If They Build It, Will They Understand It?

Exploring the Relationship between Student Code and Performance

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CANON LAB

Computing for ANyONe: Designing for equity and inclusion

Worldwide, Computer Science instruction is spreading to increasingly younger students.

Image from Robotics Learning Online

Common Assessment Techniques: Pros & Cons

Artifact analysis (very common in primary CSEd):

+ Student code integration (e.g. Scrape, Hairball, Dr Scratch)
+ Fast
- Students use code they do not understand (Brennan et al., 2012)
- Students may understand a concept, but choose not to include it

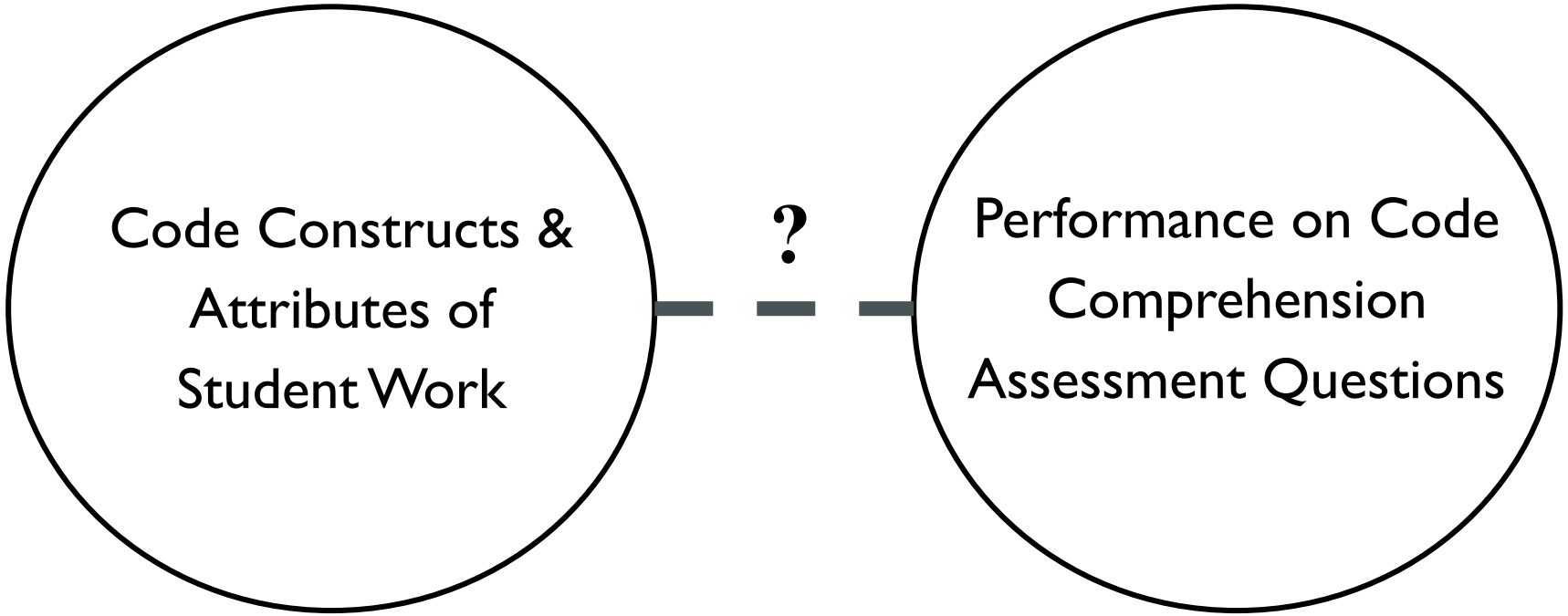
Written assessments:

+ Traditional choice (Burke et al, 2012, Franklin et al., 2013, Gordon et al., 2012, Lewis et al., 2012, Meerbaum et al., 2013)
- Not many validated assessments for elementary computing

Interviews:

+ Most complete & personalized picture (Brennan et al., 2012)
- Prohibitively time-consuming

What is the relationship between student code & assessment performance?



