The Development of Universally Designed, Fine-Grained Science Learning Map Models

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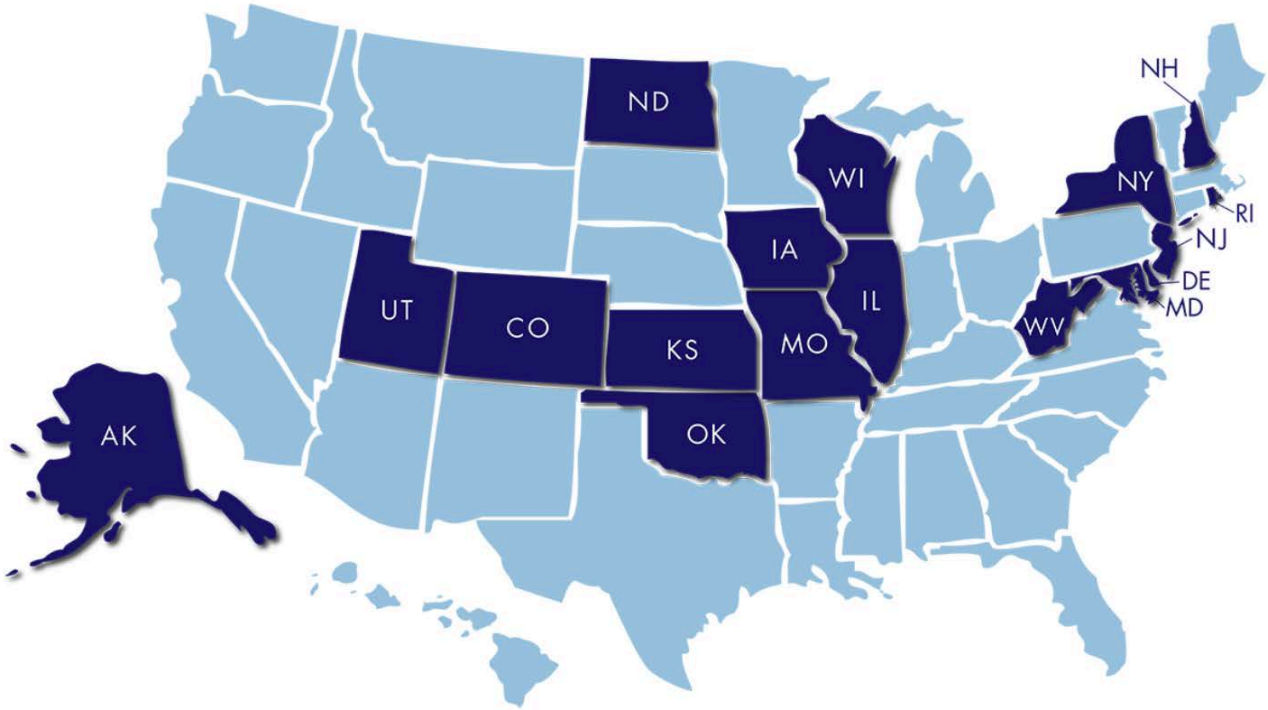
Dynamic Learning Maps Consortium



The Consortium is made up of a collection of state departments of education developing and using the Dynamic Learning Maps Alternate Assessment System.

I-SMART
Innovations in Science Map, Assessment and Reporting Technologies

An effort to bring rigorous science assessments to students with significant cognitive disabilities and any students who are not meeting grade-level standards.

It will include innovative score reports that will help teachers adjust their instruction based on assessment results.

Students with Significant Cognitive Disabilities (SCD)

- They have a disability or multiple disabilities that significantly impact intellectual functioning and adaptive behavior
  - o 1% of all students/9% of students with disabilities
  - o 81% of have an intellectual disability, autism, or multiple disabilities.
  - o 67.6% of students are taught primarily in separate classrooms from their grade-level peers.
  - o 76% of students use expressive speech to communicate (may be only 1, 2, or 3 words).
  - o Almost 60% of all students across grade levels read at the first grade level or below.

*DLM Census Survey 2012-13 (44,000 students, 14 states)

Alternate Content Standards

- Alternate science content standards are used for teaching and assessing students with SCD:
  - Link to NGSS performance expectations, but have reduced depth, breadth, and complexity
  - 43 were developed for science

  (https://dynamiclearningmaps.org/about/model#essential-elements)

Middle School

Domain: Physical
Core Idea: **PS2:** Motion and Stability: Forces and Interactions
Topic: **PS2.A:** Forces and Motion
State Standard for General Education: **MS-PS2-2:** Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.
Essential Element: EE.MS-PS2-2 **Target Level:** Investigate and predict the change in motion of objects based on the forces acting on those objects.
Precursor Level: Investigate and identify ways to change the motion of an object (e.g., change an incline's slope to make an object go slower, faster, farther).
Initial Level: Identify ways to change the movement of an object (e.g., faster, slower, stop).

