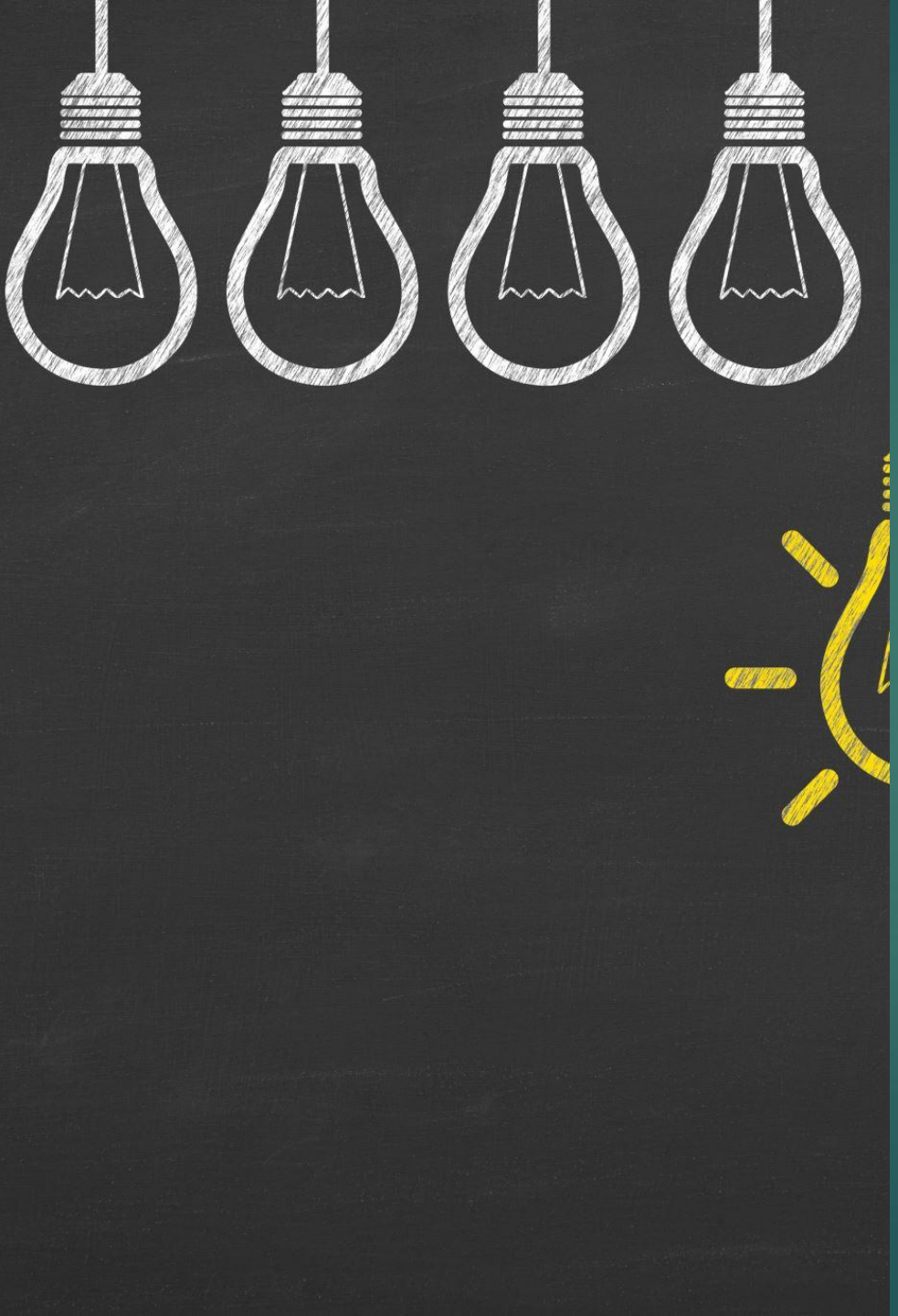


Reconsidering the Incorporation of Computational Thinking and Coding in Mathematics Education