School Context

- 296 students aged 9-10 from a school district in the US
- Students were taught 3 CT concepts: events, sequence, & loops
- At the end of each unit, students
  - made computational artifacts based on open-ended prompt, &
  - took a written assessment on concepts covered

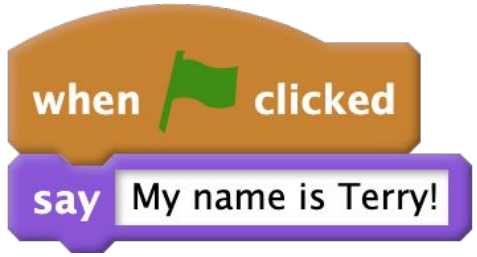
Computational Artifact Analysis

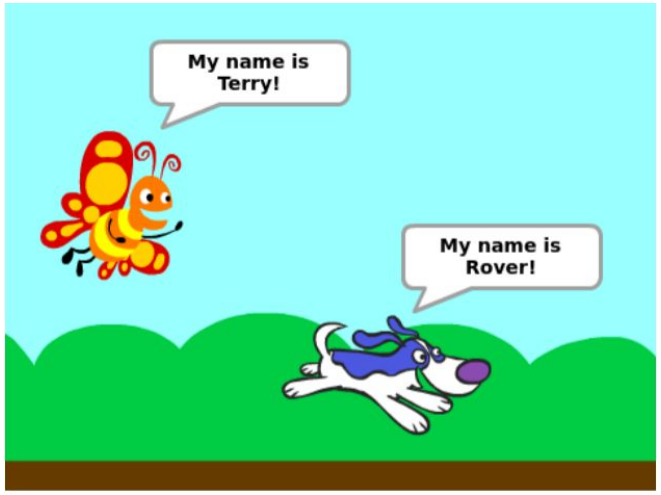
- Student Scratch projects were analyzed for:
  - Complexity: Blocks, Scripts, Sprites
  - Concept: Event & loop blocks
- Correlations between project attributes & assessment questions

Assessment Design

Focus: Structural understanding from the Block Model (Schulte, 2008)

- Predict the outcome of a script
- Figure out which script produced an outcome (Sorva, 2013)