Dynamic Learning Maps® Science Alternate Assessment

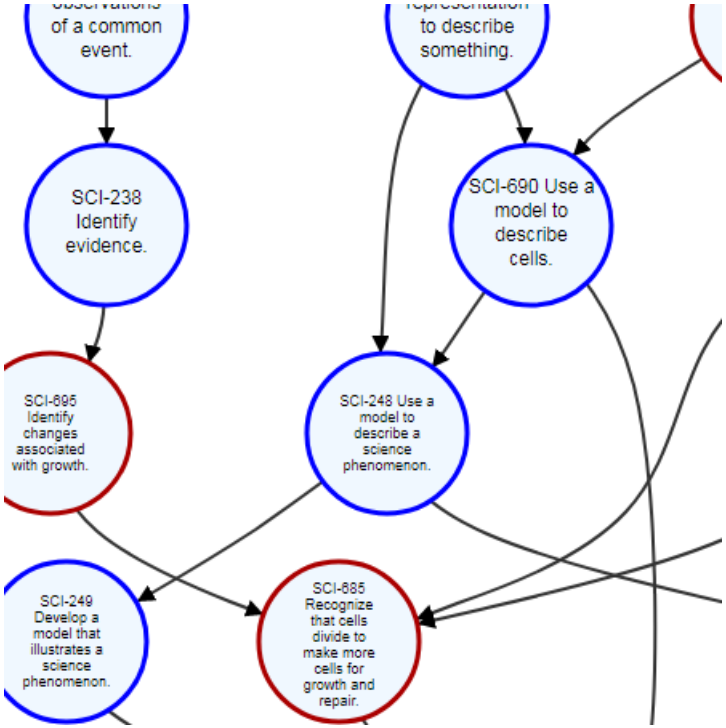
- Developed for use in English language arts and mathematics.
- Currently used in the science assessment based on the set of 34 alternate content standards.
- A cognitive model for science is in development and will be the basis of the next iteration of the science assessment.

(https://dynamiclearningmaps.org/about/tests)

Learning Map Model

(Bechard et al., 2012)

- Learning map models use a small grain-size to represent incremental learning
- In science, the learning map model describes development in multiple dimensions (DCI, SEP, CCC), resulting in a network of interconnected pathways.



Universal Design for Learning

(Meyer, Rose, & Gordon, 2014)

- 3 principles to reduce barriers to learning (CAST, 2018)
  - Focus on
    - **Representation**
    - **Action and expression**
- Knowledge of population characteristics used in creating the learning map
  - Prevalence of sensory and mobility disabilities
  - Nodes worded to be independent of sensory and mobility characteristics, when possible. Otherwise, alternate pathways are created around inaccessible nodes. (DLM, 2016)

