Principled Assessment of Computational Thinking (PACT)

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NSF-CE21 Meeting
Portland, OR
January 15-16, 2013

How can we improve CS teaching, learning, and adoption through evidence-centered assessment?

Background

Funding

- NSF-CE21 Planning Grant (9/2011 – 3/2013):
  Planning for the Assessment of Computational Thinking

- NSF-CE21 Special Project (9/2012 – 8/2014):
  Principled Assessment of Computational Thinking

- Principal Investigators: Eric Snow, Marie Bienkowski, SRI International

Partners / Collaborators

- University of Oregon

- ECS leadership and teachers

- CSTA

- Computer science educators

- Assessment experts

Project Goals

Long Term

- High quality assessments of computational thinking

- Help with the adoption of high school computer science courses through assessments that stakeholders recognize as useful for making decisions about student learning

Short Term

- Create **design patterns** for major computational thinking concepts that can be used to develop new assessments as curriculum evolves

- Develop a computational-thinking **conceptual-assessment framework** in the context of Exploring Computer Science (high school pre-AP CS)

- Create, for Exploring Computer Science, **4 unit assessments, a summative assessment, and field test** them by April 2014.

Project Activities

- Align *Exploring Computer Science (*ECS) lesson objectives to CSTA, NETS, Common Core, NGSS, and state science and CTE standards.

- Create conceptual assessment framework for ECS computational thinking practices (CTPs).

- Use Evidence-Centered Design to guide the development assessment design templates for ECS CTPs.

- Use CTP design templates to guide the development of assessments for *Exploring Computer Science.*

- Pilot/field test *Exploring Computer Science* assessments.

Project Scope

Current partner sites for developing and field testing assessments for the *Exploring Computer Science* curriculum include:
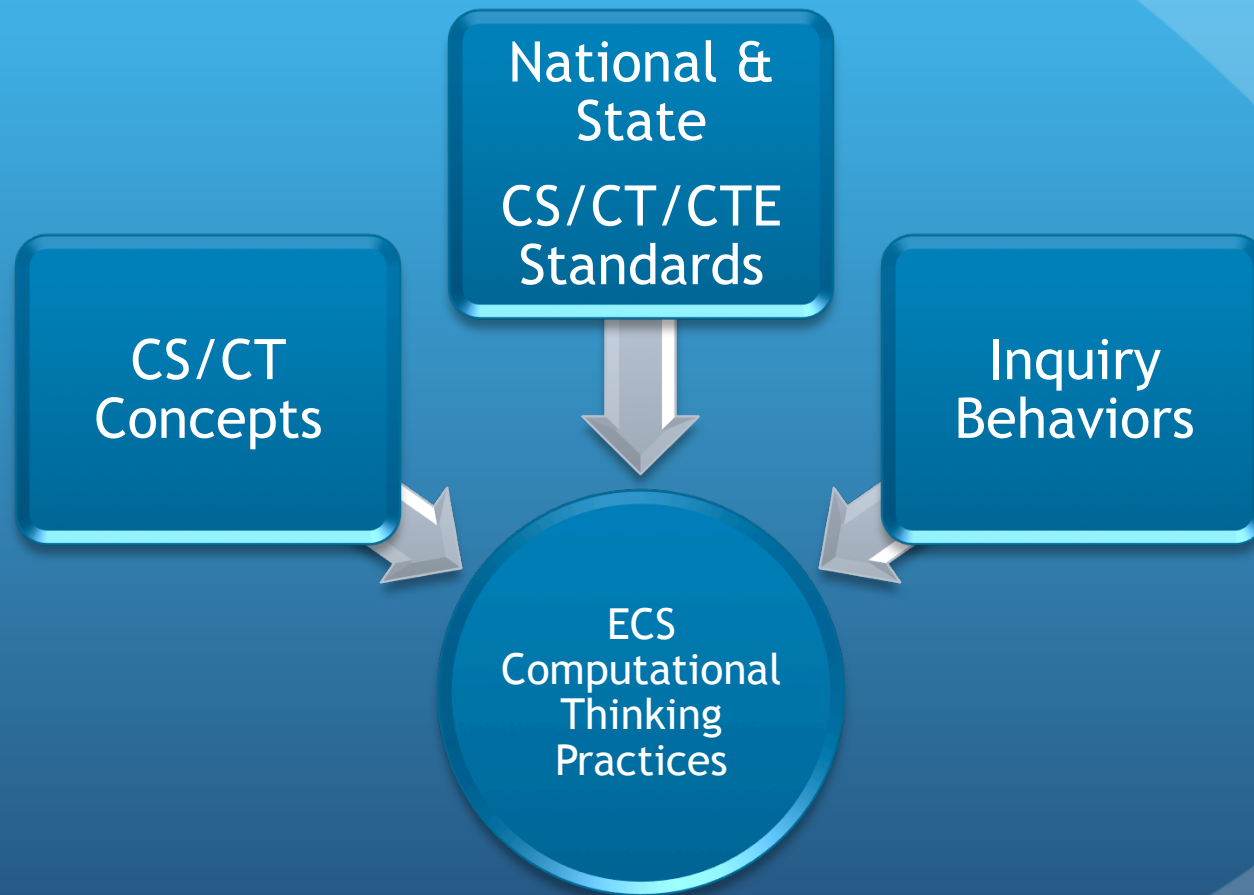
- Santa Clara, CA
- Los Angeles, CA
- Chicago, IL

