Connecting Preservice Teachers with Digital Resources for the Classroom: Can Educational Digital Libraries Help?

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Overall Project Goal

- Understand the **educational impact of NSDL** tools and services on three key user groups:
  - Preservice teachers
  - Practicing teachers
  - Students in science classrooms
- Examine the **cognitive and metacognitive impact** of NSDL tools and services
  - Potential for long-term impact
  - Support for deeper learning (teachers & students)

Cognitive Impact

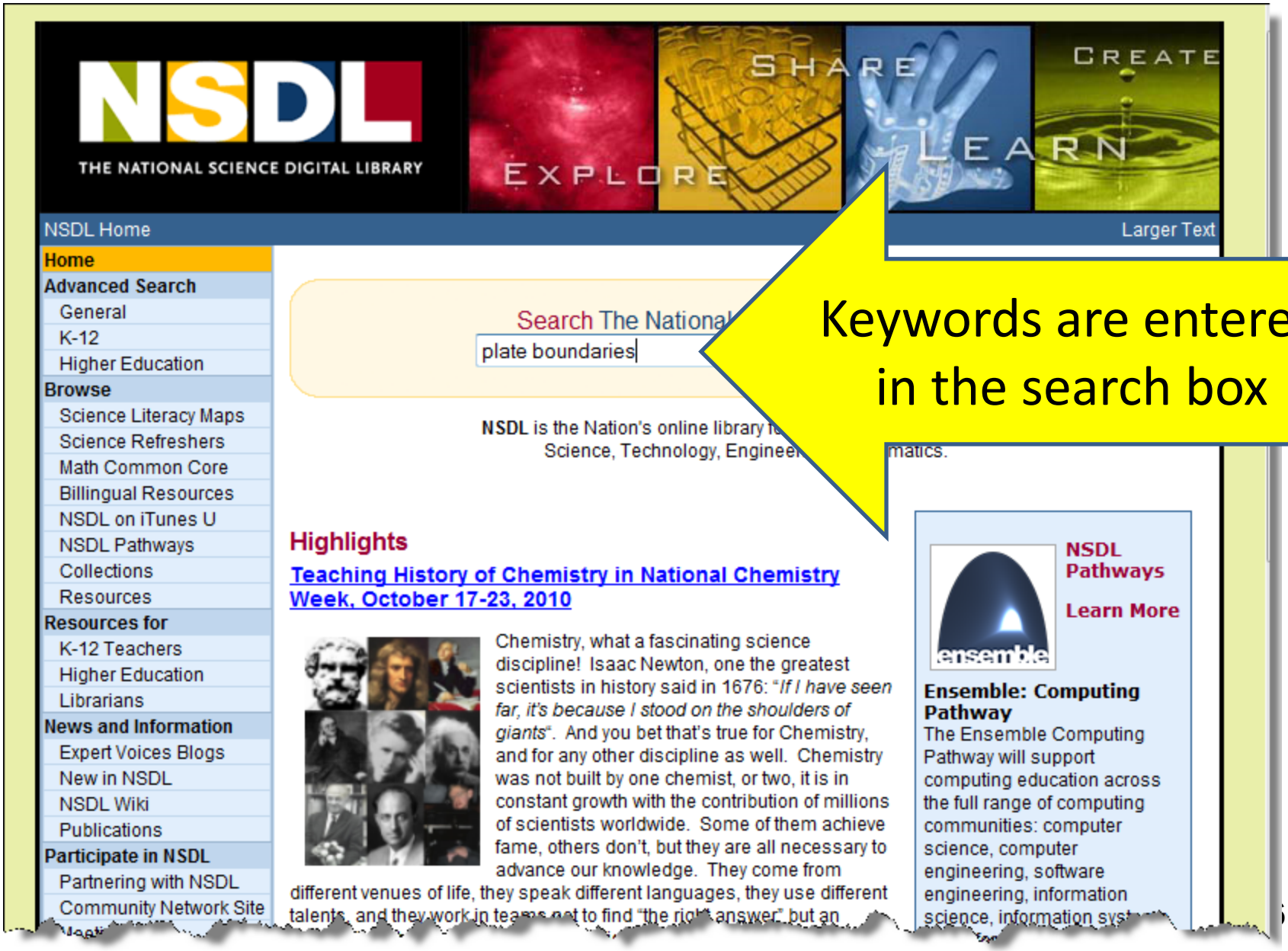
- **Examine cognitive and metacognitive processes** when teachers and students
  - **Search** for digital resources
  - **Evaluate** returned results
  - **Learn** from selected resources