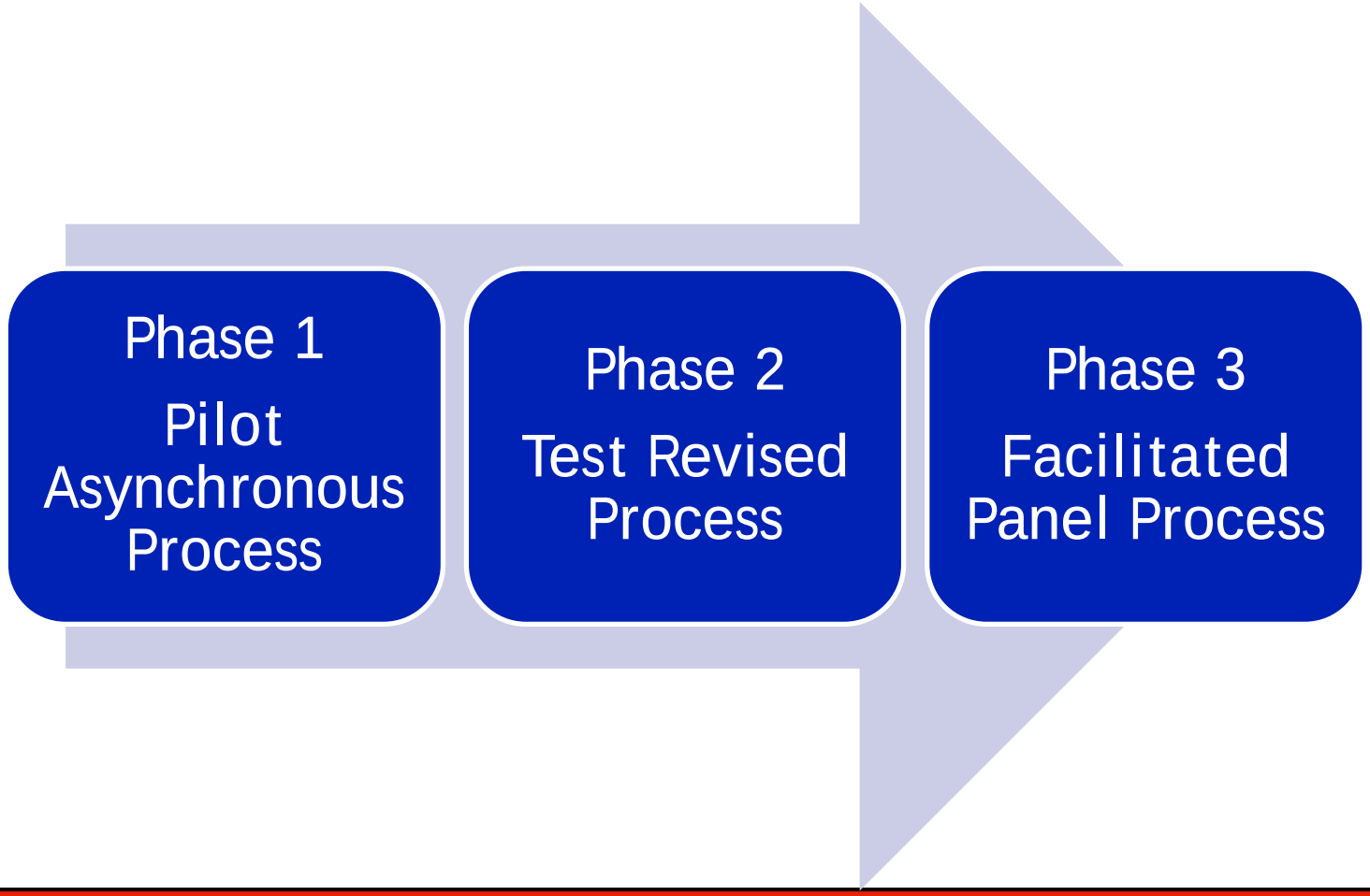
Research Question

- How can we develop fine-grained learning map models that use principles of Universal Design for Learning to describe how all students can progress toward grade-level science alternate standards and provide appropriate points of access to NGSS-linked content for all students?

Learning Map Model Development

- Organized by *neighborhood*
  - one per alternate content standard
- Steps
  - Create hypothetical map models
    - Describe DCI and SEP components of alternate content standard
    - Literature review (preacademic to 12th grade)
    - Create nodes and connections
  - Internal review
  - **External review**

Development of Process and Criteria



Phase 1

- Adaptation of process used with ELA and mathematics learning map models (DLM, 2016)
- Asynchronous online process piloted with four learning map neighborhoods (95 nodes)
- Reviewers were experts in science and/or special education from 8 states
- Findings:
  - Lack of consensus
  - Challenging to ensure common understanding of nodes
- Revisions
  - Review criteria were refined
  - Provide example node observations

Learning Map Model Review Criteria

Category	Content Criteria	Accessibility Criteria
Node	Node has a clear relationship with the EE.	The node content is accessible to students with the most significant cognitive disabilities.
	Node is appropriately sized (i.e., distinct from surrounding nodes and contains a single concept).	The node content is free of significant barriers for students with sensory impairments, limited mobility, or limited communication abilities.
Connection	Connections are logical and accurate, reflecting incremental development of a knowledge or skill by connecting a less complex node to a more complex node.	The connection represents an appropriate learning sequence for students with the most significant cognitive disabilities.
		The connection describes a logical learning sequence for students with sensory impairments, limited mobility, or limited communication abilities.

Phase 2

- Test refined criteria with three learning map model neighborhoods (104 nodes)
- Reviewers from eight states
- Major findings:
  - Refined criteria streamlined the process
  - Node observations were helpful
  - Lack of consensus still an issue
- Revisions
  - Develop facilitated panel process

Phase 3 Method

- Educators recruited from five states (I-SMART states)
  - Each panel had 2 special educators and 2 science educators
- Advance training and materials
- On-site training and practice
- Process
  - Individual ratings
  - Table discussion and panel recommendations

