#19-1

Innovations in Science Map, Assessment & Report Technologies

I-SMART

PROJECT BRIEF

Developing & Evaluating Science Learning Map Models

Center for Accessible Teaching, Learning, & Assessment Systems

KEY POINTS

I-SMART researchers created 11 new science learning map model neighborhoods with accompanying research narratives. Neighborhood maps included 32 to 52 nodes (skills) and 36 to 83 connections.

The new science neighborhoods expanded on models previously developed for the Dynamic Learning Maps® (DLM®) Alternate Assessment System and included new coverage of foundational, pre-academic knowledge and new connections to existing ELA and mathematics neighborhoods.

The map development process included several steps: research synthesis, draft map creation, internal multi-disciplinary review and resulting revisions, external expert review and resulting revisions, and final map adoption.

The final neighborhoods had a total of 485 nodes (skills) and 740 connections.

The resulting neighborhoods will serve as the basis for assessments and could also be used to help teachers plan and adjust instruction.

Access sample research narratives and map neighborhoods at ismart.works.

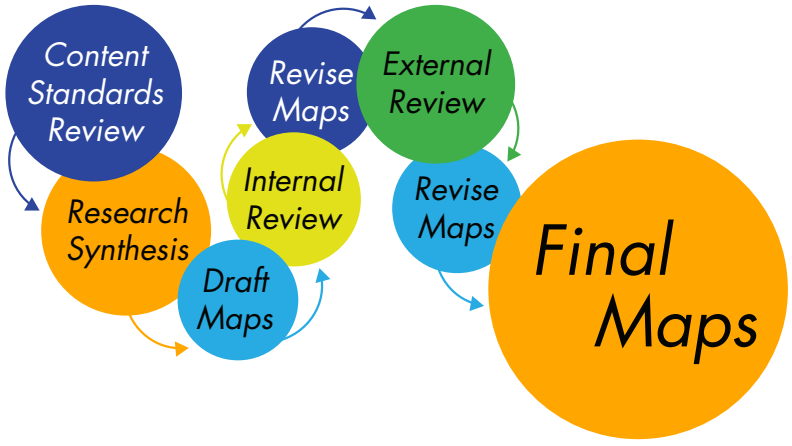
I-SMART is a research and development project that develops learning map model-based assessments and reporting tools to improve achievement of multidimensional science standards for students with and without disabilities. I-SMART's first goal was to develop 11 new science learning map models using a rigorous, iterative process.

DEVELOPING LEARNING MAP MODELS

I-SMART science learning maps were developed in neighborhoods that focus on a single content standard. Staff analyzed the content of each standard to create descriptions for disciplinary core ideas (DCI) and science and engineering practices (SEP) components. Staff reviewed and synthesized existing research on how students develop knowledge and created a set of fine-grain nodes and connections to visually represent the pathways students may follow to acquire knowledge. Each node represents a discrete skill along the pathway and each connection represents the relationship between skills. Map models begin with foundational skills, and progress in complexity toward achievement of the content standard.

Many resources were used in map development, including learning progressions literature, Next Generation Science Standards, American Association for the Advancement of Science literacy maps, cognitive psychology literature, and the Universal Design for Learning principles.

Map structures were reviewed through both internal and external processes. For internal reviews, the multi-disciplinary research team read research narratives, examined draft neighborhoods, and provided feedback. Map developers then incorporated internal feedback prior to conducting an external review.



FURTHER INFORMATION

» Swinburne Romine, R., Andersen, L., Schuster, J., & Karvonen, M. (2018). *Developing and Evaluating Learning Map Models in Science: Evidence from the I-SMART project.* Lawrence, KS: University of Kansas, Center for Accessible Teaching, Learning, and Assessment Systems (ATLAS).

» National Research Council. (2012). *A framework for k-12 science education: Practices, crosscutting concepts, and core ideas.* Washington, DC: National Academies Press.

» NGSS Lead States. (2013). *Next generation science standards: For states, by states.* Volume 2: Appendices. Washington, DC: National Academies Press

» http://udlguidelines.cast.org

I-SMART is a collaboration among five states (MD, MO, NJ, NY, OK), the University of Kansas Center for Accessible Teaching, Learning, and Assessment Systems (ATLAS), CAST, and BYC Consulting.

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EXTERNAL REVIEW

I-SMART staff brought 10 educators to a two-day, face-to-face meeting to review the 11 learning map models. Educators were selected based on experience with science content instruction and special education. Prior to the event, educators completed training on the structure of the models and review criteria. Organized into three panels by grade-band (elementary, middle, and high school), educators applied evaluation criteria to the map nodes and connections and also suggested revisions. Panelists evaluated:

- if there were clear relationships between nodes and the standards
- if node content was accessible and free from significant barriers
- if the connections were accurate and represented appropriate and logical learning sequences,
- if overall the neighborhood provided accessible and appropriate content for all students in the grade band, including students with disabilities.

Panel processes included individual ratings and group discussion to reach consensus. Reviewers also compared the complexity of science map nodes to related ELA and mathematics nodes from the same grade band (i.e., horizontal relationships) and the continuity of science content progressions across grade bands (i.e., vertical relationships).

Educator feedback was a key component in developing I-SMART science learning map models.

Overall, panelists determined a median of 91% of nodes met criteria, and a median of 88% of connections met criteria. Panelists also verified the majority of the neighborhoods contained both accessible and appropriate content for all students, and the horizontal relationships of the neighborhoods were suitable. Panelists were only able to examine the vertical relationships of four middle school neighborhoods, but found that the nodes gradually increased in complexity and the content in neighborhoods overlapped sufficiently.

EXTERNAL REVIEW FEEDBACK

An external evaluator met with educators to gather feedback about the review process. Panelists generally perceived their on-site experience as positive. Panelists suggested extending the orientation and training time to improve the external review process. Educators also suggested that materials include more examples of how a wider variety of students can demonstrate their learning. Overall, the review procedures, materials, and resources supported the quality of the feedback collected.

POST-REVIEW PROCESS

I-SMART staff reviewed all recommendations and accepted those meeting criteria for logic and consistency with the neighborhood map, and the map's research narrative. Suggested revisions were generally related to editing, use of concepts or semantics, and changes to nodes or connections. Staff added 12 nodes and revised 64 nodes, and also added 44 connections and deleted 12 connections. The final neighborhoods had a total of 485 nodes and 740 connections. Sample neighborhoods are available at ismart.works.