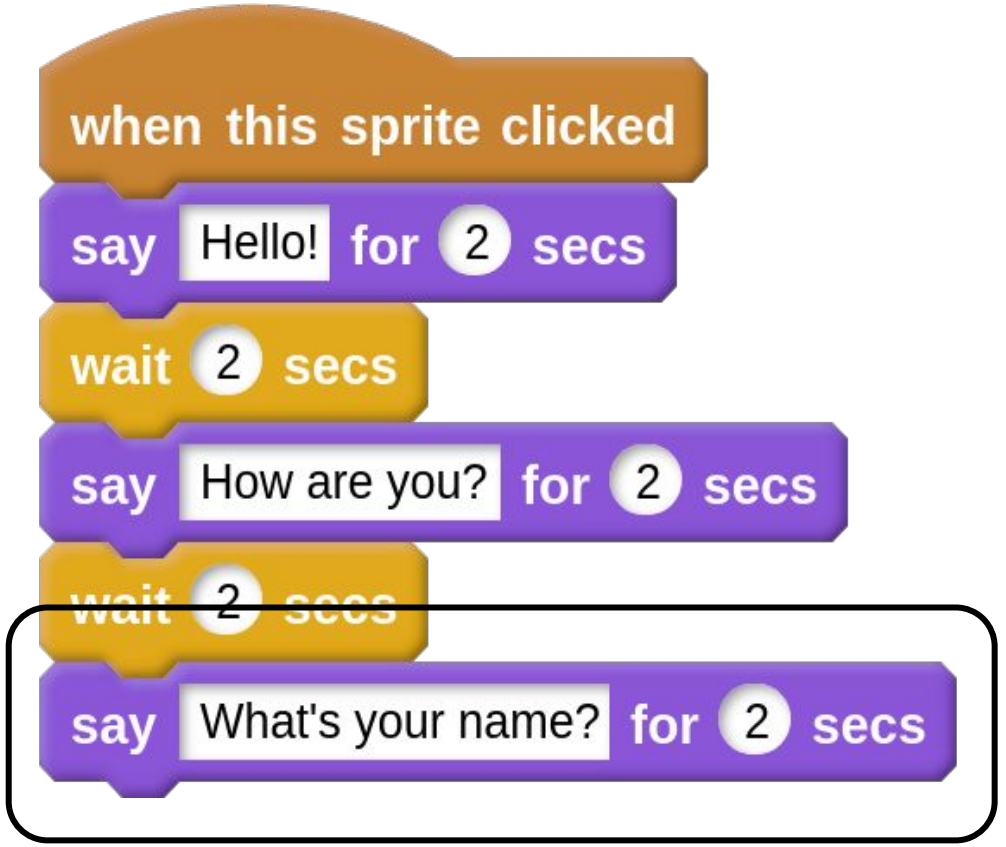




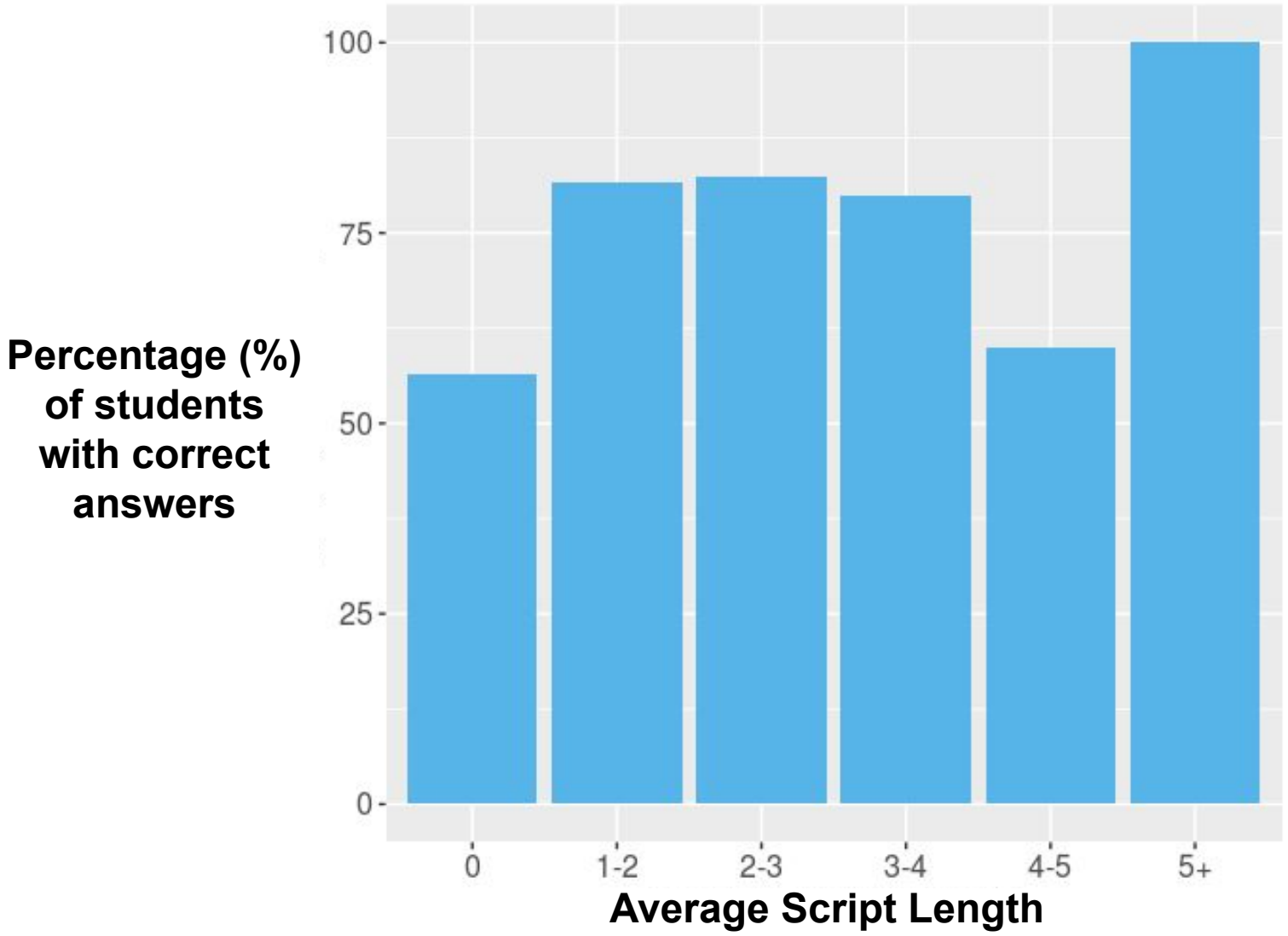
Weak or no correlation between artifact attributes & question performance