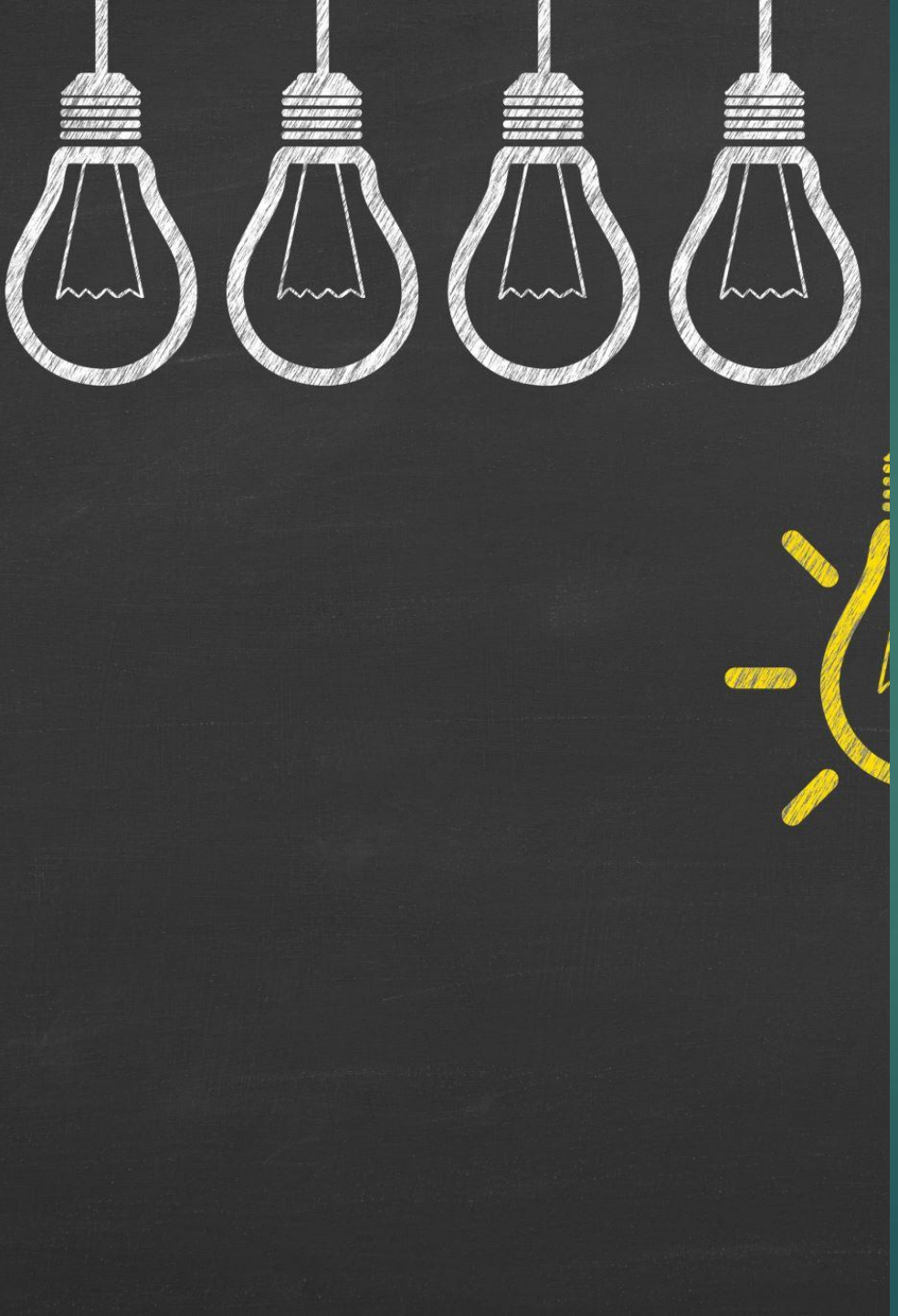
Erica Huang

SYMETRI PRESENTATION

MARCH 31, 2022

Agenda

- Master’s thesis research results
- Possible future research directions
- Questions, ideas and suggestions



Incorporating Computational Thinking and Coding in BC Secondary Mathematics Classrooms

Erica Huang

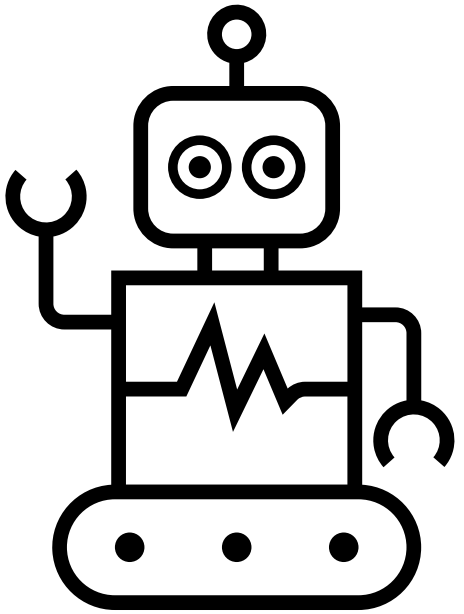
MASTER THESIS PRESENTATION

MARCH 10, 2020

What is Computational Thinking (CT)?