Research Questions

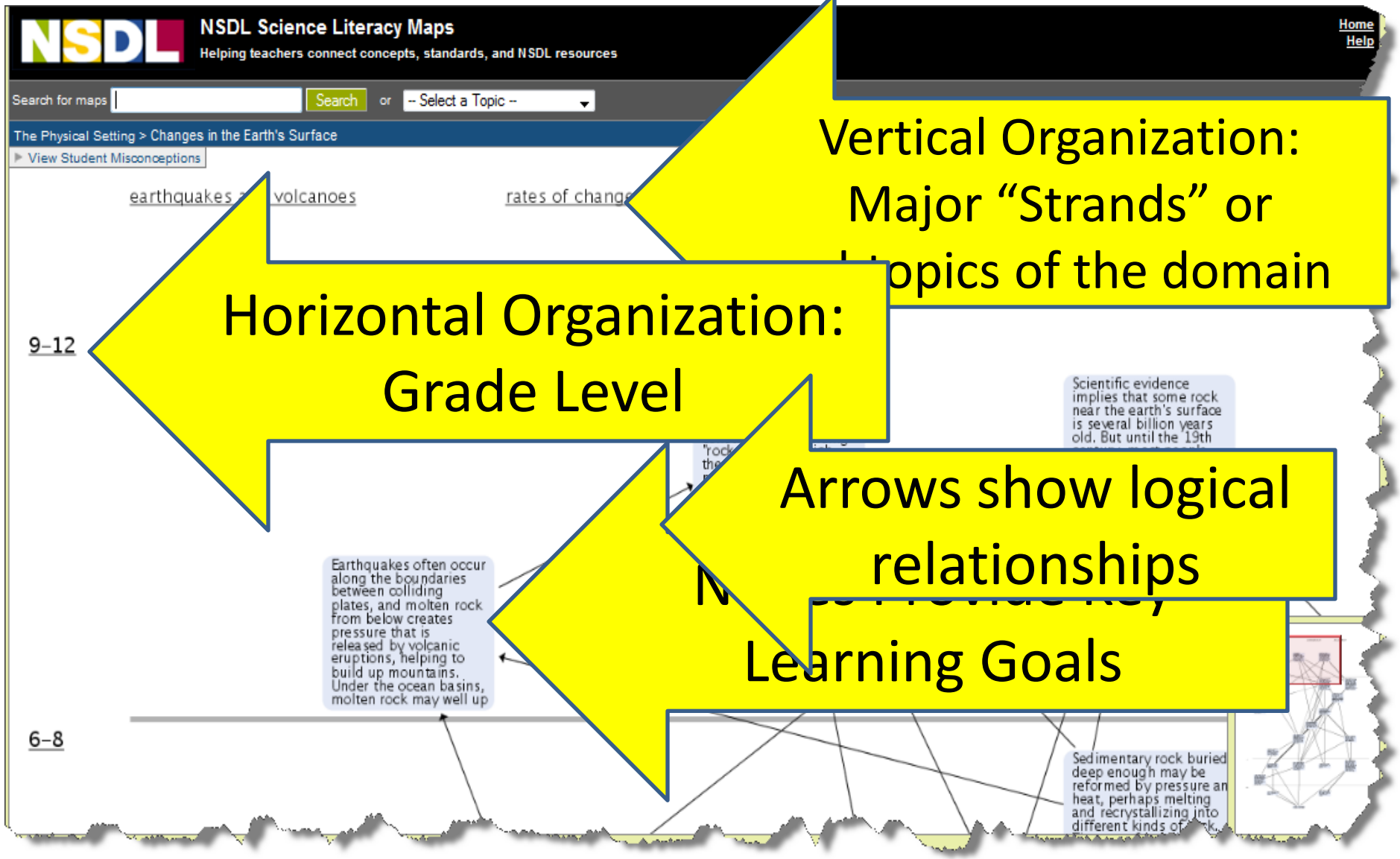
- Does use of **NSDL impact preservice teachers' cognitive processes** during search for and evaluation of digital resources?
  - Attention to domain content, resource characteristics
  - Depth of domain processing
- Do preservice teachers **find and use resources with similar educational content** when using NSDL vs. Google?