		Blocks			Scripts		Sprites	Loops/Events	
	Q	Tot	Uni	Cat	Tot	Len	Tot	Tot	Uni
Events & Sequence	Q1	-	-	VW	-	VW	-	-	VW
	Q2	VW	VW	VW	VW	VW	-	VW	VW
	Q3	**W**	VW	VW	VW	-	-	VW	VW
Loops	Q4	VW	VW	VW	VW	-	-	VW	VW
	Q5	-	-	VW	VW	-	-	VW	-
	Q6	VW	-	-	VW	-	-	VW	VW
	Q7a	-	-	VW	VW	-	-	VW	VW
	Q7b	VW	-	VW	VW	-	-	-	VW
	Q7c	VW	VW	VW	VW	-	-	VW	VW

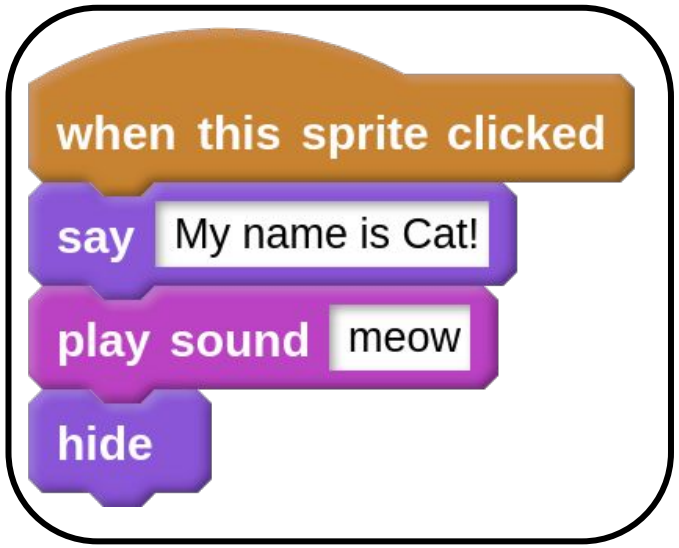
Sequence Question: Circle the "Say" block that will be run last.

