Was That CT? Assessing Computational Thinking Patterns through Video-Based Prompts

Krista Sekeres Marshall

University of Colorado, Boulder

Virginia Tech

Something about me

- Luna Xu (徐璐娜)
- Ph.D., Computer Science, Virginia Tech
  - Advisor: Dr. Ali R. Butt
- M.Eng., Computer Engineering and Science, Shanghai University
- B.Eng., Computer Engineering and Science, Shanghai University

Computational Thinking Pattern

- There is a real need to move beyond definitions and into operationalizing (LeCompte & Schensul, 1999, p. 153) computational thinking so that it is understandable, observable and measureable
- Instead of defining CT, we should concretely define what we expect students to learn
- Therefore, Computational Thinking Pattern (CTP) have been defined.

CTP (cont.)

- Recognizing Computational Thinking Patterns (Basawapatna, Koh et. al.)
  - Collision
  - Transportation
  - Generation/Absorption
  - Diffusion
  - Hill Climbing
- STEM simulation
  - Transformation
  - Proximity
  - Percent Chance
- From students
  - Movement
  - Strategy
  - Design

Teaching

Games/ Simulations	Computational Thinking Patterns
Frogger	Generation, Absorption, Collision, Transportation, Movement*, Strategy*, Design*
Pac-Man	Absorption, Collision, Diffusion, Hill Climbing, Movement*
Sims	Multiple Diffusions, Hill Climbing
Contagion Spread Simulation	Random Movement*, Transformation*, Proximity*, Percent Chance*
Forest Fire Simulation	Transformation*, Proximity*, Percent Chance*

Table 1 Games/ Simulations and corresponding Computational Thinking Patterns (adapted from Basawapatna, Koh, & Repenning, 2010)

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Measuring transfer

- Measures of transfer often show different results than those that measure only recall.
- “Instructional differences become more apparent when evaluated from the perspective of how well the learning transfers to new problems and settings” (National Research Council, 2000, p. 77).
- When teaching students computational thinking skills, evidence of transfer to focus areas in K-12 education (often math, literacy and science) is of importance to the use and sustainability of the curriculum.
- CTP Video-Prompt Survey

CTP Video-Prompt Survey

- Michael Crotty (1998), "…the view that all knowledge… is contingent upon human practices, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context" (p. 42).

Method

- Over 500 middle school students
- Fall 2010 semester at the end of the AgentSheet unit
- AgentSheet as part of the coursework / using AgentSheet as a part a statistics unit in a mathematics class
- A pilot version of the CTP Video-Prompt Survey was also given to teachers and community college students during the 2010 Scalable Game Design Summer Institute

Method (cont.)

- Participants were also asked to complete pre and post motivation surveys and individual interviews were conducted with teachers and select students
- Directly named any of the patterns/ described the pattern in other words with the same meaning