"The thought processes involved in **formulating problems and their solutions** so that the solutions are in a form that can be **effectively** carried out by **an information-processing agent**"

Wing, J. (2011)



What is Computational Thinking (CT)?

CT involves:

- the ability to think in abstractions
- the ability to think in terms of decomposition
- the ability to think algorithmically
- the ability to think in terms of evaluations
- the ability to think in generalizations

Selby, C. C., & Woollard, J. (2014)

CT and Coding in BC's Math Curriculum

Curricular Competency

Elaborations +

Students are expected to be able to do the following:

Reasoning and analyzing

- Use logic and patterns
  - including coding
  - games
- Use reasoning and logic to explore, analyze, and apply mathematical ideas
- Estimate reasonably
- Demonstrate and apply mental math strategies
- Use tools or technology to explore and create patterns and relationships, and test conjectures
- Model mathematics in contextualized experiences

Content

Elaborations

Students are expected to know the following:

- operations with rational numbers (addition, subtraction, multiplication, division, and order of operations)
- exponents and exponent laws with whole-number exponents
- operations with polynomials, of degree less than or equal to 2
- two-variable linear relations, using graphing, interpolation, and extrapolation
- multi-step one-variable linear equations
- spatial proportional reasoning

CT and Coding in BC's Math Curriculum

Background Information ▾ Change Grade ▾

Core Competencies

Communication ▾ | Thinking ▾

Big Ideas

Decomposition helps us solve difficult problems by managing complexity.

Algorithms are essential in solving problems computationally.

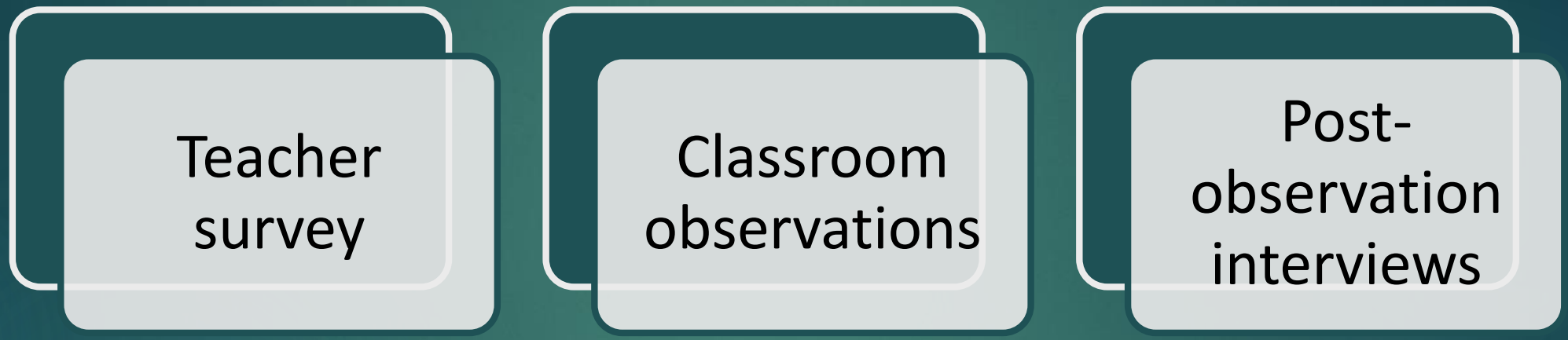
Programming is a tool tha allows us to implement computational thinking.

- a thought process pattern recognitio decomposition to algorithm in a way computer can exe
- *Sample questions t inquiry with studen*
  - How do we programmin to use in sol specific prob
  - Why is code important?
  - What factors

My Research Questions

- How do mathematics teachers understand CT?
- What CT and coding activities are developed and used in BC's mathematics classrooms?
- What challenges do teachers encounter?
- To what degree are CT and coding integrated into our mathematics courses?