Control Condition

NSDL Keyword Search



NSDL Science Literacy Maps



Vertical Organization: Major "Strands" or topics of the domain

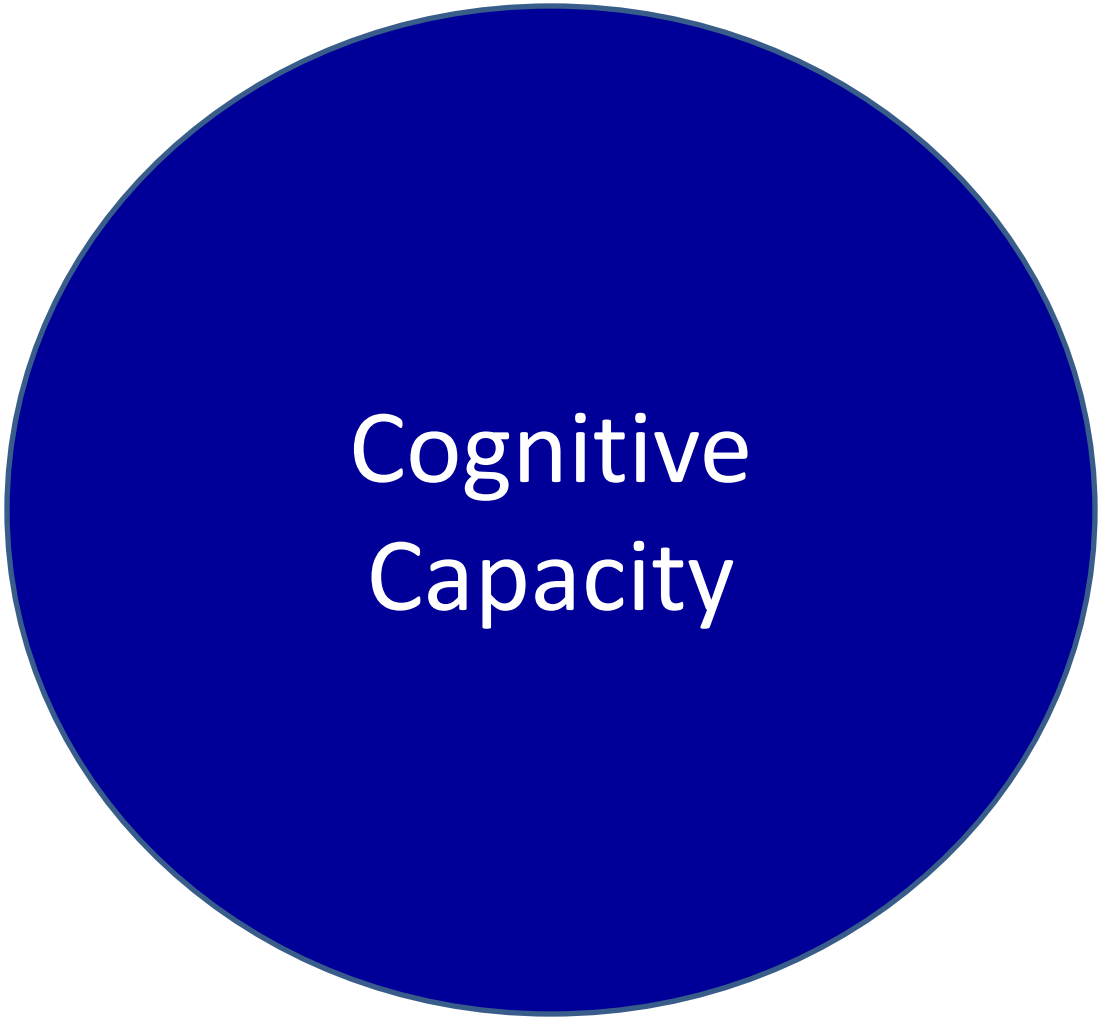
Horizontal Organization: Grade Level

Arrows show logical relationships