Sample Diversity

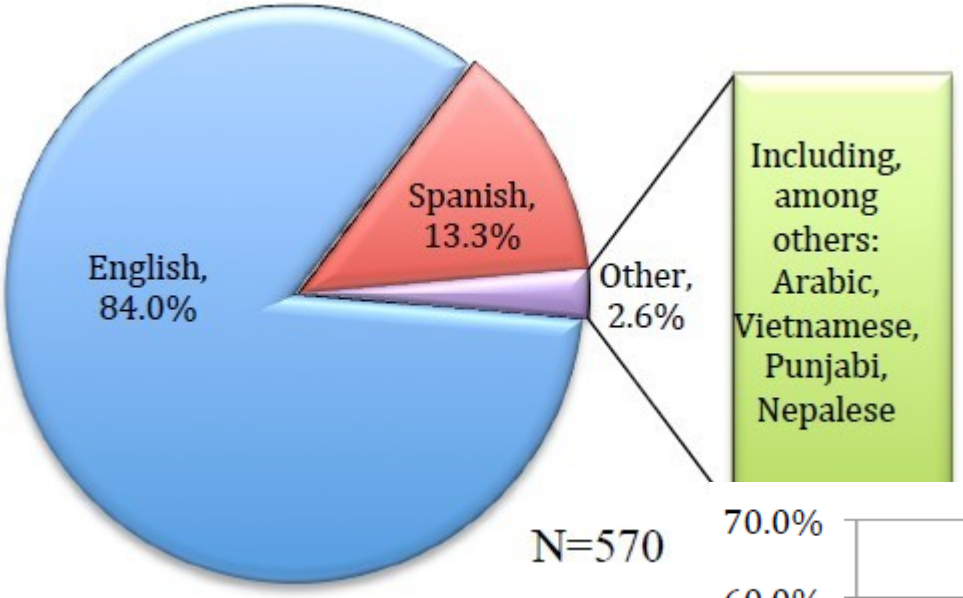

Chart 1: Respondents' Primary language Spoken at Home

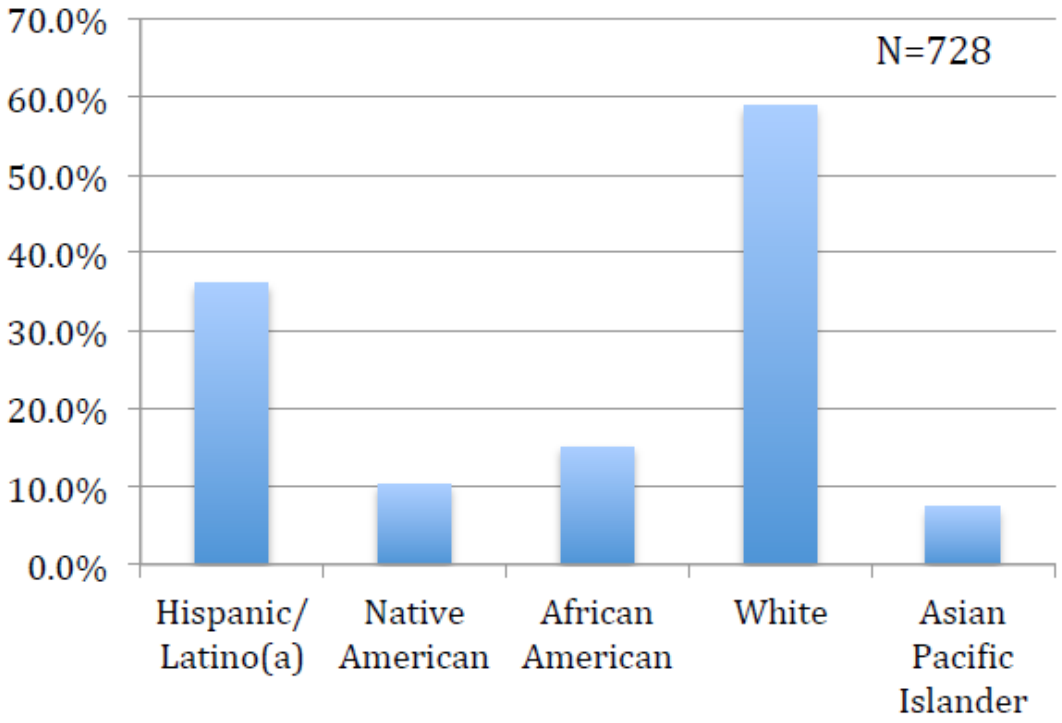

Chart 2: Respondents' Races/Ethnicities

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Grade	Percent	Number
4th	0.4%	2
5th	2.4%	13
6th	31.8%	181
7th	26.3%	150
8th	35.4%	202
9th	0.2%	1
10th	3.7%	21
N=570		

