Designing a Video-Based Survey for Assessing Computational Thinking

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NSF DRL-1312129 Promoting Computational Thinking through Game & Simulation Design (oDREAMS)

Operationalizing Computational Thinking

- Computational thinking (CT) is a problem-solving process that includes (but is not limited to) the following characteristics:
  - **Formulating problems** in a way that enables us to use a computer and other tools to help solve them.
  - Logically **organizing and analyzing** data
  - **Representing data** through abstractions such as models and simulations
  - Automating solutions through **algorithmic thinking**
  - Identifying, analyzing, and implementing possible solutions with the goal of achieving the most **efficient and effective** combination of steps and resources
  - **Generalizing and transferring** this problem solving process to a wide variety of problems

Source: http://www.iste.org/docs/ct-documents/computational-thinking-operational-definition-flyer.pdf?sfvrsn=2

Computational Thinking Enhanced by…

- Confidence in dealing with complexity
- Persistence in working with difficult problems
- Tolerance for ambiguity
- The ability to deal with open ended problems
- The ability to communicate and work with others to achieve a common goal or solution

Source: http://www.iste.org/docs/ct-documents/computational-thinking-operational-definition-flyer.pdf?sfvrsn=2

sCALABLE GAME DESIGN

What students do in oDREAMS

1. Learn about **Computational Thinking** by creating increasingly complex games
2. Leverage **Computational Thinking** to create STEM simulations (NGSS)

Computational Thinking
Patterns

- Connecting reasons to program (world) with abstracted phenomena (representation) that relate to programming code (tech)
- Fundamental to agent based programming
- Used to design professional development, instructional resources and assessment

Construct of Computational Abstraction

High

Respondents see a connection between real-world situation and prior game. Respondents can both name the CTP and describe it.

Respondents see a connection between real-world situation and prior game but struggle to describe it fully. Respondents can name the CTP or describe it, but not both.

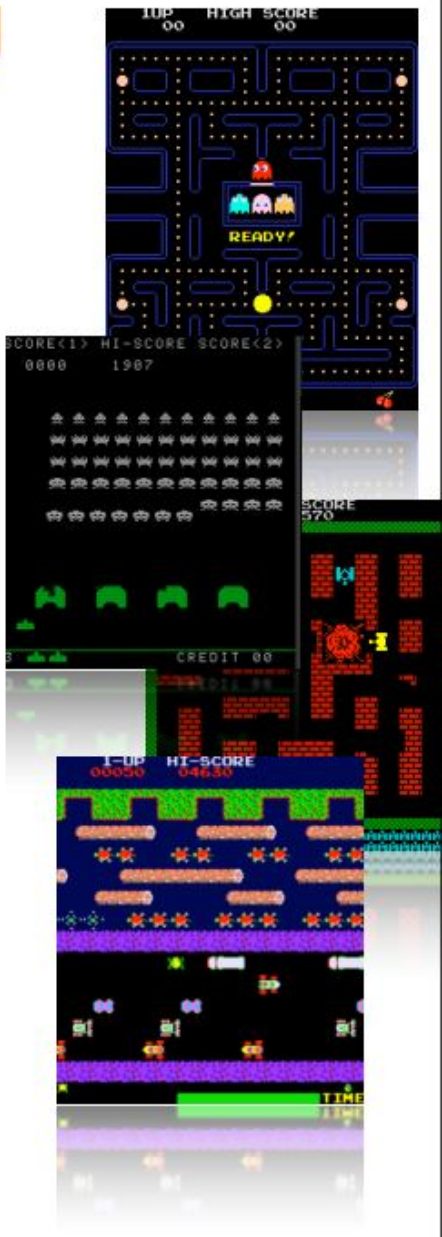
Respondents see basic connection between real-world situation and prior game that does not include a computational thinking pattern

