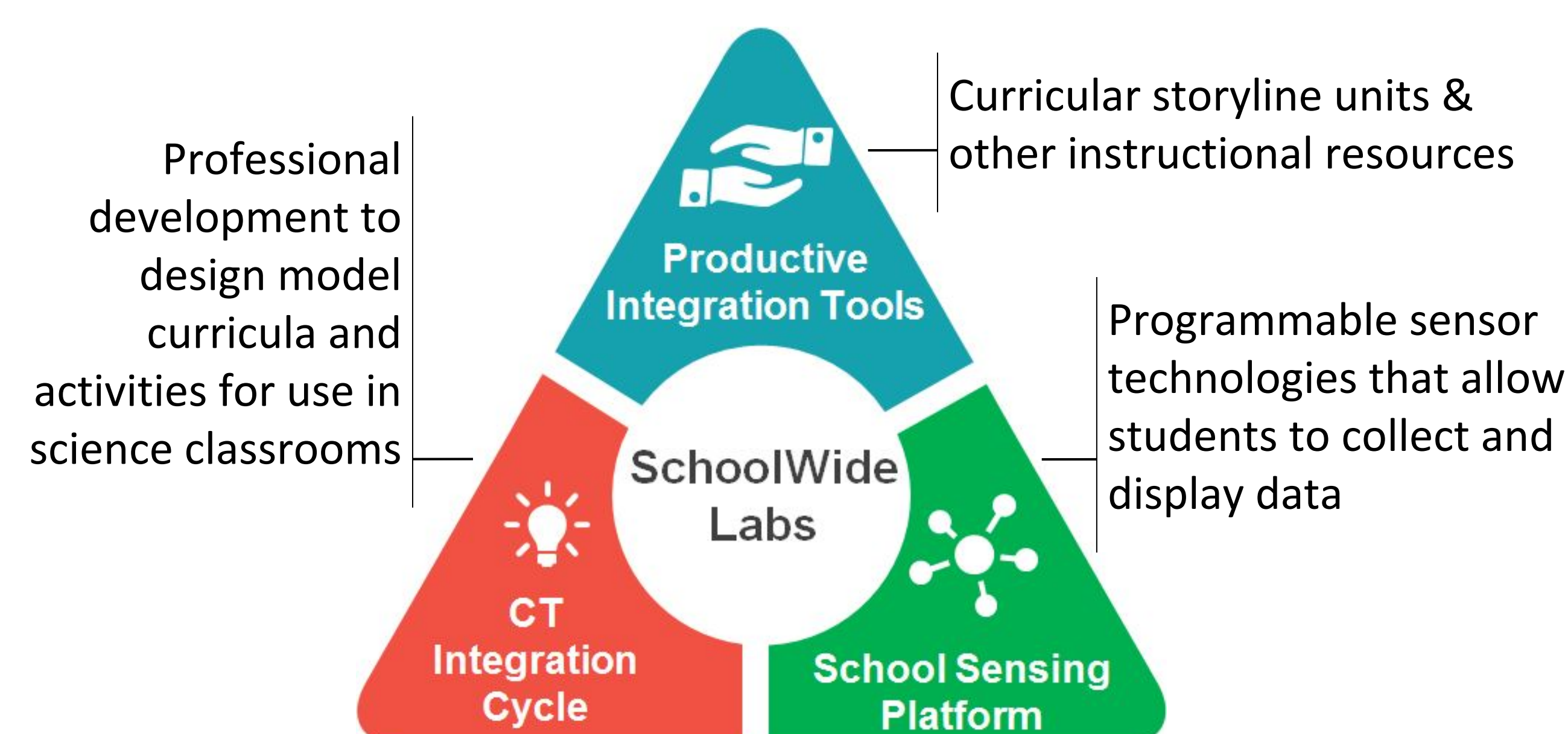# Introducing Middle School Students to Programmable Sensor Technologies Through an Immersive Experience
