Developing a Suite of Standards-based Instructionally Supportive Tools for Middle School Computer Science (ASSIST-MSCS)

SRI Education

ASSIST CS

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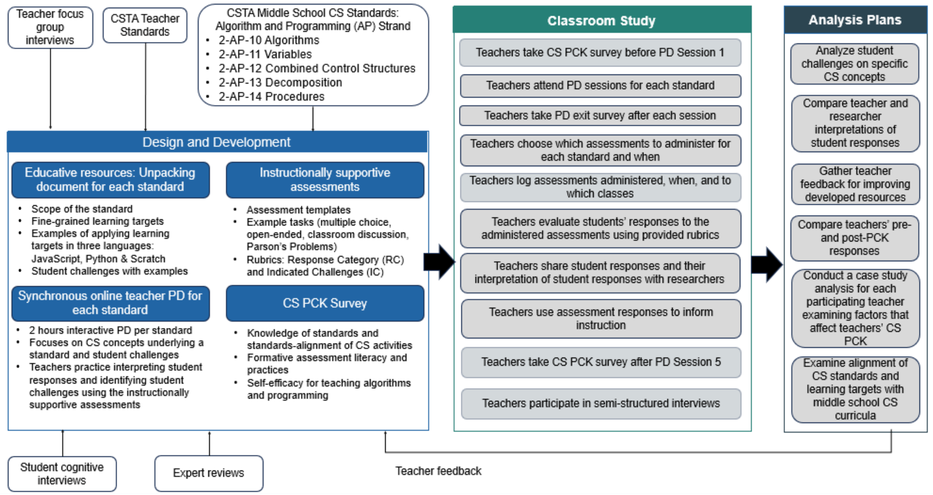
Why do CS teachers need standards-aligned instructional supports?

- Many K–12 CS teachers do not have formal training in CS.
- Most K–12 CS professional development (PD) is tied to a specific curriculum and programming language, with a focus on facilitation of the curriculum as opposed to understanding of the CS concepts or formative assessment practices.
- Teachers see PD for different curricula as distinct and do not make connections between CS concepts across curricula.
- The CS teacher standards highlight the need for teachers to have knowledge of CS skills and to be able to use this knowledge to develop learning experiences and use assessments.
  - ❑ Standard 1. CS Knowledge and Skills
  - ❑ Standard 4. Instructional Design
    - 4a. Analyze CS curricula
    - 4b. Develop standards-aligned learning experiences
    - 4g. Inform instruction through assessment
- Teachers with understanding of the CS concepts are better equipped to support students with their learning.

Project Aim and Approach

Support K–12 teachers' CS pedagogical content knowledge (PCK) with standards-aligned professional learning that focuses on teachers' conceptual understanding of CS standards and their standards-aligned formative assessment literacy and practices.



Key Findings

- Teachers appreciated the deep dive into CS concepts and found it supportive of their teaching and their confidence with CS.
- Teachers appreciated the assessment tasks but needed support with deciding when to incorporate them into their instruction.
- Students are not used to unplugged activities outside programming environments and found it difficult to transfer their understanding of CS concepts; teachers appreciated the unplugged exercises.
- Teachers' interpretation and application of rubrics do not always match that of researchers (sometimes due to lack of content knowledge, sometimes due to a focus on other aspects such as clarity of explanations versus content).
- Teachers considered the developed professional learning resources to be more beneficial for teachers with a few years of CS teaching experience compared to first-time CS teachers.

Project Next Steps

- Analysis of student and teacher data from second pilot study.
- Disseminate research insights and teacher professional learning resources to a broader audience.

Formative Assessment Task Examples

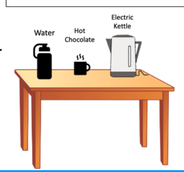
Identifying algorithm(s) for a given scenario: An example task with a Response Category (RC) rubric (students are assigned only one RC based on their response)

Which of the following is an algorithm a person could use to make hot chocolate?

A.
Step 1. Buy hot chocolate packet.
Step 2. Get a clean mug.
Step 3. Turn on the music.
Step 4. Drink hot chocolate.
Step 5. Boil water in a kettle.

C.
Step 1. First, bring water to a boil in a kettle.
Step 2. Open one hot chocolate pack.
Step 3. Put the hot chocolate powder into a mug.
Step 4. When the water is between 195°F and 205°F, add it into the mug.
Step 5. Stir it and serve

B.



D. Option A and C

E. All of the options

If student answers:	Possible inference about student understanding:	Response Category (RC)
A	Challenges with order and final goal: Student does not realize that the steps of an algorithm need to be in order/sequential and the last step should be the goal which is making hot chocolate.	RC1
B	Challenge with representation: Student does not realize that an algorithm is a process or ordered set of steps to get to a goal state; a static diagram depicting objects is not an algorithm.	RC2
C	**No challenge identified: Student understands what defines an algorithm.**	**RC3**
D	Challenge with representation: Student may think that everything that forms a list/procedure is an algorithm, and hence, student does not understand what defines an algorithm.	RC4
E	Challenge with understanding algorithm: Student does not understand what defines an algorithm.	RC5
No response (missing)	Student may not know how to engage with this task or may have just skipped the task.	M

Predicting the output of a program updating variable values: An example task with an Indicated Challenge (IC) rubric (students can be assigned multiple IC categories, with an option of no categories indicating they do not display any challenges)

What would the program print out?

```
1 var number = 0;
2 for(var i = 0; i < 5; i++){
3   number = 0;
4   number = number + 5;
5   console.log(number + "*");
6 }
```

Desired Response:
5*
5*
5*
5*
5*

If student response contains:	Possible inference about student understanding:	Indicated challenge (IC)
Increasing values of **number** each time it is printed, such as: 5, 10, 15, 20, 25 OR 0, 5, 10, 15, 20	Student may not recognize that **number** is re-initialized and reset to 0 repeatedly within the loop	IC1
Enters 0 for the first number	Student may not recognize that **number** is increased before it is printed	IC2
Increases the value of **number** by something other than 5	Student may not recognize that **number** is re-initialized each time and may not understand how to evaluate variable update statements.	IC3
Does not include the * after any or some of the numbers	Student may not recognize how string concatenation works using "join" or the "+" operator.	IC4
Prints out 4 numbers or 6 numbers (instead of 5)	Student may not recognize how indexing works in a loop and may harbor an "off by 1" error.	IC5
Prints out only 1-3 numbers or more than 6 numbers	Student may not recognize how many times a loop repeats actions.	IC6
No response (missing)	Student may not know how to engage with this task or may have just skipped the task.	M

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