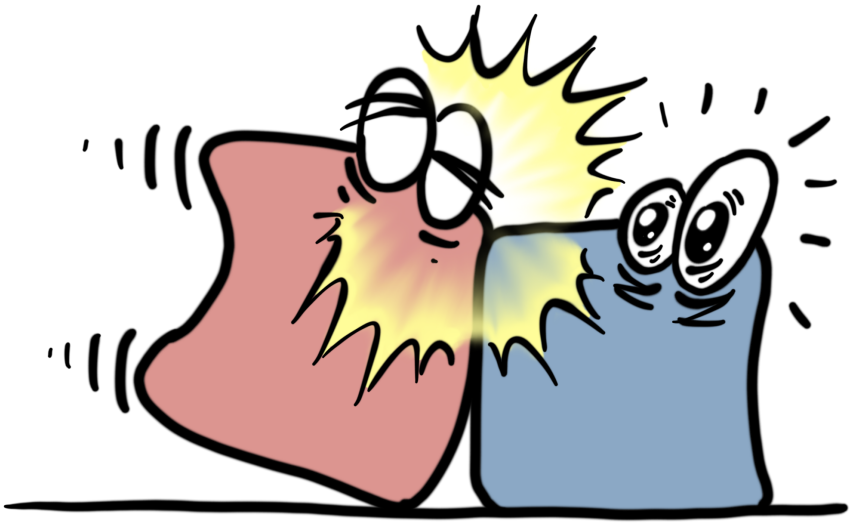
Respondents see no connection between real-world situation and prior game

Low

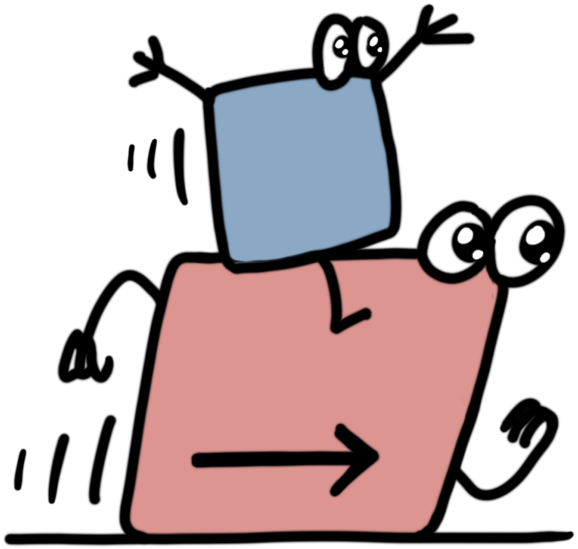
basic computational thinking patterns

- **Collision**; Frogger: Frog meets Truck
- **Push**; Sokoban: person pushes boxes
- **Transport**: Frogger: logs transport frogs
- **Generate**: Space Invaders: defenders shoot rockets
- **Absorb**: Bridge Builder: tunnel absorbs cars
- **Choreography**: Space Invaders: mother ship makes attack alien ships move left and right and descend
- **Polling / Counting**: Pacman: game over when all the dots are eaten