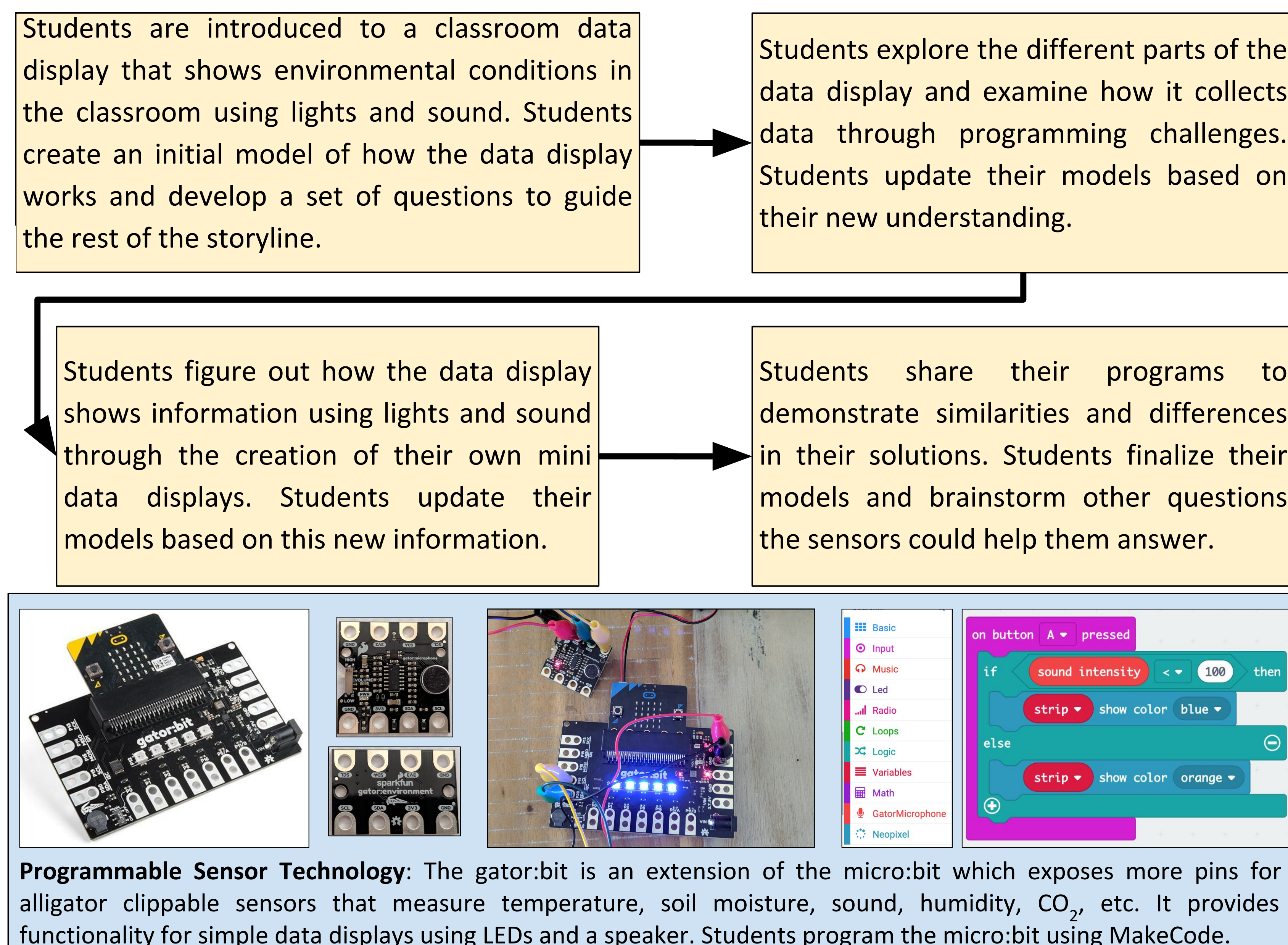
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Research Context

