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Computational Thinking Practices: Analyzing and Modeling a Critical Domain in Computer Science Education

Principled Assessment of Computational Thinking

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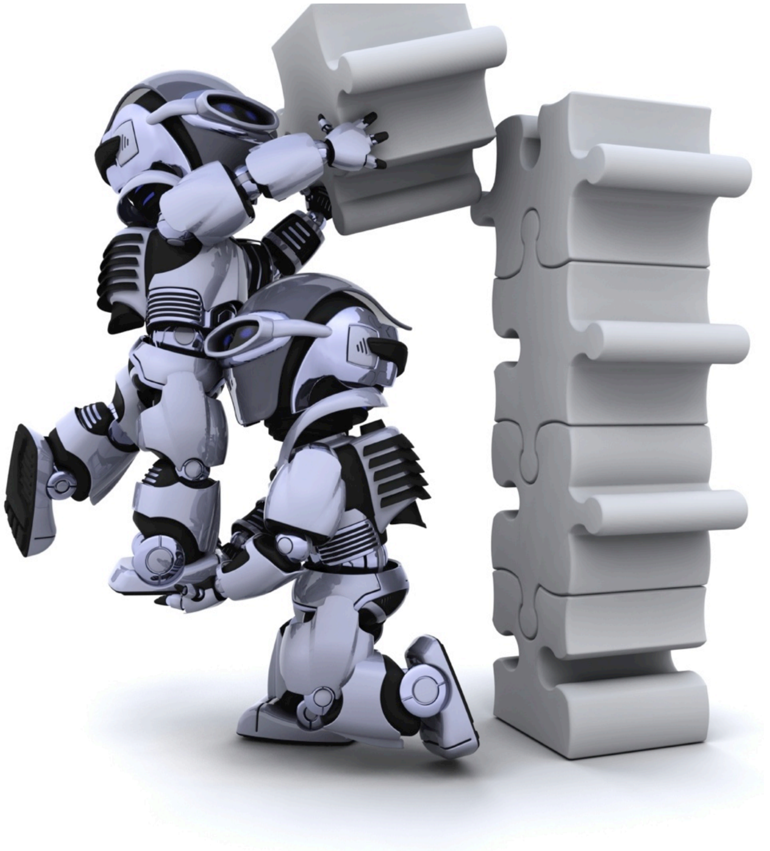
Computational Thinking

- Defining computational thinking
- Importance of computational thinking
- Importance of assessment in computational thinking



Exploring Computer Science (ECS)

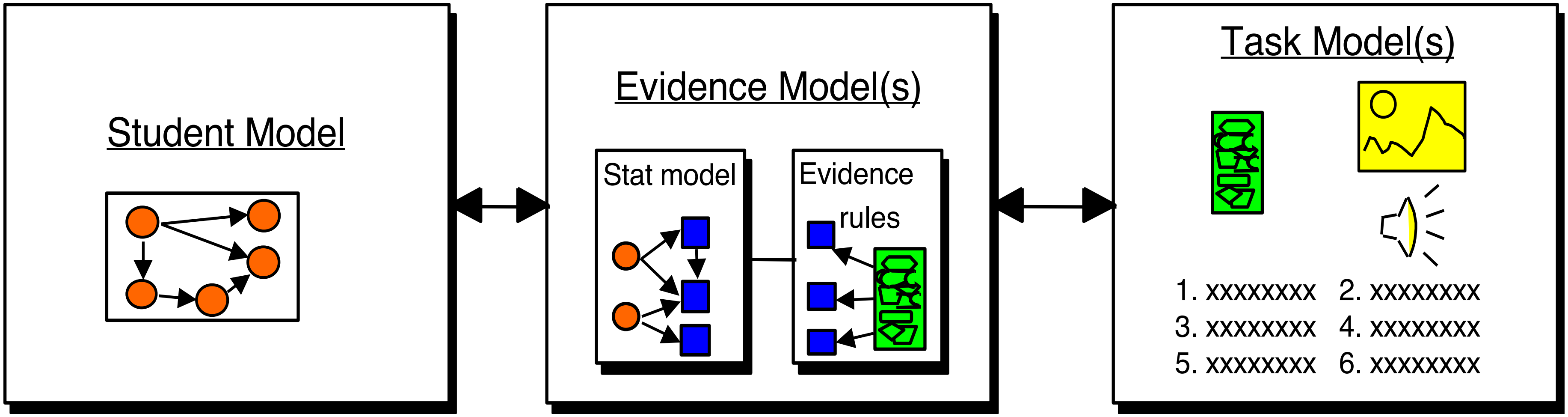
- High school curriculum, pre-Advanced Placement
- Focus on increasing underrepresentation in CS
- CS concepts, inquiry teaching and learning, and equity and classroom culture are all emphasized
- Currently 6 units

