Evidence Sharing: Designing Middle School Science Storylines Integrating Sensor Technologies and Data-Driven Science

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Project Goals

Broadening Participation in Computational Activities through Place-Based Investigations in Mainstream Science Classes

NGSS+CT (Storyline) curricula and activities for teachers and students

Sensor technologies for data-driven scientific investigations about school and community

Professional learning model to support science teachers to implement CT-Integrated middle school science lessons
Professional Learning: CT Integration Cycle

Co-Design

Researchers / teachers learn about computation and co-design Storylines+CT lessons

Reflect

Researchers / teachers reflect on implementation and refine for the next design cycle

Implement

Teachers implement the Storylines+CT using sensor technologies

Research-Practice Partnership
School Sensing Platform

Gator:bit which exposes more pins on the micro:bit for alligator clippable sensors. Additionally provides functionality for simple data displays using LEDs and a speaker.

Platform is portable and affordable. Core CT Practices (Weintrop et al., 2016): collect data streams with sensors, build models via programming, analyze & communicate using visualizations.

Students program data collection, data analysis, and data displays using MakeCode.

Classroom data display that shows the conditions in the classroom: temperature, humidity, carbon dioxide, and noise.
Research Approach

Use iterative design-based approach to studying teaching learning over time

Middle School Participants:
  Y1: 3 science teachers; 363 students
  Y2: 5 science teachers; 488 students
  Y3: 10 science teachers; ? students

In each DBR cycle, teachers participated in CT Integration cycle: learn about CT, co-design storylines integrating CT via sensor technologies, enact in classrooms, and reflect/revise.

Use case study method to study different teachers’ cycles
Evidence: Teacher Learning

Supporting teacher learning, participation, and agency:
• Use iterative design-based approach to studying teaching learning over time, as requires intentional design
• Use videos, interviews, and surveys
• Examine teacher learning in co-designing and adapting storylines
• Examine teachers as modelers

Supporting student learning:
• Student exit tickets (Penuel et al., 2016)
• Student artifacts
### Year 1

<table>
<thead>
<tr>
<th>Lessons Learned</th>
<th>Adaptations for Year 2</th>
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<tr>
<td>More information needs to be provided to teachers about what is expected when implementing CT practices.</td>
<td>Integrate more CT activities into PD and make the goals of the CT practices more explicit</td>
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<td>Highlighting the place-based aspect of scientific investigations supports student engagement.</td>
<td>Continue to highlight place as an important part of the units</td>
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<td>A one week unit is likely too short to meaningfully implement many science and CT practices.</td>
<td>Create a longer unit with a richer set of activities</td>
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<td>Limitations in Y1 storyline</td>
<td>Target phenomena that will yield a rich set of data for data driven analysis</td>
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Year 2

Teachers want to introducing programming and the micro:bit as tools for scientific inquiry so investigations using those tools feel authentic to their students

Sensor Immersion Storyline where students investigate how a classroom sensor system collects, analyzes, and displays information
Sensor Immersion

Exemplar Model of the Classroom Environment Sensor System and Display

**Interactions:** The lines in the model. How the information travels from the micro:bit to the sound sensor and environmental sensor back to the micro:bit. Once the data is back at the micro:bit, it is sent using the radio to the Chromebook. Additionally, the micro:bit sends data to the LED display to tell it the color and number of LEDs to light up. This is based on the value on the sensor data returned.

**Mechanisms:** Programming the micro:bit to perform the specific actions of collecting the sensor data and determining how to display the data collected using the LED strip and the LEDs on the micro:bit.

LEDs, light up in different colors. The more LEDs that are lit, the higher the value of the sensor data. Different colored LEDs represent different sensor measurements (i.e. temperature is green). If the data are over a certain threshold, the LEDs blink.

Micro:bit, brain. It controls when the sensor takes data, how the data are displayed, and sends data to the Chromebook. Must be programmed to complete these actions. Additionally the numerical value of the data and first letter of the data being measured are displayed.

Information about all the data from both sensors are transferred from micro:bit/gator:bit to receiver micro:bit/Chromebook using radio communication.

Power for System

Graph showing data

Graphical Data Display
Overarching Findings

Storylines are a useful approach to integrate CT, sensor technologies, and science in a complimentary way.

CT integrated science approach helps teachers see value of adding programmable sensor systems to their curriculum and can help students see sensor systems as tools for scientific inquiry.

Place based investigations of scientific phenomena as well as sensor usage and programming can play a large role to engage students.

A versatile sensor system supports students’ engagement in CT and Science Practices.
Thanks

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I know what we need to investigate next.

I have some ideas about how to investigate and answer the questions we have.

SEET 2

SEET 3