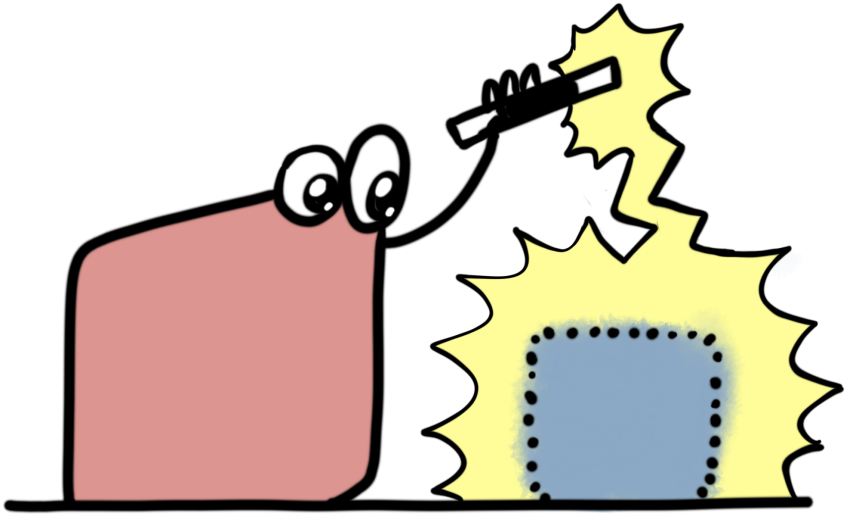




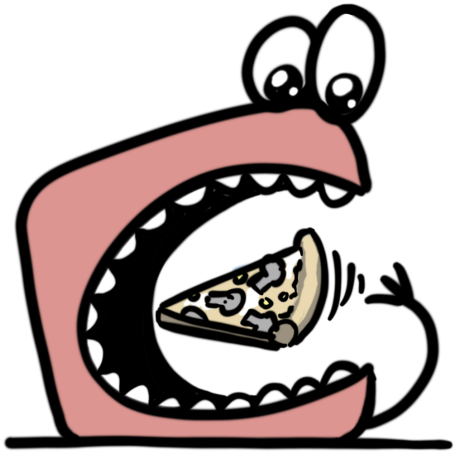
Collide



Transport



Generate

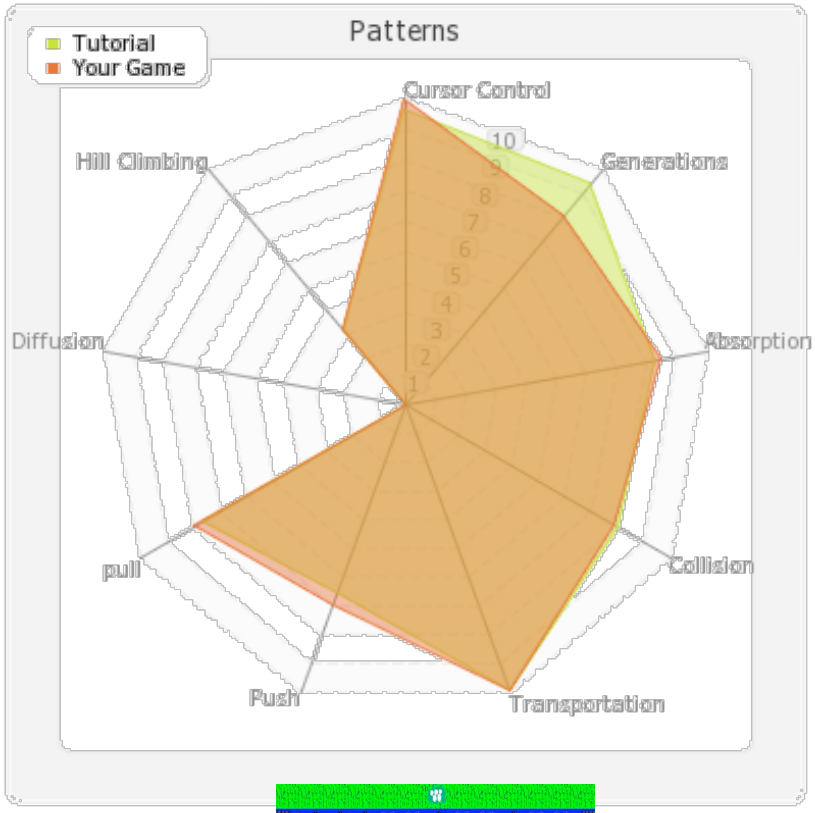


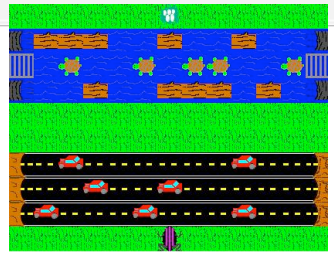
Absorb

Instrumentation Challenge

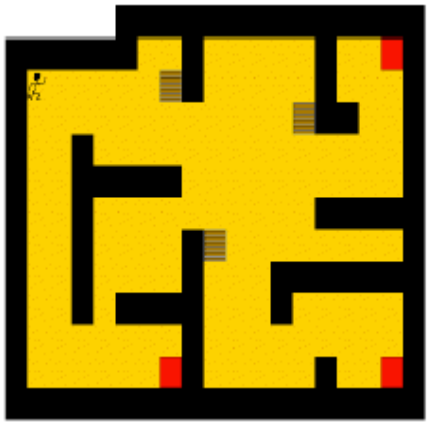
- ***Assessing Transfer***: how can we measure that skills acquired in game design can be leveraged in STEM simulation building?