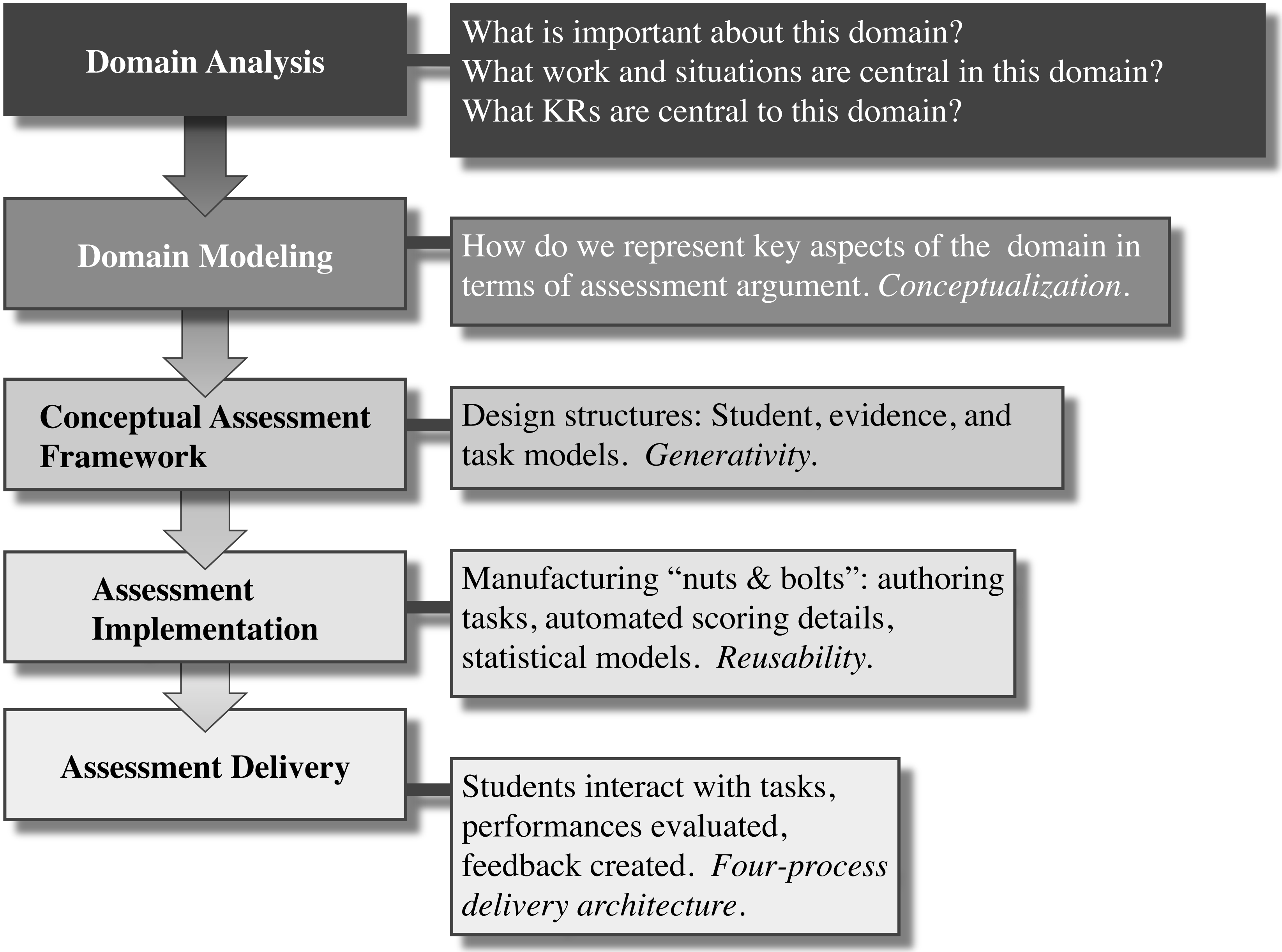
Human Computer Interaction
Problem Solving
Web Design

Introduction to Programming
Computing and Data Analysis
Robotics

- Scaling up to multiple sites across the US, in part via Code.org

Evidence-Centered Design





Domain Analysis

What is important about this domain?
What work and situations are central in this domain?
What KRs are central to this domain?

Domain Modeling

How do we represent key aspects of the domain in terms of assessment argument. *Conceptualization*.

Conceptual Assessment Framework

Design structures: Student, evidence, and task models. *Generativity*.

Assessment Implementation

Manufacturing “nuts & bolts”: authoring tasks, automated scoring details, statistical models. *Reusability*.

Assessment Delivery

Students interact with tasks, performances evaluated, feedback created. *Four-process delivery architecture*.

- From Mislevy & Riconscente, 2006

Computational Thinking Practices

- Analyze the effects of developments in computing.
- Design and implement creative solutions and artifacts.
- Design and apply abstractions and models.
- Analyze their computational work and the work of others.

Cross-cutting Practices

- Communicate computational thought processes, procedures, and results to others
- Collaborate with peers on computing activities

Focal Knowledge, Skills, and Attributes (FKSAs) for ECS units

ECS Unit	Focal KSA	Computational Thinking Practice
Unit 1: Human Computer Interaction	Students are able to explain why an object is or is not a computer	Analyze the effects of developments in computing.
Unit 2: Problem Solving	Students are able to compare the tradeoffs between different algorithms for solving the same problem	Design and implement creative solutions and artifacts.
Unit 3: Web Design	Students are able to apply abstraction to separate style from content during web page design and development	Apply abstractions and models.
Unit 4: Introduction to Programming	Students are able to evaluate debugging and testing methods in terms of how they relate to the problem or program	Analyze their computational work and the work of others.

Development of Task Information

Focal KSA **(The construct of interest)**	**Students are able to explain why an object is or is not a computer**
Potential Observations (**The quality of the work product that reflects on the construct)**	Appropriateness of the explanation of why an object is or is not a computer
Potential Work Products **(The work that is produced by the student)**	An explanation of why an object is or is not a computer
Characteristic Features **(Features of the task that are required)**	The student must be presented with an object that has clear characteristics to allow for the evaluation of whether it is a computer.
Variable Features **(Features that can vary across different tasks and still have the task aligned to the construct of interest)**	Whether the object could be considered a computer or not The degree to which the important characteristics are explicitly stated in the problem or must be inferred by the test taker.

Next Steps

- Currently piloting assessments (approximately 1500 students)
- Initials results show that students are able to display abilities related to computational thinking
- Results of the pilot will be used to refine the assessments and may be used to update the focal KSAs and their corresponding information.

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