took of me teaching it. And oh, my gosh, there's so many noticings that I had watching myself. I think that I was surprised, because I think a lot of it feels like I'm telling them to do this, I'm telling them. Like, "Oh, I told you. You have to start with this block."

But I don't feel like – watching the videos, I don't feel like I explicitly said that a lot. I feel like I let them make a lot of inferences on their own. I think I tried to guide them and I tried to remind them, like, "Oh, what block goes next?" I think I asked a lot of questions, and I kind of tried to generate more curiosity and more sort of interest.

Because I was wondering does KIBO actually come like that or is it something Dr. Justice designed. But as you noticed, I had taken different blocks from the big tub and little tub and kind of mixed them together and kind of made my own tub. And definitely, the thought of the algorithm was always in my head. The goal is for them to make a pattern, and we're focusing on colors, making a pattern with colors. So, the way I guess I thought of it was this is gonna be roughly the algorithm.

I let the clapping and the ear be a part of it, because I felt like that was – I don't know, it was just a way for the whole group to engage with KIBO at once instead of one person just pressing the button and KIBO doing it and kind of repeating that. They knew, and I think that that kind of helps build the algorithm in their mind when they have to do something physical like clapping. So, I took those blocks, and I kind of built a rough algorithm and said, you know, “I think that this is gonna work for my groups.”

And all the groups across the board, they were all very, very motivated to work with KIBO. And I set that expectation before we started working with KIBO that first week. “This is KIBO, we’re gonna be super gentle with him. We’re not going to press on him. This is what he’s used for. He is not a BattleBot.” And they wanna explore with KIBO. They want to learn with KIBO. Through all the groups, no matter how I differentiated the lesson, they were just excited to learn with KIBO.

And not only were they excited to learn from KIBO, they were all, I would say, successful kind of exploring with KIBO. Maybe not to the same extent. They didn’t get to the same level of advancement, but they were all successful in their exploration in getting KIBO to do what they wanted.

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Awareness of Student Learning: CT Precursors

Noticing CT precursors helped teachers teach from an *additive* perspective—where students' social, cognitive, and affective capacities informed inclusive lesson design (i.e., not as a deficit perspectives exclude what students already know).

Once noticed, **Naming** CT precursors helped teachers recognize CT concepts, practices, and perspectives that students were already familiar with.

Connecting those CT concepts, practices, and perspectives to what they were teaching helped teachers understand they didn't have to work so hard at integrating CT in their classroom because it was already there—always already present in their students' lives.

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This CT learning routine is guided by a lesson design methodology called Material Inquiry.

Material Inquiry

"Lead with materials and listen for inquiry."

- Material Inquiry is rooted in generative learning methodologies, focused on:
  - Doing as knowing;
  - Serendipity; and
  - Enacted encounters with materiality.

- Material Inquiry activities begin with open-ended prompts that privilege process, not outcome.

- Material Inquiry design learning pathways that build interdependent community know-how and citizenship.

The heart of Material Inquiry is something we call *material learning*. But talking about material learning is challenging because putting materials into words is difficult.

One reason for this difficulty is that the kind of learning we're pointing to is based on participation *with* materials, rather than working *on* materials. It feels counterintuitive to try to 'explain' something that is fundamentally experiential. It's like expecting a *description* of music to be an adequate substitute for *hearing* music.

https://www.materialinquiry.com/mi-details.html

See also: Ten Principles for Making Material Inquiry (last slide). And for more, see: Cabral & Justice (2013, 2019); Justice (2015, 2016) (Citations in the References slides.)

More on Generative learning:

Generative learning is a process of self-perpetuating change. Specific to teacher learning, teaching practices are inspired and influenced by the instructional approaches experienced in a professional development program. Teacher learning becomes generative when they make connections with their students' lived experiences and then design instruction based on their professional knowledge, personal knowledge, and knowledge gained from students.

(Assaf & Lopez, 2015; Assaf et al., 2016; Ball, 2009, 2020; Brito & Ball, 2020; Liu & Ball, 2019)

In teacher learning, generative learning theory is conceptualized from sociocultural foundations, whereby the process of learning to teach is...

1. A generative social process mediated by language
2. in a community of practice,
3. where teachers collectively define, negotiate, and share stories about what it means to teach and learn.

(Battey & Franke, 2008; Danish et al., 2020; Wenger, 1998)

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What comes next: Expressive CT— Make or Expand a Story.

1. Where do you come from? Why do you love your community? Interview an elder or a neighbor and share their story.

2. Explore a favorite book and notice emergent structure—what repeats? what changes? what stays the same? Expand, explore, and engage that structure.