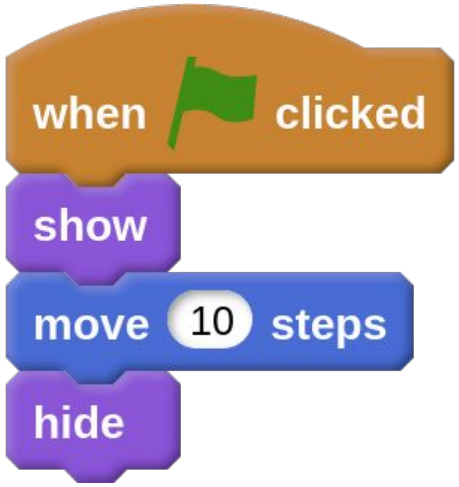


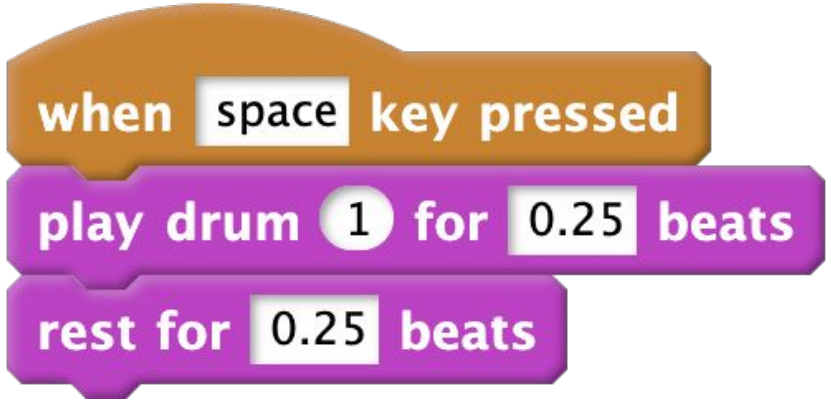
Very weak correlation between script length & correct answers

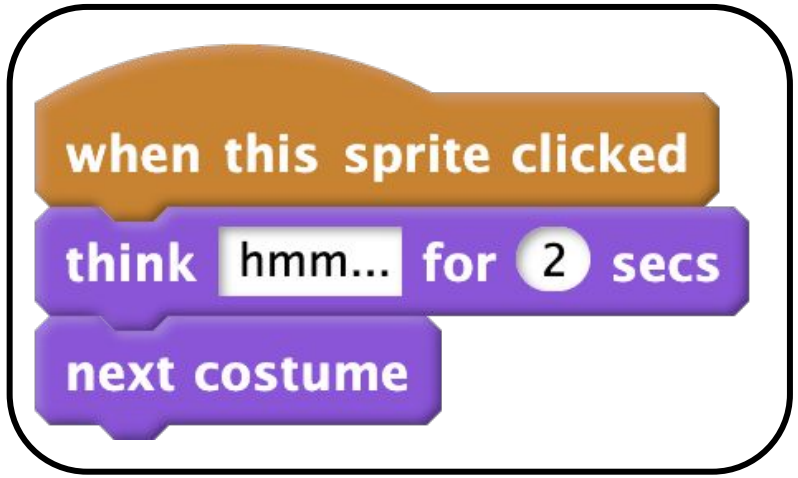


Events Question: Circle all the scripts that run when you click the sprite.