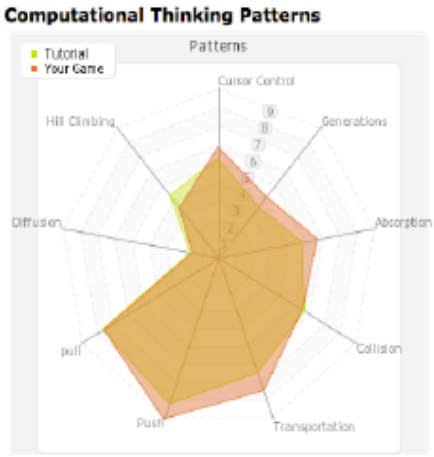
Computational Thinking Pattern Analysis

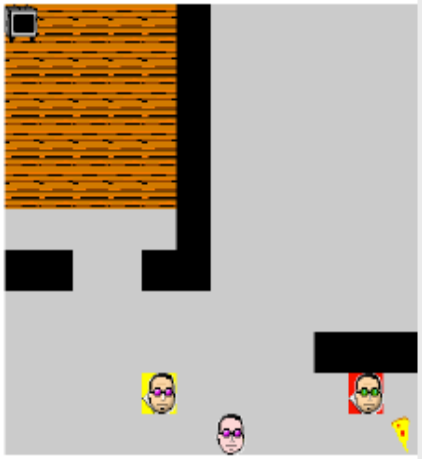


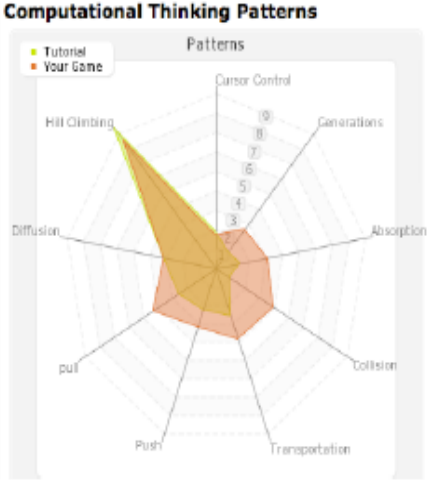


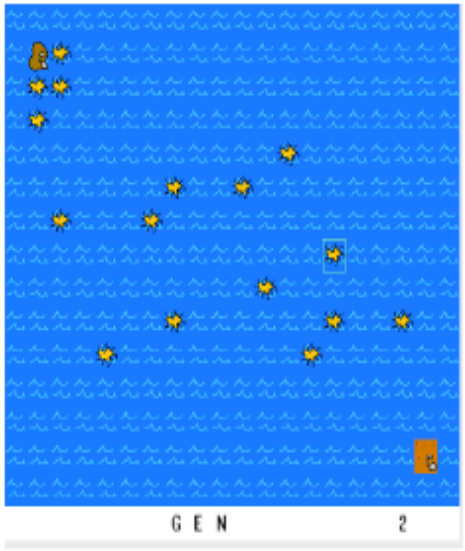
Assessing Transfer

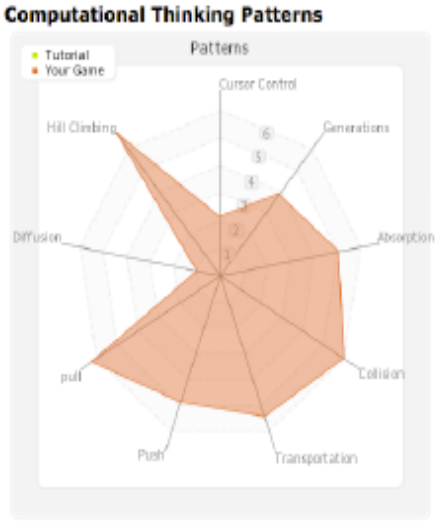












I think this video is like transport because I observed an eagle picking up a fish while it continued to move and this is transport because the eagle is moving the fish from one place to another.