Curricular storyline units & other instructional resources

Professional development to design model curricula and activities for use in science classrooms

Productive Integration Tools

SchoolWide Labs

CT Integration Cycle

School Sensing Platform

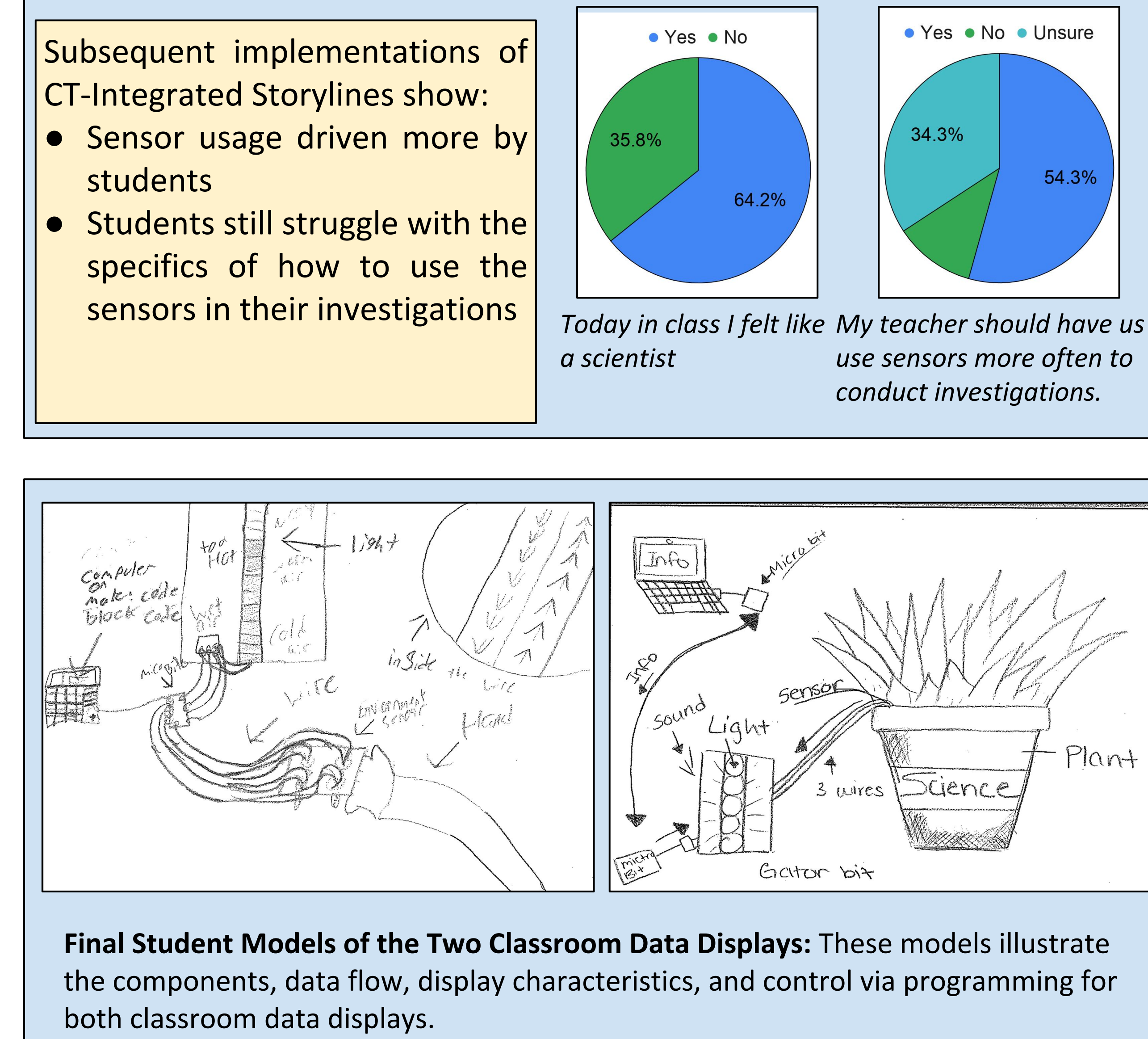Programmable sensor technologies that allow students to collect and display data

