Understanding and Supporting District Systems Change Around Computer Science Education

Quinn Burke, Jeremy Roschelle, Pati Ruiz, & Josh Weisgrau
AERA Annual Conference Sun, April 11, 4:10 to 5:40pm EDT
Division L, Division L - Section 9: Policy Implementation and Going to Scale Structured Poster Session
Powerful Learning with Computational Thinking
Digital Promise White Paper
Inclusive Participation of Students Historically Marginalized From Computing

Commitment From District Leadership
Digital Promise & the League of Innovative Schools
<table>
<thead>
<tr>
<th>District</th>
<th>Student Enrollment</th>
<th>Urbanity</th>
<th>% Low Income</th>
<th>% Latinx</th>
<th>% Black</th>
<th>Equity Focus Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iowa City Community School District (IA)</td>
<td>14,000</td>
<td>Becoming Urban</td>
<td>37</td>
<td>12</td>
<td>19</td>
<td>Greater inclusion of growing number of Black, Latinx and ELL students</td>
</tr>
<tr>
<td>Indian Prairie School District (IL)</td>
<td>28,000</td>
<td>Suburban</td>
<td>17</td>
<td>12</td>
<td>9</td>
<td>Title I schools with large achievement gaps compared to higher income schools</td>
</tr>
<tr>
<td>Talladega County Schools (AL)</td>
<td>7,500</td>
<td>Rural</td>
<td>71</td>
<td>2</td>
<td>33</td>
<td>Engaging students from low socio-economic households and female students</td>
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</tbody>
</table>
From the District’s application:

“Our focus is on two specific populations, students from low socio-economic households and female students. Of the high school students currently enrolled in a computer science or engineering course,

- **16% of our more affluent students** are enrolled, while only **4% of our students in poverty** are enrolled.
- **Only 30% of the students are female**
Our District Leaders

Brooke Morgan
Coordinator, Innovative Learning
Talladega County Schools

Adam Kurth
Director of Technology and Innovation
Iowa City Community School District

Brian Giovanini,
Director of Innovation
Indian Prairie School District
A Focus of Competencies: *What are the key skills & practices?*

### Powerful Learning with Computational Thinking

**Computational Skills**
- Recognizing recurrent patterns
- Organizing steps into a sequence
- Dividing problems into smaller parts
- Filtering for what is most important
- Iteratively testing, finding errors, and fixing

**Computational Practices**
- Collecting, Analyzing, and Communicating Data
- Automating Procedures and Processes
- Using Models to Understand Systems
## Talladega’s CT Pathways Map

### TCBOE DLCS Standards

### Computational Thinking Pathways

#### Grade K:

By the end of Grade K, what will ALL students know and be able to do?

<table>
<thead>
<tr>
<th>Relevant Standards (From Alabama DLCS)</th>
<th>What do the Standards Mean? (Unpack/Reraste in your own words.)</th>
<th>Key Vocabulary (Students will KNOW/understand...)</th>
<th>What Does it Look Like in Class? (Students will be able to DO...)</th>
<th>Opportunities to Learn (Lessons, Resources, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ALGORITHMIC THINKING</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>D LCS 1.</td>
<td>I can identify the order of events related to a specific task.</td>
<td>Algorithm: A precise sequence of instructions for processes that can be executed by a computer.</td>
<td>Math</td>
<td>Write informational or explanatory text, such as how-to articles. - Create/draft outlines for writings or projects. - Express a routine as a sequence of step-by-step instructions. - Map or outline a story. - Create decision trees.</td>
</tr>
<tr>
<td>List the sequence of events required to solve problems.</td>
<td>I can identify what comes next or if a step is out of order.</td>
<td>Bug: Part of a program that does not work correctly.</td>
<td>Science/SS</td>
<td>List steps for a process. - Create if/then statements for concepts. - Order a sequence of events related to an experiment.</td>
</tr>
<tr>
<td>Examples: tying shoes, making a sandwich, brushing teeth.</td>
<td>I can tell the order of events for a specific task.</td>
<td>Debugging: Finding and fixing problems in an algorithm or program.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>I can identify what comes next for specific tasks.</td>
<td>Sequence - To arrange in a particular order</td>
<td></td>
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<tr>
<td></td>
<td>I can identify a step that is not in the correct order.</td>
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https://www.kodable.com/
Students use basic coding skills to follow a sequence.

Beebot Challenge Cards
Lesson where students follow directions to get the Beebot from point A to point B.

Nearpod Lesson: Room on the Broom
Story sequencing.

Seesaw: Sequence the Story
Activity for story sequencing that can easily be assigned to students.

Debugging: Unspotted Bugs
A lesson to help students understand the step involved in debugging.
Overview - Focus on Teacher Capacity

In Year #3, development activities have supported pilot teachers (within each Core district) to implement the inclusive pathway.

- Designing, implementing, and iterating on professional development resources for teachers (largely, K-8)
- Centering equity in the development of resources and tools to support the pathway.
- Teachers enacting PD within their own classrooms
- Making improvements based on implementation experience & identifying common challenges & opportunities (via teacher interviews & focus groups)
Computational Thinking Pathways Toolkit

The **CT Pathways Toolkit** is a resource for school districts to guide them in the design and articulation of their own system-wide K-12 learning pathway in computational thinking (CT) and computer science (CS). The purpose of a pathway is to involve all students in a district in learning critical CT and CS skills throughout their K-12 education.
Step #1  Articulating the Why?