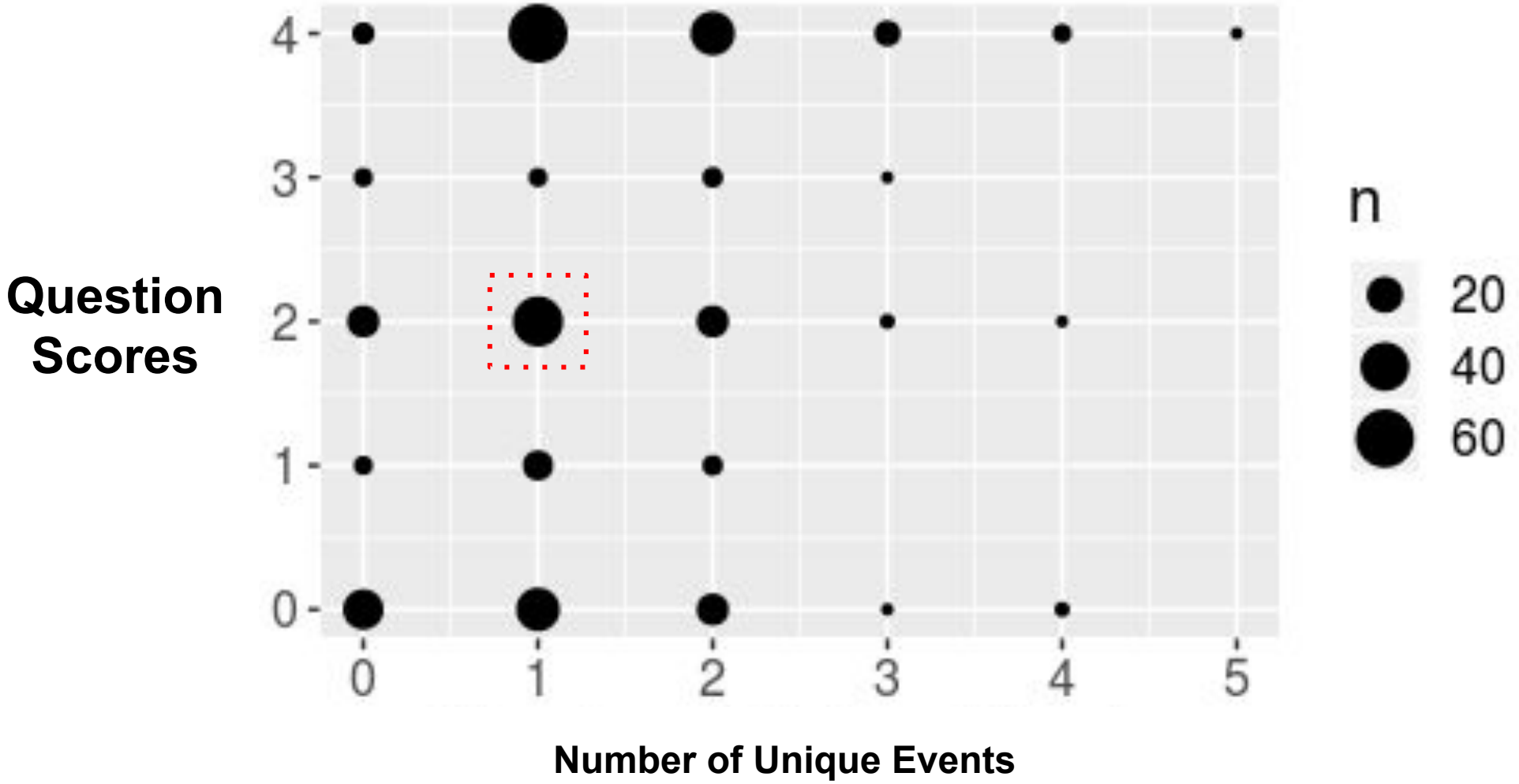




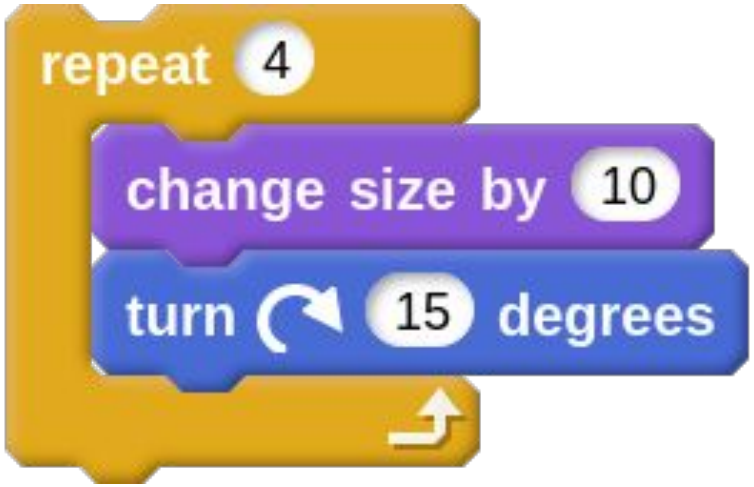