Learning Goals

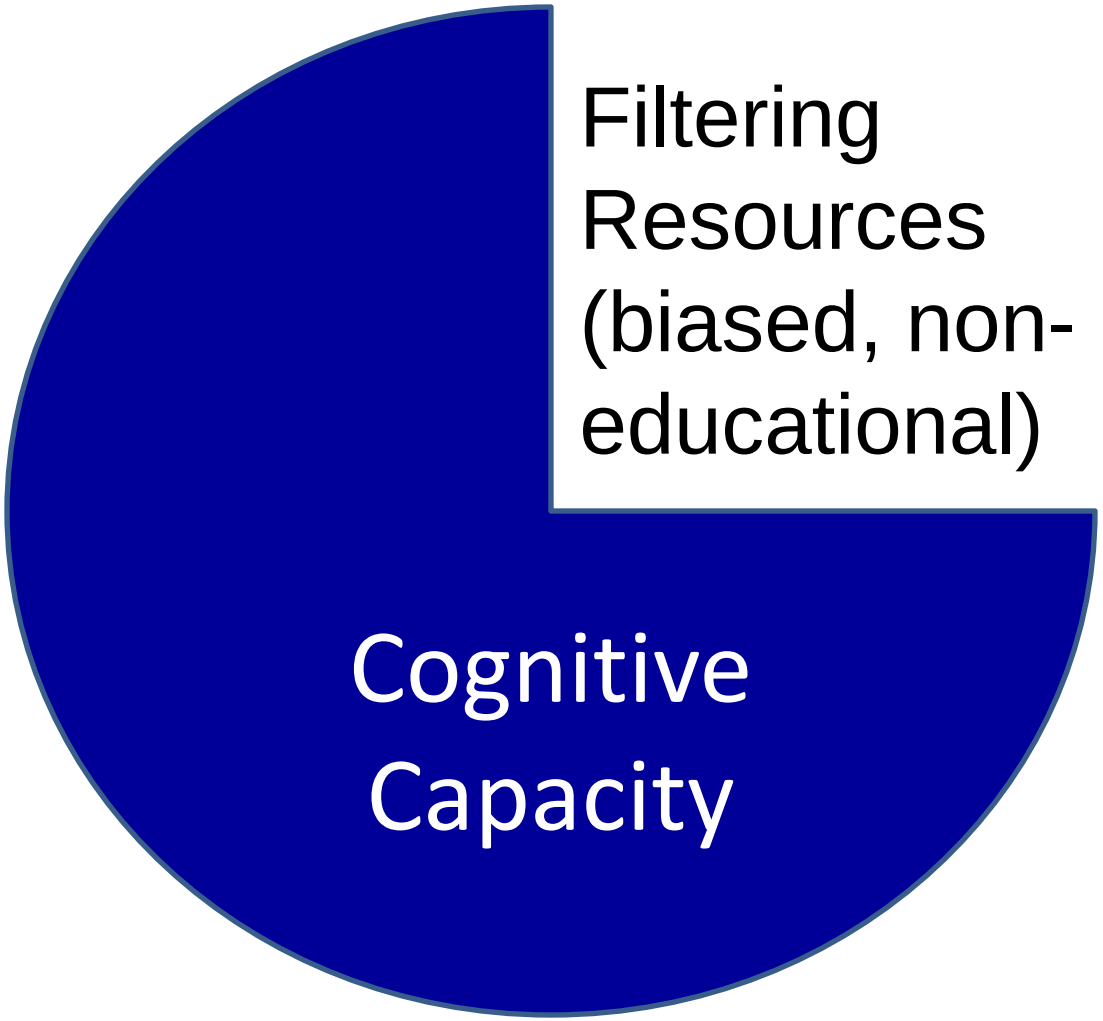
Rationale for Cognitive Impact

Cognitive Load



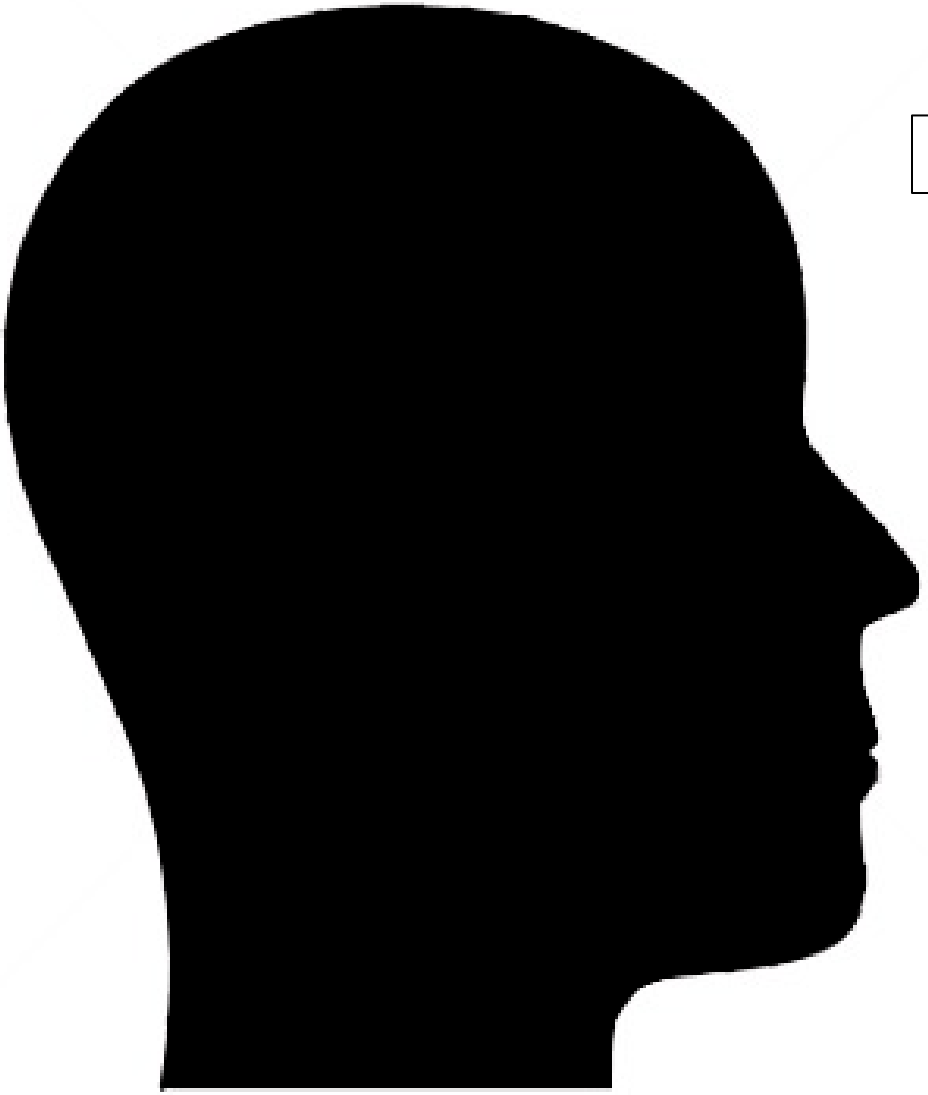
Rationale for Cognitive Impact

Cognitive Load



e.g., Sweller (1988); Paas, Renkl, & Sweller (2004)