Phase 3 Results

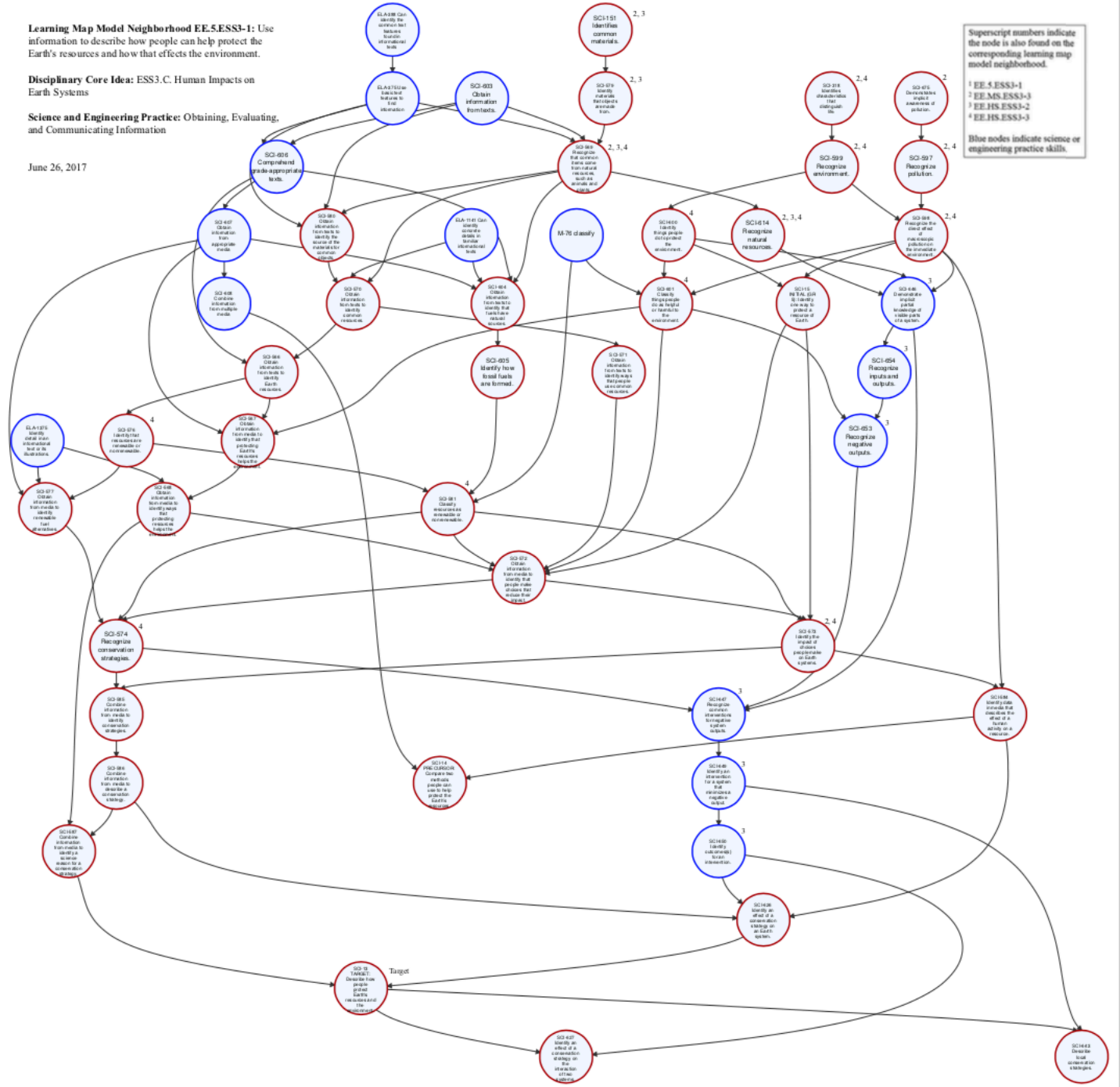
- 7 learning map neighborhoods were evaluated
  - 293 nodes and 431 connections
- 2-step post panel review process
  - Step 1 – accept recommendations that meet criteria for logic, consistency with the neighborhood map, and consistency with the research.
  - Step 2 – discuss recommendations that may not meet criteria and accept or reject based on consensus decision
    - 56% of recommendations were forwarded to step 2
    - 30% of node and 49% of connection recommendations were rejected

Learning Map Model Neighborhood EE.5.ESS3-1: Use information to describe how people can help protect the Earth's resources and how that effects the environment.

Disciplinary Core Idea: ESS3.C. Human Impacts on Earth Systems

Science and Engineering Practice: Obtaining, Evaluating, and Communicating Information

June 26, 2017



Conclusions

- The facilitated panel process yielded more actionable information
  - Panels able to reach consensus after discussion
  - Accessibility evaluations were better informed by content expertise
  - Able to collect more complex feedback from panels
    - More elaborate rationales
    - Redrawings of map sections
- Common understandings of node content is the most challenging issue for this process
  - Observations and wording are critical
  - Fine grain size makes evaluating connections more challenging

Implications

- Process for evaluating hypothetical cognitive models both for science content and accessibility before assessments are developed and empirical data are collected
- Refinement of the learning map model as a construct
- How to provide access to NGSS-based science content to students with significant cognitive disabilities

For more information contact

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