- Research Practice Partnership between CU Boulder, Utah State University, Denver Public Schools, and SparkFun Electronics
- Three Year Design Based Implementation Research[2] Project to integrate computational thinking into middle science and STEM classes in Denver Public Schools
- Utilizes instructional design techniques[1] proven successful in implementing the Next Generation Science Standards[6]
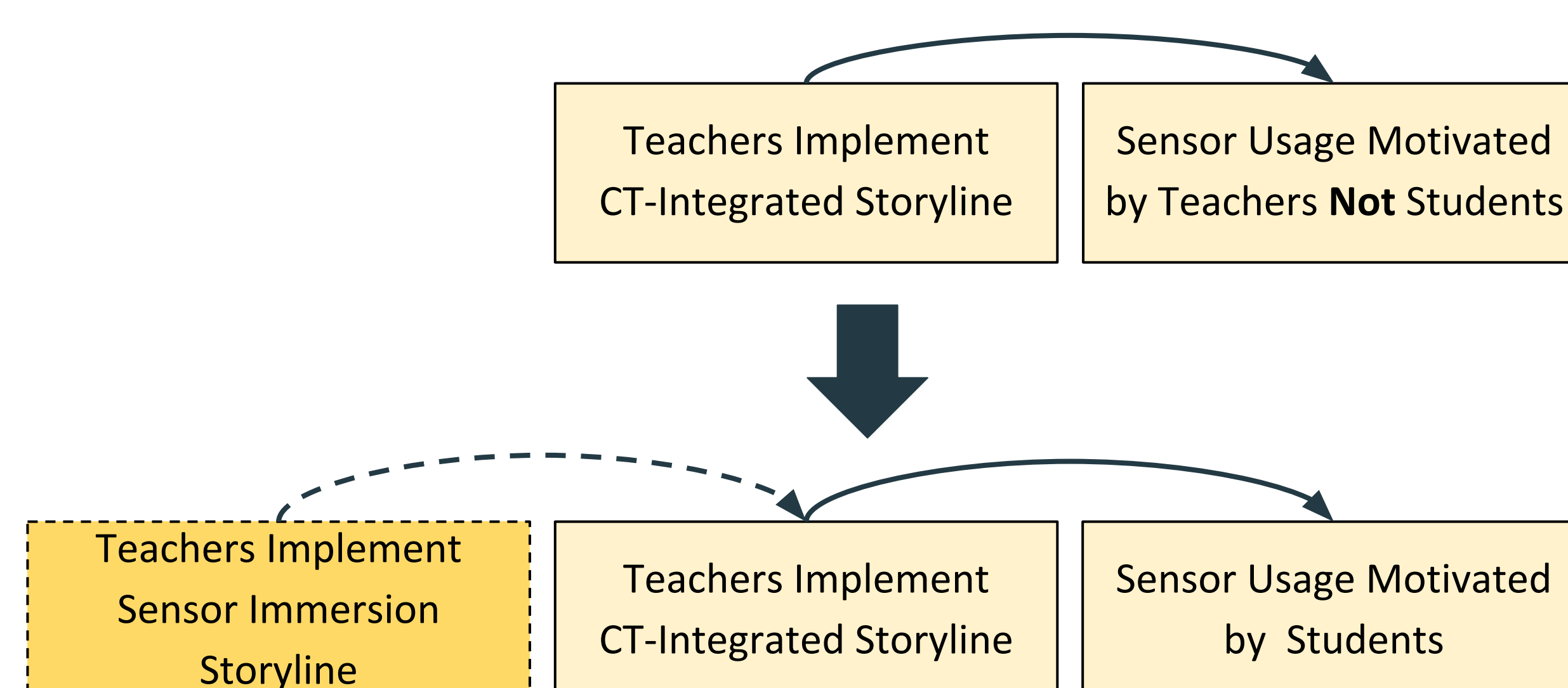
Motivation

Teachers Implement CT-Integrated Storyline → Sensor Usage Motivated by Teachers **Not** Students