Always looking for new ECS partners!

Standards Alignment

- Gain a better understanding of how ECS CT practices and learning objectives are related to relevant national and state standards (e.g., CSTA, Common Core).

- Provide value to ECS team, especially teachers and others who have to convince stakeholders that ECS helps students learn valuable knowledge and skills.

- Worked with local ECS teacher to develop draft document that shows the alignment between ECS Unit learning objectives and CT practices, and CSTA, ISTE, Common Core, Next Generation Science/ Engineering, and CA and IL state learning and CTE standards.

- Currently under review/revision. Will be posted on ECS and PACT web sites early Spring 2013.

ECS Computational Thinking Practices (CTP)

Focal Practices

- Analyze the effects of developments in computing.

- Design and implement creative solutions and artifacts.

- Apply abstractions and models.

- Analyze your own computational work and the work of others.

Cross Cutting Practices

- Connect computation with other disciplines.

- Communicate thought processes and results.

- Work effectively in teams.

Evidence-Centered Assessment Design

Formal, multiple-layered framework organized around three guiding questions:

1. What complex of knowledge, skills, or other attributes should be assessed?

2. What behaviors or performances should reveal those constructs?

3. What tasks or situations should elicit those behaviors?

ECD views an **assessment as evidence** to provide support for an **argument** about what a student knows and can do.

ECD is a particularly useful framework for dealing with novel and/or hard-to-assess constructs, like computational thinking practices.

ECS-CTP Design Templates

Design Patterns are tools for organizing assessment arguments at a narrative level.

Focal KSAs are the core of design patterns.
- Specify the **K**nowledge, **S**kills and **A**ttributes one wants to measure.
- Often represent a blend of relevant standards and curriculum objectives.

Potential Observations specify the behaviors that count as evidence of the Focal KSAs.

Potential Work Products specify the types of tasks that can elicit the desired behaviors.

ECS-CTP Design Templates

Analyze one's own computational work and the work of others.

Focal KSA	Potential Observations	Potential Work Products
Ability to determine if a given algorithm successfully solves a stated problem. (Overall ECS Objective)	Correctness of the statement as to whether or not the given algorithm successfully solves a stated problem. The accuracy of the explanation of how a given algorithm addresses a problem.	The statement about the correctness of the algorithm. An explanation of how the algorithm addresses a problem.

Developing and Field Testing CTP Assessments

- Use ECS-CTP Design Patterns to guide development of four ECS unit assessments (Units 1-4), and a summative assessment.

- Assessment items for ECS units 1-2, where the majority of topic-focus areas are **introduced**, will most likely be multiple-choice or short answer format and will focus on eliciting declarative knowledge (knowing *what*).

- Assessment items for units 3-4, where most topic-focus areas are **reinforced**, will also be multiple-choice or short answer format and will focus on eliciting a combination of declarative and schematic (knowing *why*) knowledge.

- The summative assessment will consist of scenario-based tasks with embedded multiple-choice and short answer items, and will focus on eliciting declarative, schematic and procedural (knowing *how*) knowledge.

Challenges

Specifying assessment argument for ECS Computational Thinking Practices.

- Mapping to ECS Units.

- Consideration of standards.

- Grain size of design pattern attributes (e.g., Focal KSAs).

- Interdisciplinary effort that takes sustained attention and time.

ECS implementation schedules and plans (i.e., which units, topics-focus areas) vary across partner sites.

Measuring procedural knowledge using traditional assessment formats (i.e., paper and pencil).

Questions? Comments? General Interest?

- Thank you!

- Come see our poster later today!

- Email:
  - Eric Snow – eric.snow@sri.com

- Two web sites:
  - http://pact.sri.com
  - http://www.sri.com/work/projects/principled-assessment-computational-thinking-pact