Research Methodology



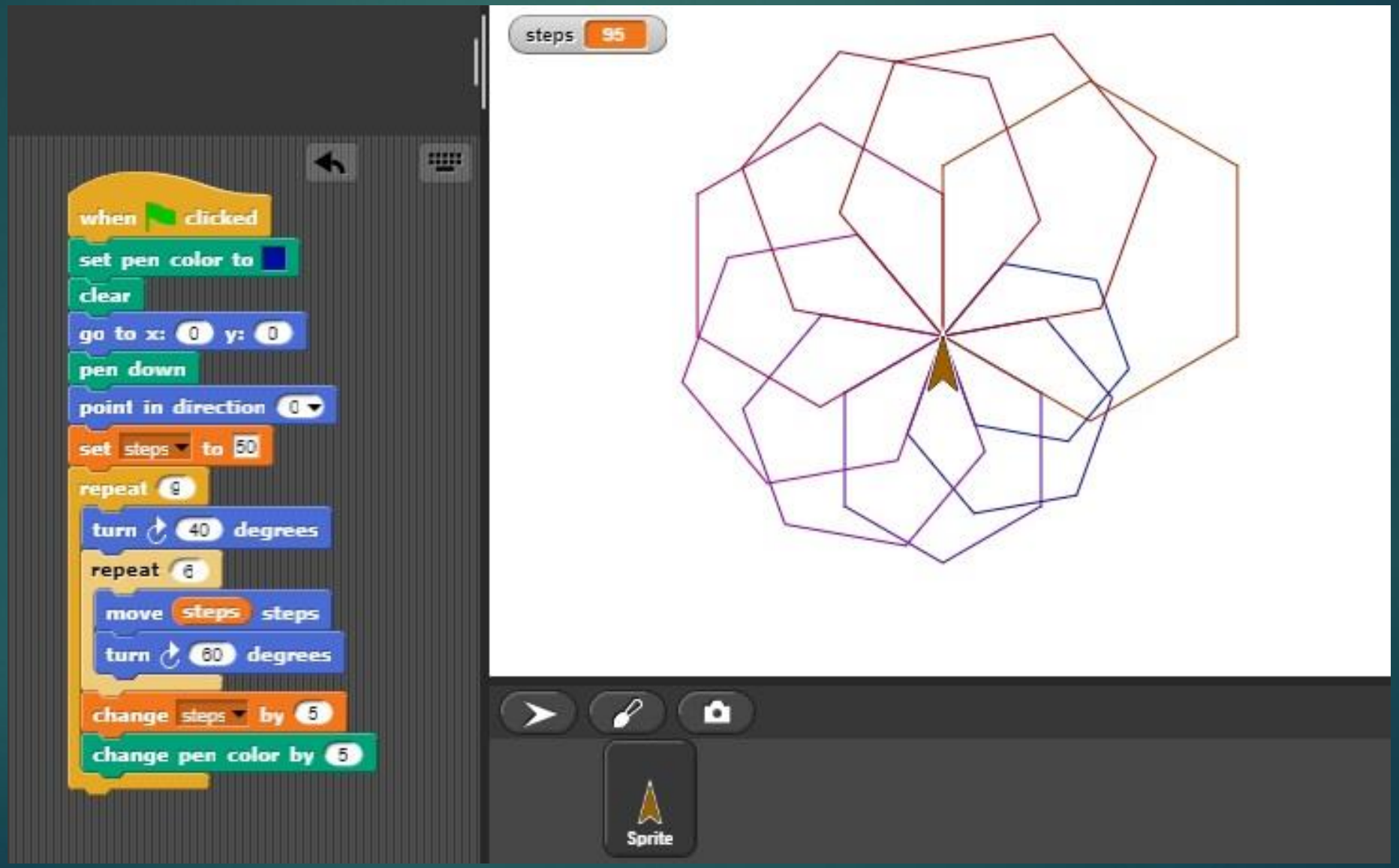
- 19 survey participants from 2 school districts
- 3 classroom observations and interviews
- data collected in Spring and Fall 2019