-- 6th grade student

Its kind of like frogger because just like the video when the bird got the fish its like the frog getting hit by the car.

-- 8th grade student

Q88. **If you were going to create a program that was like the video above, how likely are you to agree with each statement:**

	Not at all	Not very much	A little bit	A lot
I would program the eagle agents like I programmed the frog in Frogger	○	○	○	○
I would program the fish agent like the tunnels in Frogger				
I would use COLLISION to program the eagle picking up the fish				
I would use TRANSPORT to program the fish swimming in the water				
I would include the water as an agent				
I would include the houses as an agent				
I would use ABSORB to program the eagle flying				
I think the eagle catching the fish would be programmed like the frog landing on a log in Frogger				

This video is like collision because I observe the two sumo wrestlers colliding with each other like how the car collides with frogger in the frogger game.

-- 6th grade student

Frogger is a man? I don't know, these are the weirdest videos for this.

-- 10th grade student

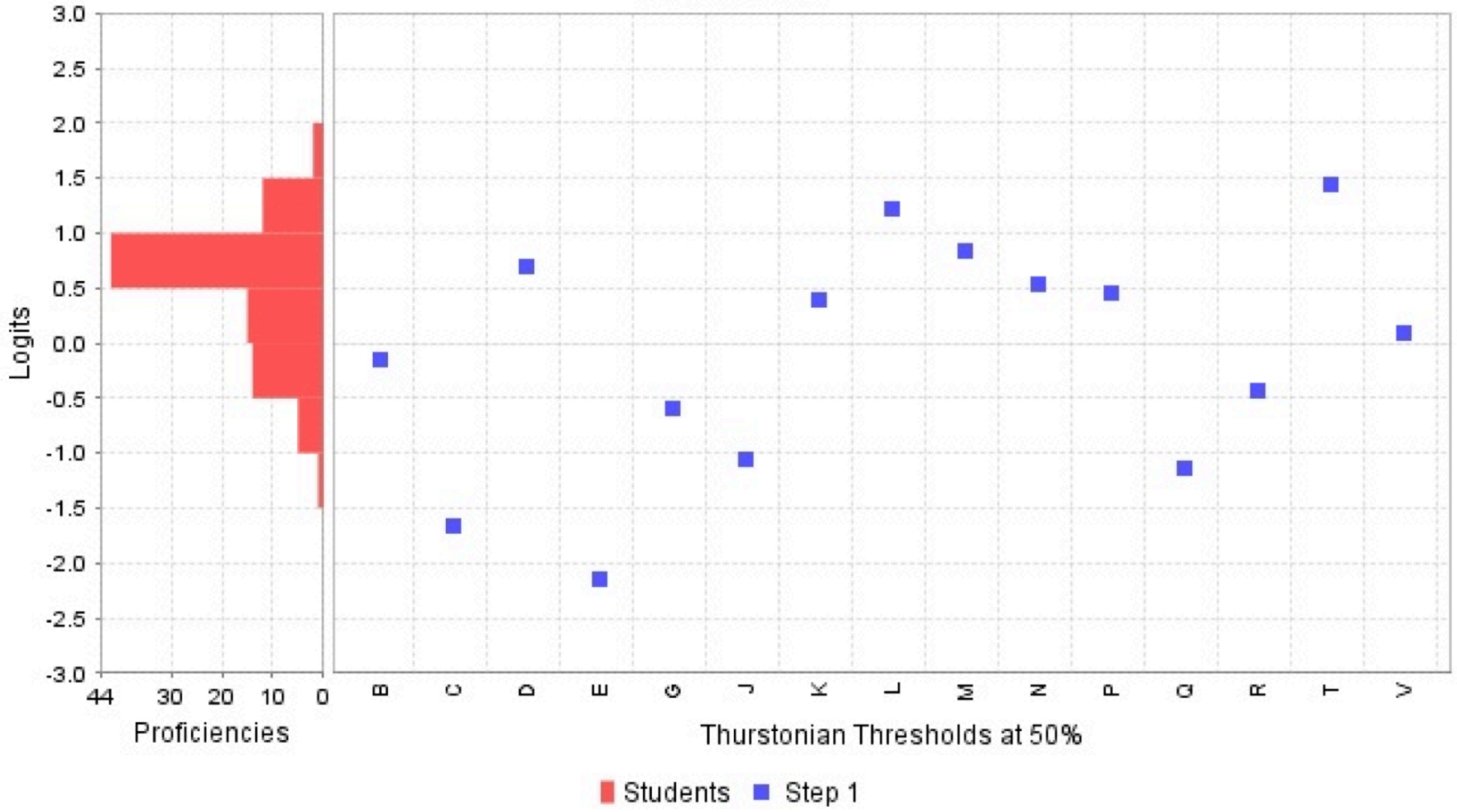
I don't see any correlation between sumo wrestlers fighting and frogger

