**Assessments as Complex Systems Learning Events: Tensions and Opportunities**

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**Abstract**

As part of an investigation cumulative learning, Web-based Inquiry Science Environment projects related to global climate change, plate tectonics, and photosynthesis have been redesigned. Visualizations provide opportunities for students to explore the consequential role of energy in each system. Two tools – Energy Stories and MySystem – serve as assessments and learning events. Energy Stories ask students to synthesize their ideas about how energy is transferred and transformed. MySystem serves as a way for students to represent their understanding of a non-linear process, provided it occurs at a singular level.

**Curriculum and Context**

Web-based Inquiry Science Environment

Technology-enhanced visualization-rich materials

Consistent with California standards

Knowledge integration framework

(Linn, Davis & Bell, 2004)

Promote cumulative learning

Energy as core idea

Redesign of projects

Visualizations: explore the consequential role of energy in each system

Assessments as learning events

**MySystem**

Represent understanding of a non-linear process, provided it occurs at a singular level.

**Energy Stories**

Synthesize ideas about how energy is transferred and transformed.

Write a story to explain to Gwen how the earth is warmed by energy. Be sure to include:

*How energy changes/transforms*

*Where energy comes from*

*How energy moves*

*Where energy goes*

**Methods and Data**

**Design-Based Research**

**Cross Classified Structure**

**Thermodynamics**

Conduction as transfer of energy

Predict-Observe-Explain: Which is warmer, metal or wood?

**Plate Tectonics**

Convection as transfer of energy

Predict-Observe-Explain: What will happen to dye in water?

**Global Climate Change**

Radiation as transfer of energy, Transformation of energy

Predict-Observe-Explain: How do variables impact global temperature?

**Eliciting Ideas**

**Add Ideas**

**Develop Criteria**

**Sort Ideas**

**Knowledge Integration Levels**

Complex Link

Trans or more full, valid links between non-normative, relevant ideas

Non-normative or non-relevant links

3

No Link

Non-normative but relevant ideas or non-normative links

4

Non-normative and irrelevant ideas or “I don’t know!”

5

Non-normative but irrelevant ideas

6

No response

7

**References**


Ontological differences across direct and emergent processes (Ch, 2005)

Identifying nonsalient, mechanistically consequential processes (Liu & Hartle-Silve, 2009)

**Design Implications**

Challenges relate to determining what constitutes an appropriate level of systems science given:

The age and experiences of 6th grade students

Pressures to cover the scope/breadth of the curriculum

Pressures to teach to California State Science Standards

Desire to represent topics in ways that reflect disciplinary perspectives

Integrating energy as a core idea

**Next Steps**

Analyze latest data from Global Climate Change and Redesign to foster understanding of complex systems and the role of energy in them

Cumulative learning related to energy: cohort and individual student trajectories across projects

Explore dimensional analysis if indicated, for Energy Stories and MySystem

**Acknowledgments**

Thank you to the’s team and principals who partnered with us in this research and their classes of students, and the TELS community for their support and feedback

Arizona State Univ. • The Concord Consortium • Educational Testing Service • New York Univ. • North Carolina Central Univ. • Technion-Israel Institute of Technology • Univ. of California, Berkeley • Univ. of Minnesota • Univ. of Toronto • Vanderbilt Univ.