Teachers Implement Sensor Immersion Storyline → Teachers Implement CT-Integrated Storyline → Sensor Usage Motivated by Students
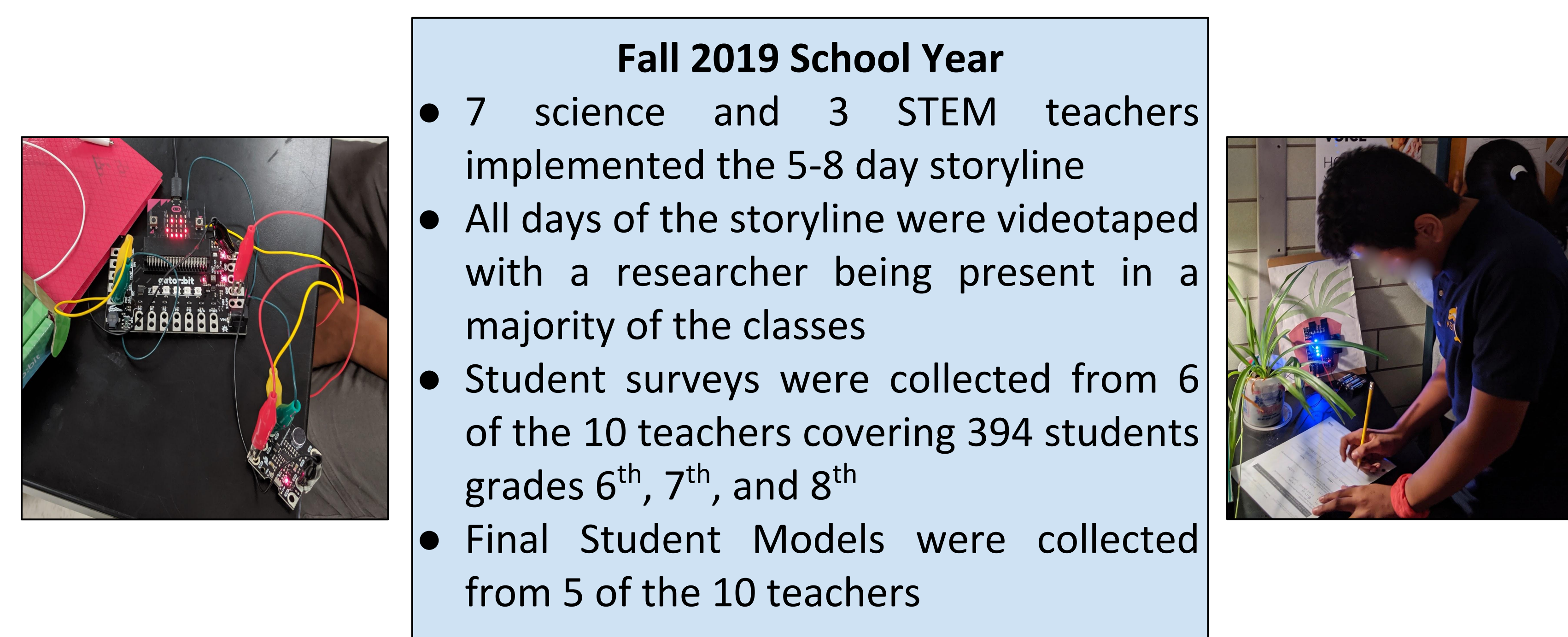
- After two design cycles[3-5], it became clear that using the sensors to help answer scientific questions was not student driven.
- Through reflection with the teachers, we all decided to design a sensor immersion storyline to introduce the students to the sensors before implementing additional CT-integrated storylines.
- Students wanted to use the sensors in other storylines, but could not articulate how or why they would use them.

Sensor Immersion Storyline

Students are introduced to a classroom data display that shows environmental conditions in the classroom using lights and sound. Students create an initial model of how the data display works and develop a set of questions to guide the rest of the storyline.

Students explore the different parts of the data display and examine how it collects data through programming challenges. Students update their models based on their new understanding.

Students figure out how the data display shows information using lights and sound through the creation of their own mini data displays. Students update their models based on this new information.

Students share their programs to demonstrate similarities and differences in their solutions. Students finalize their models and brainstorm other questions the sensors could help them answer.

Programmable Sensor Technology: The gator:bit is an extension of the micro:bit which exposes more pins for alligator clippable sensors that measure temperature, soil moisture, sound, humidity, CO_2, etc. It provides functionality for simple data displays using LEDs and a speaker. Students program the micro:bit using MakeCode.

Implementation

Fall 2019 School Year
- 7 science and 3 STEM teachers implemented the 5-8 day storyline
- All days of the storyline were videotaped with a researcher being present in a majority of the classes
- Student surveys were collected from 6 of the 10 teachers covering 394 students grades 6th, 7th, and 8th
- Final Student Models were collected from 5 of the 10 teachers

Results

Subsequent implementations of CT-Integrated Storylines show:
- Sensor usage driven more by students
- Students still struggle with the specifics of how to use the sensors in their investigations

Today in class I felt like a scientist — Yes 64.2%, No 35.8%

My teacher should have us use sensors more often to conduct investigations. — Yes 54.3%, No 34.3%, Unsure

Final Student Models of the Two Classroom Data Displays: These models illustrate the components, data flow, display characteristics, and control via programming for both classroom data displays.

Future Work

Revisions to the Sensor Immersion Storyline
- Teachers construct their own data display to anchor the storyline
- Increased focus on how the pieces of the system fit together and function
- Develop an incremental knowledge building experience for students who participate over multiple years

Acknowledgements

References

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