Theoretical Lens: Structuring Features of Classroom Practice

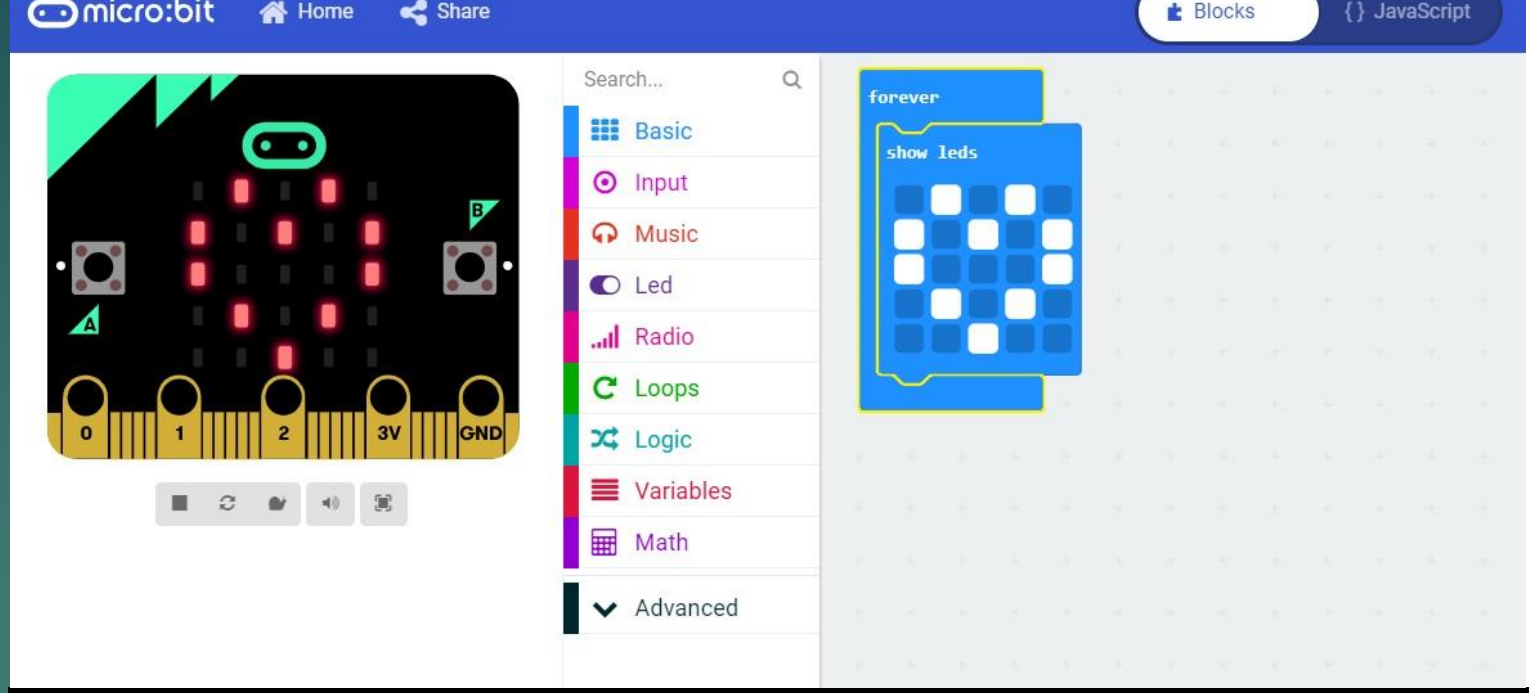
- Working environment
- Resource systems
- Activity format
- Curriculum script
- Time economy

Ruthven, K. (2009). Towards a naturalistic conceptualisation of technology integration in classroom practice: The example of school mathematics. Education & Didactique, 3(1), 131-149.