3. Do something else: thank you cards in code; robot apologies; Makey Makey mad libs!

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Kinderlab Robotics (KIBO): https://kinderlabrobotics.com/
Ozobot Robot: https://ozobot.com/
Edison Robots (not ideal with ECE): https://meetedison.com/
ScratchJr. (for ECE prereaders; tablets): https://www.scratchjr.org/
Scratch: https://scratch.mit.edu/
Makey Makey (ECE and any age): https://makeymakey.com/
micro:bit (not ideal for ECE): https://microbit.org/

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What comes next: Essential Reading (for teachers)

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Brennan, K. A., & Resnick, M. (2012). *New frameworks for studying and assessing the development of computation thinking: Using artifact-based interviews to study the development of computational thinking in interactive media design.* Proceedings from American Educational Research Association annual meeting, Vancouver, Canada. https://web.media.mit.edu/~kbrennan/files/Brennan_Resnick_AERA2012_CT.pdf

Resnick, M. (2017). *Lifelong kindergarten: Cultivating creativity through projects, passion, peers, and play*. MIT Press.

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What comes next: Essential Reading (for students)

CT & CT Precursors Booklist

This booklist is ever-expanding. If your favorite is missing please let me know.

Sharing permissions are set to “comment” so users can sort according to keywords or titles or authors, etc.

Share the wealth! Pass it on.

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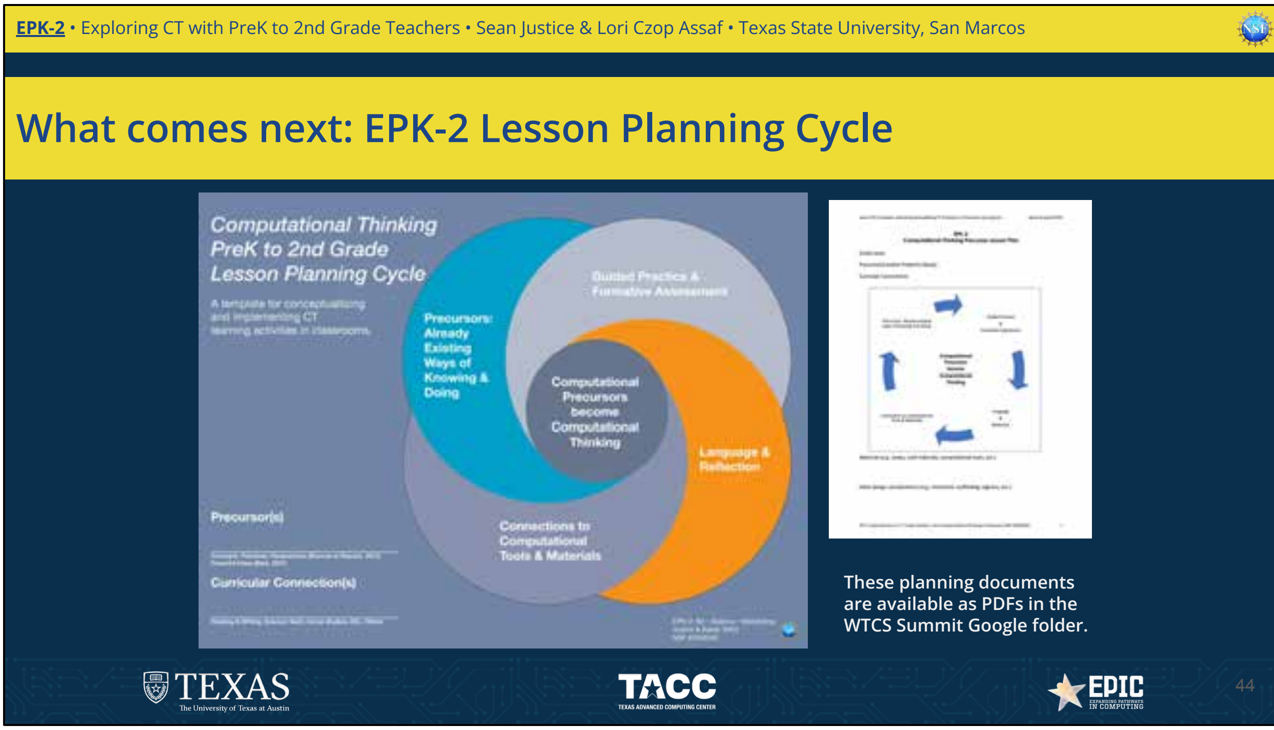

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What comes next: Ten Principles for Making Material Inquiry

1. Invite responses to multimodal text(s) as an experience of meaning making rather than as an exercise focused on tool use.
2. Encourage exploration of the way different tools and materials express differently, e.g., hard graphite vs soft charcoal; fast, skittery motion vs slow, smooth motion; looped percussion vs continuous melody; interactive touch via the keyboard vs a handmade interface collage.
3. Facilitate collaborative interactions between learners and story elements or domain prompts by focusing on interpersonal relationships, e.g., rather than focusing on simple appearances, ask, "How would it feel to be in this setting, or with this character?"
4. Minimize instructional talk to allow time for exploration, iteration, and purposeful play with examples, tools, and materials.
5. Maximize multimodality of learning resources, e.g., demonstrations plus videos, plus handouts, plus websites, plus instructional manuals, plus safety data sheets, etc.
6. Design participant-led show-and-shares that emphasize noticing instead of assessment, e.g., after sharing their work, learners ask each other, "What do you notice about my project?" — not, "What do you like?"
7. Arrange the classroom or studio with large tables instead of individual workstations to enhance learners' interactions with each other.
8. Share models and examples instead of step-by-step instructions.
9. Make sure tools and materials are visible, plentiful, and multimodal, e.g., digital, computational, and traditional craft or fine-art.
10. Intersperse reflective turn-and-share moments with uninterrupted making and building.