-- 10th grade student

Q92. If you were going to create a program that was like the video above, how likely are you to agree with each statement:

	Not at all	Not very much	A little bit	A lot
I would program the wrestlers like I programmed the truck hitting the frog in Frogger	○	○	○	○
I would use COLLISION when I programmed the feet hitting the ground				
I would program the wrestler by giving him code that said "Once every .2 seconds, move right"				
I would program the wrestler by giving him code that said "Once every .2 seconds move right and tell the other wrestler to move back"				
The wrestler moving to the right would be coded using TRANSPORT				

Wright Map of item logits



Taylor 2.20

Drew 0.68

Kelly -1.2

Level 1:	<-0.72 theta	(n=11)
Level 2:	-0.72 to 1.8 theta	(n=71)
Level 3:	>1.8 theta	(n=9)

*Reduced item set
(Cronbach's Alpha = 0.70)

	Likely answer if High on Construct	Level of Difficulty	Statement
Eagle and Fish	Disagree	High	I would program the fish agent like the tunnels in Frogger
	Agree	Medium	I would use COLLISION to program the eagle picking up the fish
	Disagree	Medium	I would use TRANSPORT to program the fish swimming in the water
	Agree	Low	I would include the water as an agent
	Disagree	Low	I would include the houses as an agent
	Disagree	Low	I would use ABSORB to program the eagle flying
	Agree	High	I think the eagle catching the fish would be programmed like the frog landing on a log in Frogger

	Likely answer if High on Construct	Level of Difficulty	Statement
Sumo Wrestler	Agree	High	I would program the wrestlers like I programmed the truck hitting the frog in Frogger
	Disagree	Low	I would use COLLISION when I programmed the feet hitting the ground
	Disagree	High	I would program the wrestler by giving him code that said "Once every .2 seconds, move right"
	Agree	High	I would program the wrestler by giving him code that said "Once every .2 seconds move right and tell the other wrestler to move back"
	Disagree	Low	The wrestler moving to the right would be coded using TRANSPORT

Questions?

AgentSheets
computational thinking tools

SCALABLE GAME DESIGN

emints
INSPIRED TEACHERS | INSPIRED STUDENTS

csta Computer Science Teachers Association

SRI International

SHODOR

national center for women & INFORMATION TECHNOLOGY

Google

NSF

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http://scalablegamedesign.cs.colorado.edu

	E	C	Q	J	G	R	B	V	K	P	N	D	M	L	T	Total Score
22	4	4	1	4	4	1	1	1	1	1	1	1	1	1	1	9
39	4	4	4	1	4	1	1	1	1	1	1	1	1	1	1	9
49	4	4	1	1	1	1	1	1	1	1	1	4	1	1	1	12
10	4	4	4	4	4	1	4	1	1	1	1	1	1	1	1	12
42	1	4	1	4	1	1	1	1	1	1	1	1	1	1	1	9
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