Ada’s Grade 9 Class – Snap! and Spiral art



Grace’s Grade 8 Class - Multiples of Three on Micro:bits



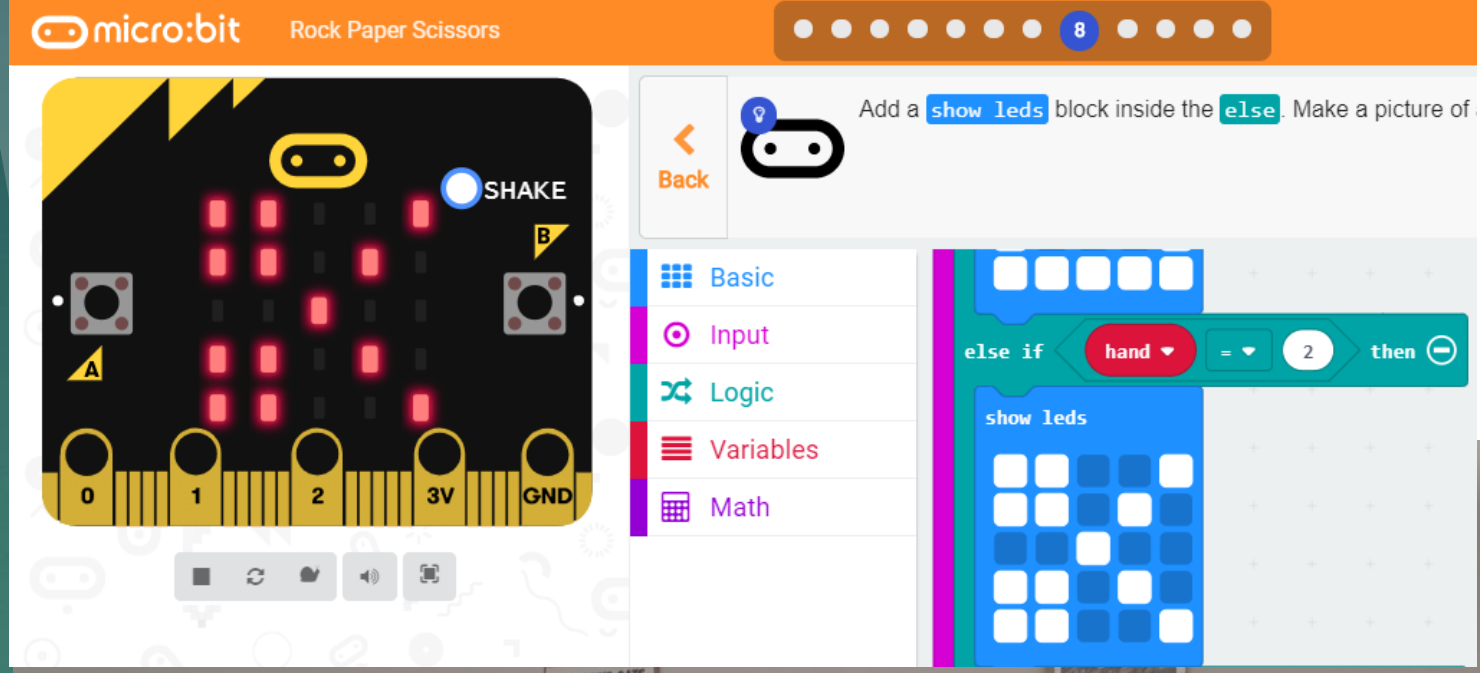
Make an upgrade version of “Mult. of 3” program