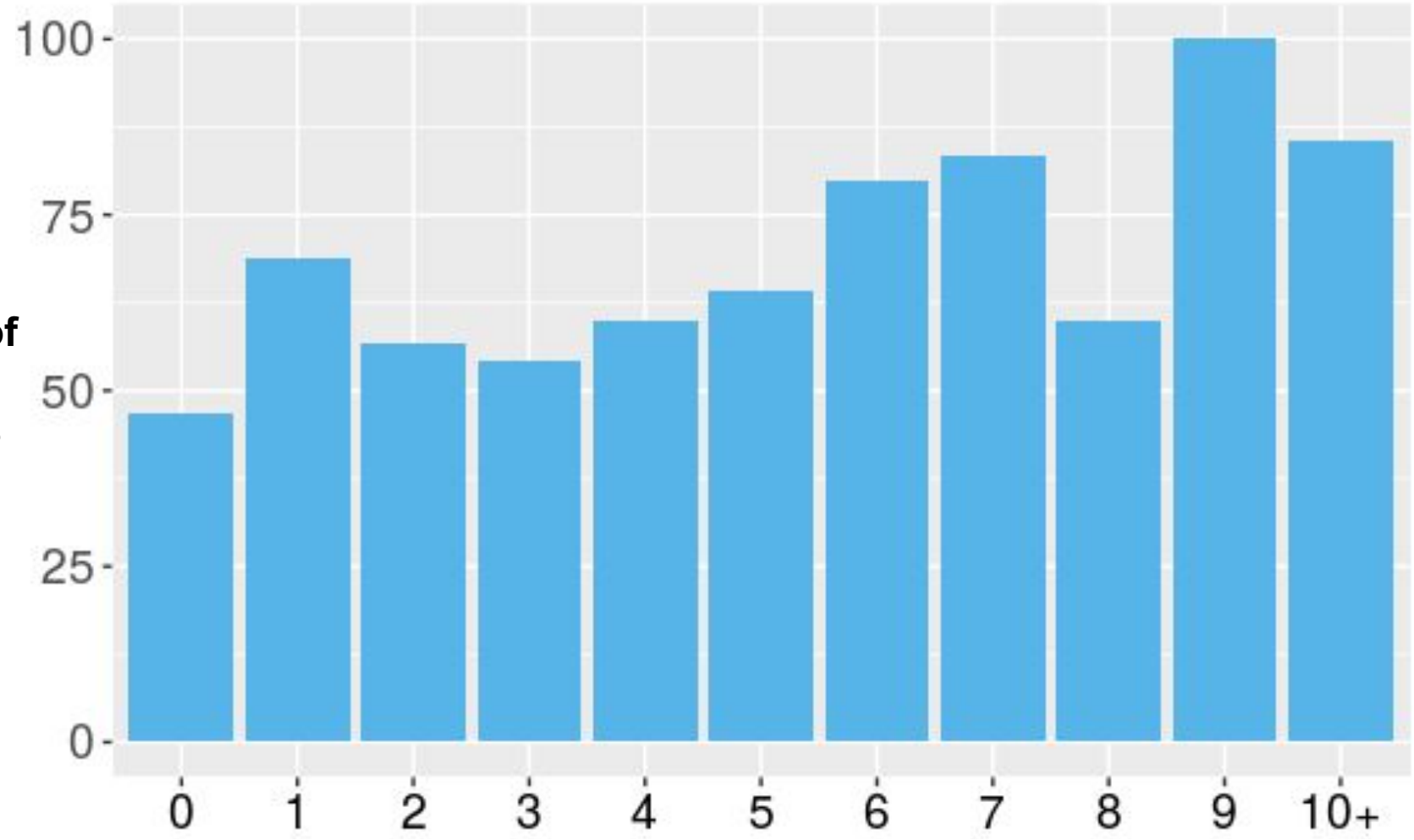
Very weak correlation between number of events & question scores