Table 2: Respondents by grade level

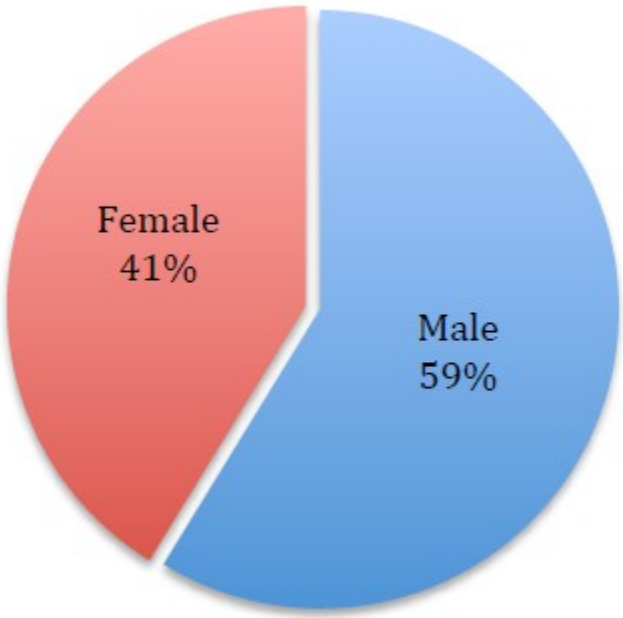

Chart 3: Respondents' Genders

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Results by Question

	Some Similarity	Percent for the Top 3 Responses			% Match Expert Response
Question 1 N=505	85.9%	34.3% (*Collision)	22.8% (*Transport)	17.7% (Strategy)	57.1%
Question 2 N=497	88.3%	54.1% (*Generation)	25.5% (Movement)	8.1% (Strategy)	54.1%
Question 3 N=494	82.2%	75.2% (*Collision)	16.2% (Strategy)	2.7% (Movement)	75.2%
Question 4 N=490	80.9%	52.2% (*Generation)	27.0% (Collision)	8.4% (Design)	52.2%
Question 5 N=489	81.6%	29.3% (Strategy)	27.3% (*Collision)	23.5% (Movement)	34.8% (+ 7.6% *Absorb)

* Expert Response

Table 3: Survey results by question

Questions

- ***Question 1***: the video depicts a flying eagle catching a fish, representing the CTPs *collision* and *transport* as the “expert responses”.
- ***Question 2***: the video shows a marching band coming out of tunnel, which is similar to the *generation* Computational Thinking Pattern.
- ***Question 3***: the video depicts two Sumo wrestlers engaging in match, representing the CTP *collision* as the “expert response”.
- ***Question 4***: the video shows a Press-dough toy squishing out dough into various shapes – generation
- ***Question 5***: the video depicts a man bowling over a chair, representing the CTPs *collision* and *absorption* as the “expert responses”.

Pilot results

Post-Institute Computational Thinking Quiz		
CT Pattern	Teachers (n=26)	CC Students (n=16)
Collision (1)	21 (81%)	16 (100%)
Collision (2)	20 (77%)	15 (94%)
Generation	22 (85%)	14 (88%)
Absorption	25 (96%)	16 (100%)
Diffusion	24 (92%)	15 (94%)
Diffusion/ Hill-climbing	25 (96%)	16 (100%)
Movement	10 (38%)	6 (38%)
	(% Match with Expert Response)	

Table 4. Identification of CTPs in Video Clips

Some things to notice

- Variety and creation
- Difference from the researchers and students
- Actor-oriented view
  - When using actor-oriented views of transfer, transfer is seen as “the generalization of learning” rather than the “formation of particular, highly valued generalizations” often used in classical transfer approaches (Lobato, 2008, p. 171).

Conclusion

- The CTP Video-Prompt Survey aims to assess skills that students can put to use in a variety of situations, including STEM simulations and areas beyond formal learning environments
- By utilizing video prompts of real-life events and relating these to CTPs used in computing, we can assess what students know about these patterns and the extent to which this knowledge can be used to model realistic situations
- As an estimated 1000 additional students will respond to the CTP Video-Prompt Survey during the current Spring 2011 semester
- Recursive analysis of the patterns emerging from student responses will give us more information on the usefulness of the CTPs

Some thoughts

- Is CTP what we want our students to learn?
- Expert responses?
- How to fill the gap in between?
- Pros:
  - Concretely define what skills students will be working to master
  - Recursive analysis of the patterns emerging from student responses (creativity)

Problem Solving in CS

- **Heuristics List**
  - Go to extremes: Often the "ends" of the problem are important special features.
  - Simplify: Try the problem on small cases to gain understanding.
  - Visualize: Use appropriate representations (diagrams, tables, etc.) for information to help organize.
  - Look for symmetries and invariants: These might be special features of importance, or they might give additional insight into the problem.
  - ….

Thank You!