Rationale for Cognitive Impact: Conceptual Knowledge Structures



Divergent

Convergent

Convection

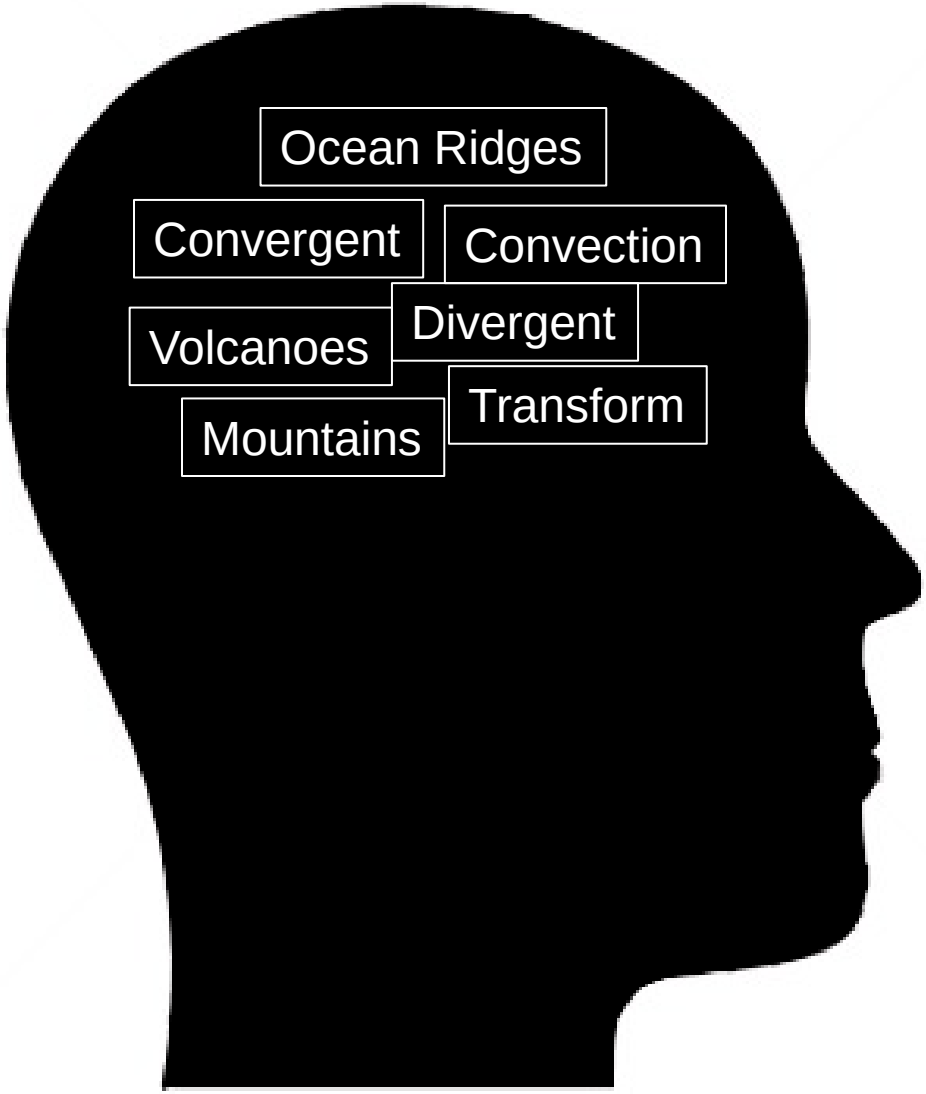
Volcanoes

Ocean Ridges

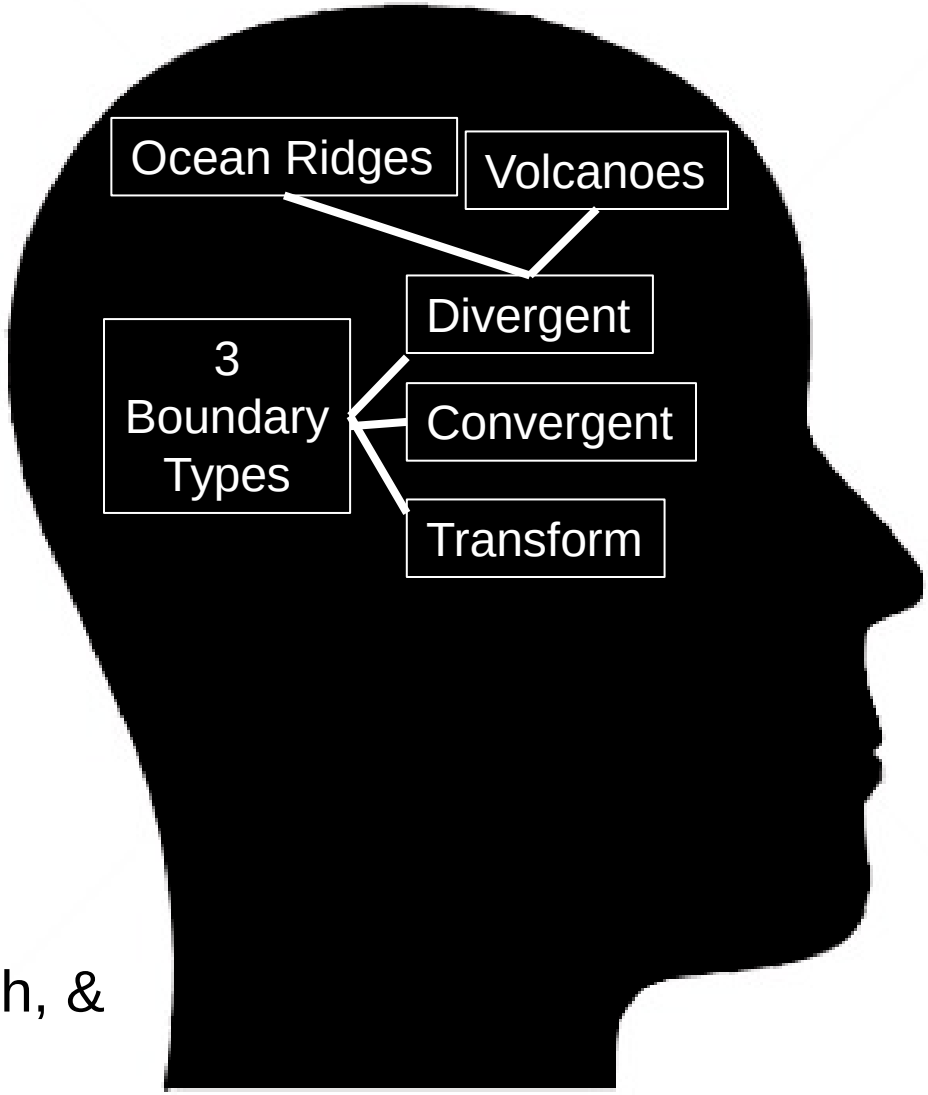
Mountains

Transform

Rationale for Cognitive Impact: Conceptual Knowledge Structures



Rationale for Cognitive Impact: Conceptual Knowledge Structures



e.g., Chi, Feltovich, & Glaser (1981)

3 Hour Experimental Protocol

Within Subjects Design:
All Participants Use All Conditions

Google	NSDL Keyword	NSDL Sci. Lit. Maps

Prior Knowledge Assessment

Introduction to Search Tool

Digital Resource: Search & Evaluation Task

Digital Resource: Learning Task

Post-Learning Knowledge Assessment

Participants

- 25 preservice teachers at University of Utah
  - Recruit for those with special interest in science
  - Wide range of prior knowledge (mostly low)
- Self-rate as
  - **Very familiar with using online searches** to find information
  - **Very successful** in finding information with online searches
  - **Anticipate very frequent use of the Web** to find information/materials for their future classrooms

the following Utah core standard and objective:

Earth Science Standard:

Explain the water cycle in terms of its reservoirs, the movement between reservoirs, and the energy to move water. Evaluate the importance of freshwater to the biosphere.

Objective:

Identify the reservoirs of Earth's water cycle (e.g., ocean, ice caps/glaciers, atmosphere, lakes, rivers, biosphere, groundwater) locally and globally, and graph or chart relative amounts in global reservoirs.