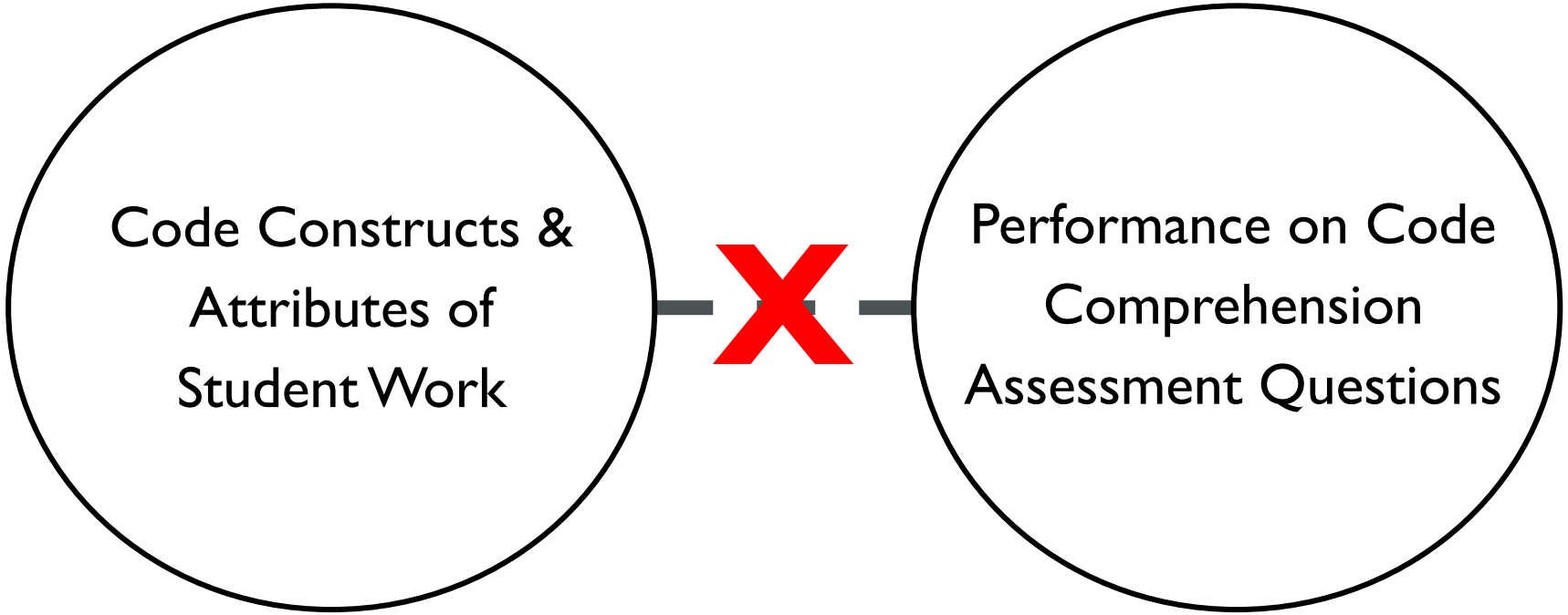
Loops Question: Unroll a loop



Very weak correlation between number of loops & correct answers



Artifact analysis shows that students *built* something, not that they *understood* something.



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Let's continue the conversation!
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Key Contributions:

- Challenges the claims made from artifact analysis in previous studies
- Weak or no correlation between attributes in code & performance on code comprehension questions
- Highlights the need for assessment techniques more suitable for primary CS education