- Vision
- Foundations
- Strategic Alignment

Why is this a priority for your schools and district? Where does the vision align with current initiatives?
Step #2  Defining & Communicating the What?

What?
- Lead
- Identify
- Define

The core of your initiative will be specific CT competencies for each grade band, defined in language your team can understand and communicate effectively.
“(T)here are some organizations that have up to 10 [essential components of CT]...We thought 10 was just too big of a number to try -- and it's not to say that we're not going to teach those other ones or introduce those. They're just not going to be the core five. These are the core five that we felt like we saw already embedded across the curriculum.”

- Dr. Brooke Morgan, Coordinator of Innovative Learning, Talladega County Schools
Step #3  Establishing the How?

How?
- Who are your district leaders
- How do these competencies stretch across grade levels?
- How do you measure success?

Planning the professional learning that will drive progress as well measurements (i.e., using “look fors”, surveys) to benchmark progress in classrooms.
<table>
<thead>
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<th>District Name</th>
<th>Context</th>
<th>Demographics</th>
<th>Equity Challenge (from District Leads)</th>
</tr>
</thead>
</table>
| Broward County Public Schools, FL | Large Urban | Title I: 58%  
  Black: 39%  
  Latinx: 35% | We need to develop a CS/CT pathway for K – 5 students that includes standardized, integrated curriculum for all students during the regular school day. Additionally, we need to expand enrollment in CS courses and opportunities for 6 – 12 students. The pathway needs to be aligned with industry certification to provide incentives for all students. |
| Fullerton County Schools, CA | Urban | Title I: 49%  
  Black: 1%  
  Latinx: 51% | A challenge we face for teachers is understanding the why and finding purpose. I know the toolkit will help in that area. |
| Kettle Moraine Public Schools, WI | Suburban | Title I: 10%  
  Black: 1%  
  Latinx: 5% | While the district already has a solid offering of middle and high school offerings, Kettle Moraine intends to (a) develop a comprehensive K-12 pathway and (b) broaden access for its elementary students with coursework that offers a “lead into” middle school curricula |
| Mineola Public Schools, NY | Suburban | Title I: 31%  
  Black: 3%  
  Latinx: 31% | Mineola will continue the work of our Districtwide Computer Science/ Makerspace Committee, started four years ago. We have teacher and administrator representation from all five buildings (PreK-12). We will identify elements of our integrated curricula that explicitly embed elements of CT. More specifically, we also would like to be able to run computer science classes in Spanish for our entering ELLs. |
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<th>Equity Challenge</th>
</tr>
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<td>North Salem Central School District, NY</td>
<td>Suburban</td>
<td>Title I: 12%  Black: 2%  Latinx: 15%</td>
<td>The first issue of equity is that not all of our students have equal and consistent learning experiences in relation to computer science and computational thinking. Experiences with CT and CS are isolated and in pockets. We'd like these pockets to be connected and for students to see the connections to computational thinking across subject areas and experience even learning in these areas K-12/. Although our numbers of male and female students in our AP CS course have improved, the course has been typically taken by white, male students. We eliminated CSA and last year began providing CSP. We'd like to be able to offer both and have the courses reflect our student population (female, male, and students of color).</td>
</tr>
<tr>
<td>Vandalia Community School District, IL</td>
<td>Rural</td>
<td>Title I: 57%  Black: 3%  Latinx: 2%</td>
<td>CS and CT thinking doesn't come to the forefront of the teachers mind while teaching a particular content area. There are huge opportunities for growth in bringing CT awareness to teachers. Most are implementing CT to some extent, but they don't realize they are doing it. Integration will be key to creating the buy-in to this new wave of thinking.</td>
</tr>
<tr>
<td>Kodiak Island Borough School District, AK</td>
<td>Rural 6 town schools 7 rural schools</td>
<td>Title I: 47%  Black: 1%  Latinx: 8%</td>
<td>Teacher's lack of knowledge about CS/CT programs and applications definitely factor into equity challenges in the district. Furthermore, students from diverse racial backgrounds (primarily Filipino and Alaskan Native) do not have an opportunity to explore CS applications. Another big challenge is getting teachers on board with adopting and integrating CS/CT activities within their schedule, one already filled to the brim with focuses on ELA and math development.</td>
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## Districts Pilot Progress

<table>
<thead>
<tr>
<th>District Name</th>
<th>Start</th>
<th>Why?</th>
<th>What?</th>
<th>How?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Set the Vision</td>
<td>Strategic Alignment</td>
<td>Identify Key Competencies</td>
</tr>
<tr>
<td>Broward County, FL</td>
<td>Jan 2021</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Fullerton County Schools, CA</td>
<td>Summer 2021</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kettle Moraine Public Schools, WI</td>
<td>May 2021</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mineola Public Schools, NY</td>
<td>Summer 2021</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Salem, NY</td>
<td>Feb 2021</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Vandalia, IL</td>
<td>Mar 2021</td>
<td></td>
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<tr>
<td>Kodiak, AK</td>
<td>Fall 2021</td>
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Thank you for joining today!

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Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

Link to CT Pathways Toolkit