Classroom Information:

This year, you have a number of **students who are lagging behind in science** and **identify themselves as "visual learners."** They don't understand how water changes forms on earth and how this is related to the global reservoirs of the water cycle. You are especially concerned with finding **resources that you can use in small group activities** to help these struggling learners master this standard/objective.

Your Goal:

Select **1-4 digital resources** that you think are **well-matched to the standard and objective** listed above ***and* will help your students learn** as they work in small groups during class. You should be sure to choose sites that you think are **high-quality** and **scientifically accurate**.

Verbal Analysis

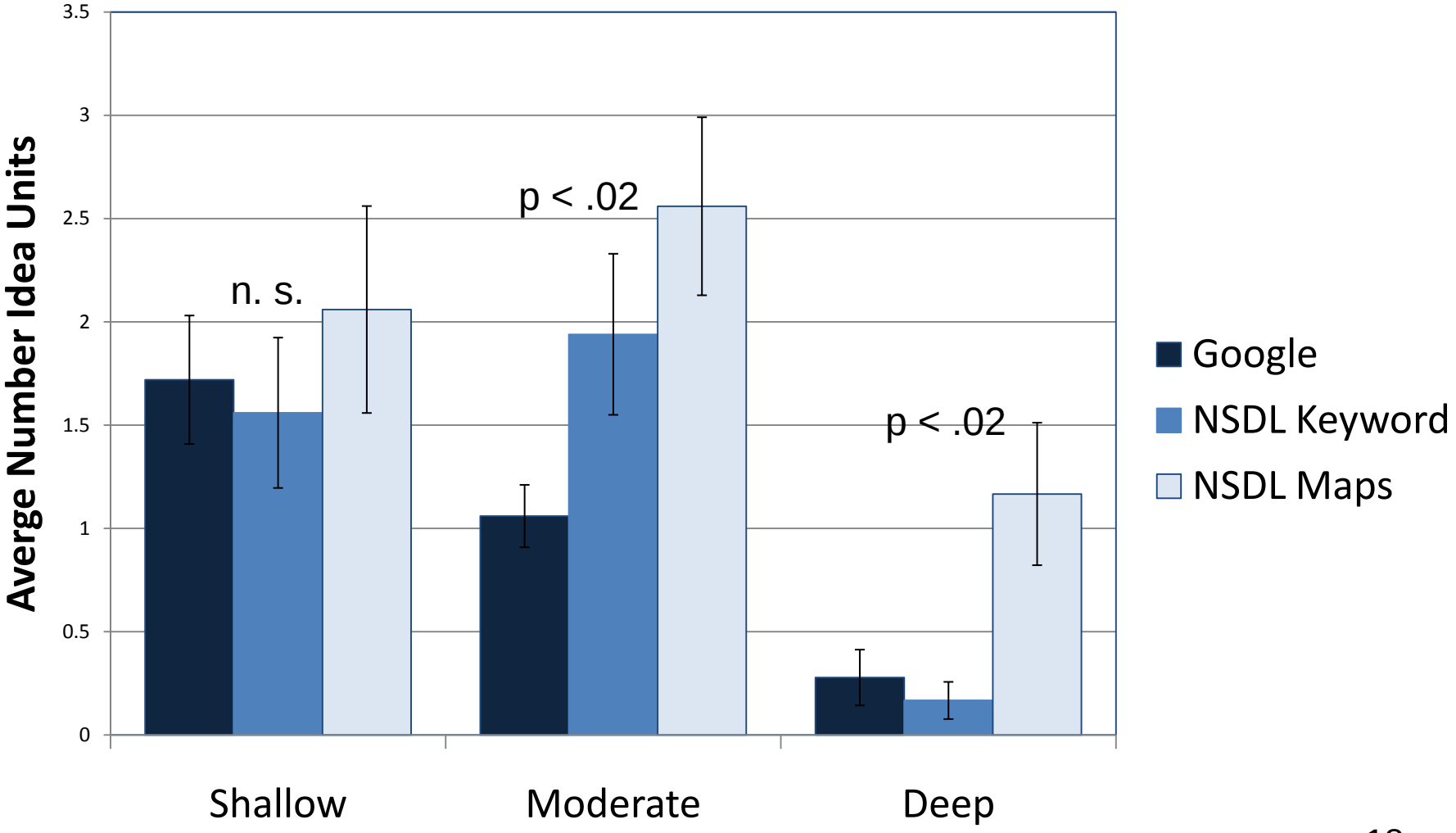
- Tag idea units related to search processes and resource evaluation
- Code each tagged comment:
  - **Content Analyses** (Shallow, Moderate, Deep)
  - **Resource Analysis** (Specificity, Task, Source)