From: Justice, S. & Assaf, L.C. (forthcoming). Expressive STEM Storymaking: Art, Literacy, and Creative Computing. In Y. Cooper and A. Lai (Eds.), *Intersections and Thresholds of STEAM Education.* Brill/Sense.

Material Inquiry *"Lead with materials and listen for inquiry."*

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EPK-2 • Exploring CT with PreK to 2nd Grade Teachers • Sean Justice & Lori Czop Assaf • Texas State University, San Marcos

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Citation: Justice, S. & Assaf, L.C. (2023, June 16). *PreK to 2nd grade teachers noticing, naming, & connecting computational thinking to literacy learning* [Conference presentation]. WeTeach_CS Summitt, University of Texas at Austin. Houston, TX.

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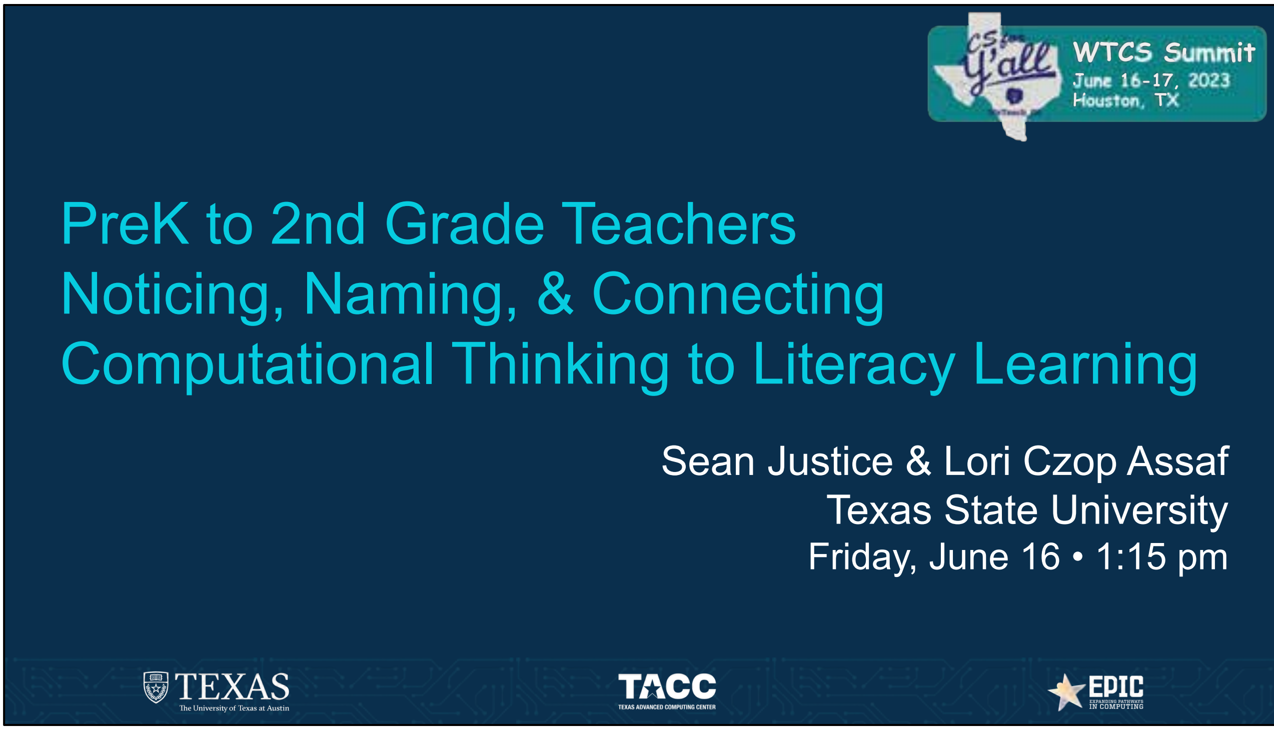

This presentation describes early elementary lesson plans that integrate CS/CT with reading, writing, and storytelling. In our CS education research we've found that PreK to 2nd grade teachers gravitate to ELA content when exploring computational thinking with their students. This presentation shares cross-curricular learning activities designed by teachers to combine CS/CT with literacy. Our goal is to share and unpack learning activities that expand PreK-2nd grade ELA content with computational tools and materials, where students design, write, and perform stories with ScratchJR, Scratch, and various robotics platforms.

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