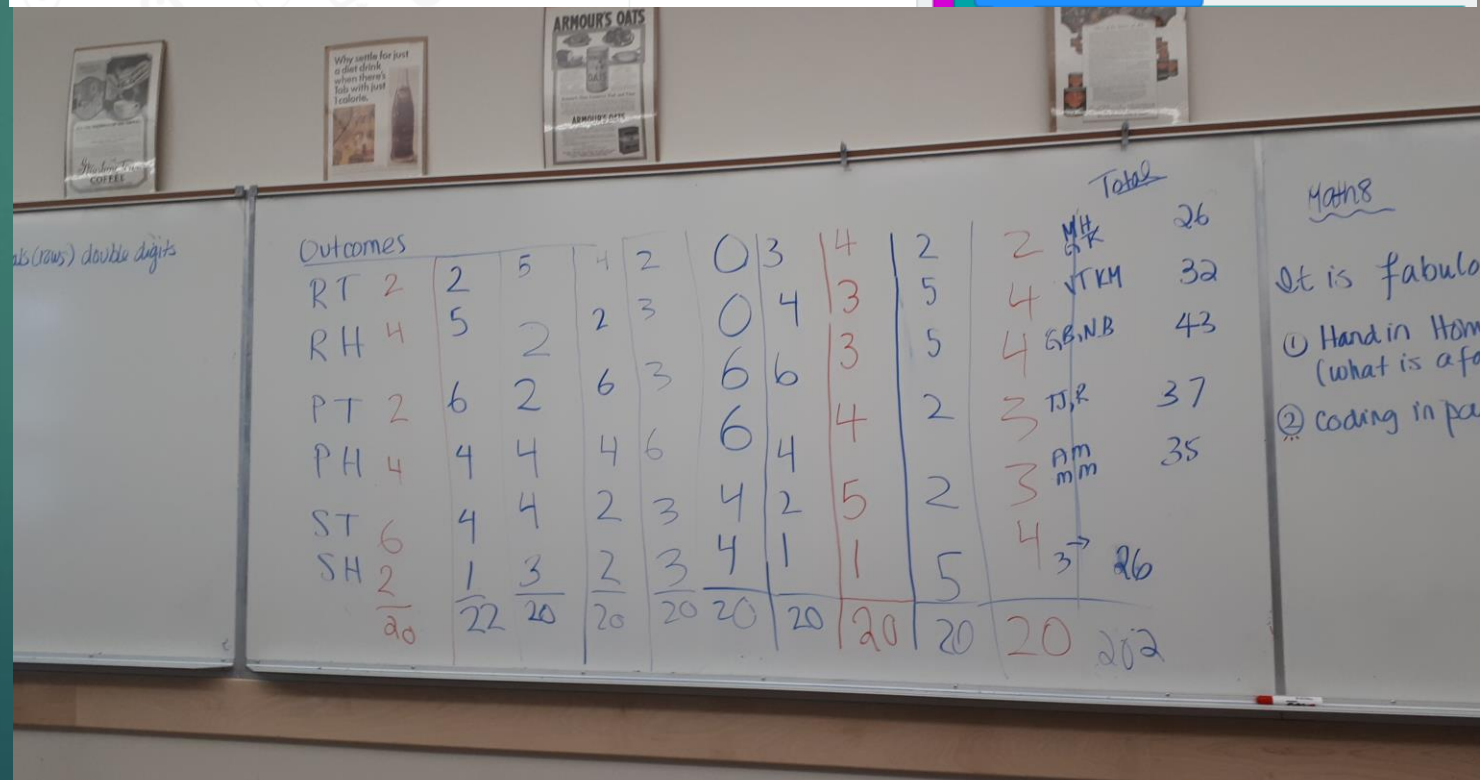
Changes to make:

Program prints the numbers from 1 to 20 with exception of:

- Multiples of 3 show “🙂” instead of the number
- Multiples of 5 show “☹” instead of the number
- Multiples of both 3 and 5 show “❤” instead of number

Julia's Grade 8 Class – Rock-Paper-Scissors + Coin-Flipper on Micro:bits





Learnings and Findings

Teachers found that these coding activities elicited a high-level engagement and were accessible to a wide range of students.

Coding provided a different context for teachers' conversations with students about mathematics concepts.

No explicit teaching of CT practices was observed.

All three teachers highlighted the lack of extensions as a major challenge and were interested in transitioning into text-based.

Possible Future Research Directions

Being Inclusive and Culturally Responsive

- **Rural areas:** How do teachers in rural areas implement CT and coding in math classrooms?
- **Indigenous communities:** Are there opportunities to collaborate with Indigenous communities on CT and coding? How can it be done in a respectful way?
- **Gender:** When CT and coding are brought into schools, how can we ensure it does not contribute to the issue of lack of diversity?

Possible Future Research Directions

Curriculum Change and Implementation

- Ontario recently also announced the addition of coding to their math curriculum. Why? How are teachers implementing it? How about other provinces?
- How do teachers approach CT in the new Computer Science 11 and 12 math courses? How do these courses affect CS education in the province?
- How can we better prepare teacher candidates?

Questions, Ideas and Suggestions

References

- British Columbia Ministry of Education. (2016, June) *Mathematics.* BC's Curriculum. https://curriculum.gov.bc.ca/curriculum/mathematics
- Selby, C. C., & Woollard, J. (2014). Computational thinking: the developing definition. Presented at the SIGCSE 2014, Atlanta.
- Ruthven, K. (2009). Towards a naturalistic conceptualisation of technology integration in classroom practice: The example of school mathematics. Education & Didactique, 3(1), 131-149.
- Wing, J. (2011). Research notebook: Computational thinking—What and why. *The link magazine*, *6*, 20-23.