Collective Argumentation Learning and Coding (CALC)

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This material is based upon work supported by the National Science Foundation under Grant # 1741910. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.
If teachers could understand coding better, and if they could teach students to code using the same methods they use to teach mathematics and science, then coding, possibly integrated with mathematics and science, could become part of the normal elementary school curriculum.
Why argumentation?

• Georgia (and Common Core) Standards
  Students are expected to
  • construct viable arguments and critique the reasoning of others
  • participate in mathematical discussions involving questions like “How did you get that?” and “Why is that true?”
  • explain their thinking to others and respond to others’ thinking

• Academic skill needed in the real world
• Fosters learning in authentic and disciplinarily appropriate ways
(Asterhan & Schwarz, 2007; Venville & Dawson, 2010)
Toulmin’s Argument Diagram

Data

Claim

Warrant

So,

Since,

Backing

Evidence presented in support of a claim

The statement under consideration

Bridge between data and claim; reasons that the particular data is relevant to the claim

Adapted from Toulmin (1958/2003)

Also, qualifiers and rebuttals

Discipline-specific reasons the warrant is valid
Toulmin’s Argument Diagram

From Conner (2008)
Research Questions

- How does the CALC approach build elementary school teachers’ content knowledge of coding?
- How do elementary school teachers use the CALC approach to support their students’ learning of coding, mathematics, and science content and practices?
- What are elementary teachers’ beliefs about using collective argumentation in teaching coding, mathematics, and science?
- What approaches to coding (e.g. trial & error, structured) do students use after CALC enactment?
- In what ways do students demonstrate an interest in STEM+C learning and careers after experiencing the CALC approach?
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Beginning of first semester

Task: Code the motor so your robot travels 6 inches; then what code do you change to make your robot travel 12 and 18 inches

No it wouldn’t work, you know how it behaved with 6 and 4, you make one go up a bit (the motor speed code) and one go down a bit, you said it would move a bit, let’s try 7 and 3.
Part of the discussion
No it wouldn’t work, you know how it behaved with 6 and 4, you make one go up a bit (the motor speed code) and one go down a bit, you said it would move a bit, let’s try 7 and 3.
Our data says 0.8 [seconds] for 6 inches and we said 3 seconds will get us 18 inches. We want to see if the claim is true or not. It turns out that it is false...the claim wasn’t true because it would have, you have to double it. It goes 6, 12, 18 which is multiplying by 2 and 3. So to get to 12 inches we need to code [motor code speed] to 1.6 and for 18 inches we need to use 2.4.

1.05 seconds makes the Roborobo travel 6 inches (07:35)

CALC: So what was the topic y'all were talking about? (7:32)

The claim wasn’t true, it would actually be 3 seconds, not 2.4 (07:35)

True or false: In 2.4 seconds, Roborobo will travel 18 inches.

Cause you double it by six cause if it went 6, 12, 18, it would actually be three seconds because every time it goes by 6 it would increase by a second (07:35)
At the beginning, many teachers were not very comfortable with coding.

Challenged in teaching children how to use collective argumentation in coding and struggled with understanding the goal of CALC.

I understand that we're trying to steer away from the trial-and-error and making arguments, I'm just not sure I know what that means. I don't know what that looks like... I feel like I'm not there, but I don't know what I'm missing... (Doris)
What we learned from our teachers

• Cyclic Learning:
  • The elementary aged students reacted differently when engaged in the CALC approach
  • For each new situation, the teachers had to learn how these reactions impacted a learning activity

• Almost all teachers believed using argumentation helps children explain the process of coding and defend their answers
• Optimistic about students’ capability of learning to code
• Teachers acknowledged the CALC course helped them to change their role as the teacher