- *Note: Search and Evaluation tasks last 10 minutes (time-controlled).*

Depth of Domain Processing

Shallow	Aesthetic or arbitrary	“We'll just try the first one that comes [clicks 1st result]” “Sweet, this one is a game!”
Moderate	Keyword matching or Vague Content Analysis	“let's see if we can find better function of the cells” I'm just trying to find out basic information abuot cells and that one seemed... like it wasn't going to help me
Deep	Analysis of science content	“[the resource talks about] the distribution of water among the different types of reservoirs on earth, and that goes between the two”

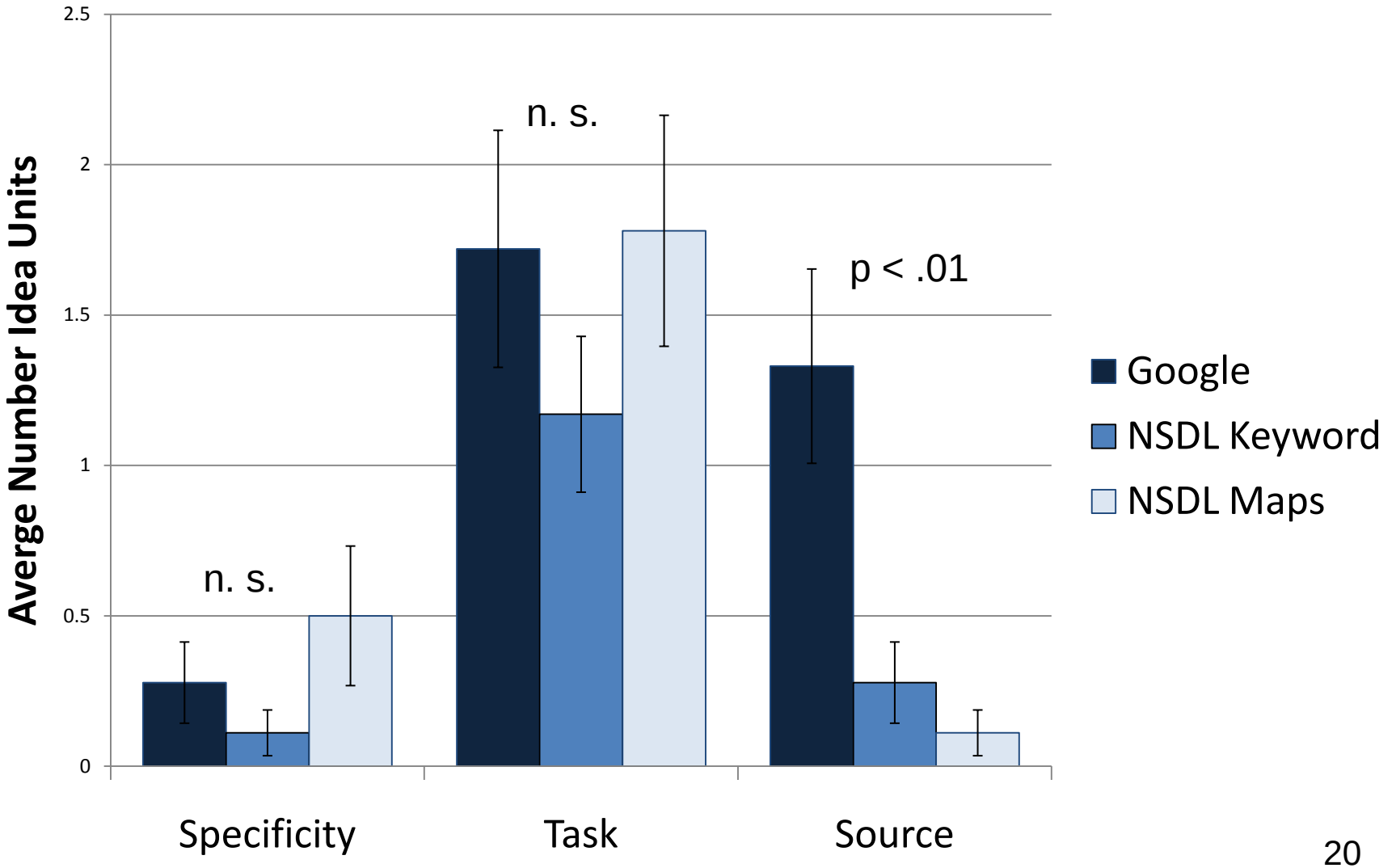
NSDL Promotes Deeper Analysis of Science Content



Digital Resource Characteristics

Specificity	Granularity or Coverage of Resource	“Hmmm, I don't know if that covers everything I'm looking for…”
Task	Evaluate match to task context	“I know this is for a high school class so I'm going to look through the topics that are 9-12”
Source	Evaluation of resource sponsor	“here's something from earth.nasa.gov...NASA is a pretty big scientific org”

NSDL Reduces Burden of Source Evaluation

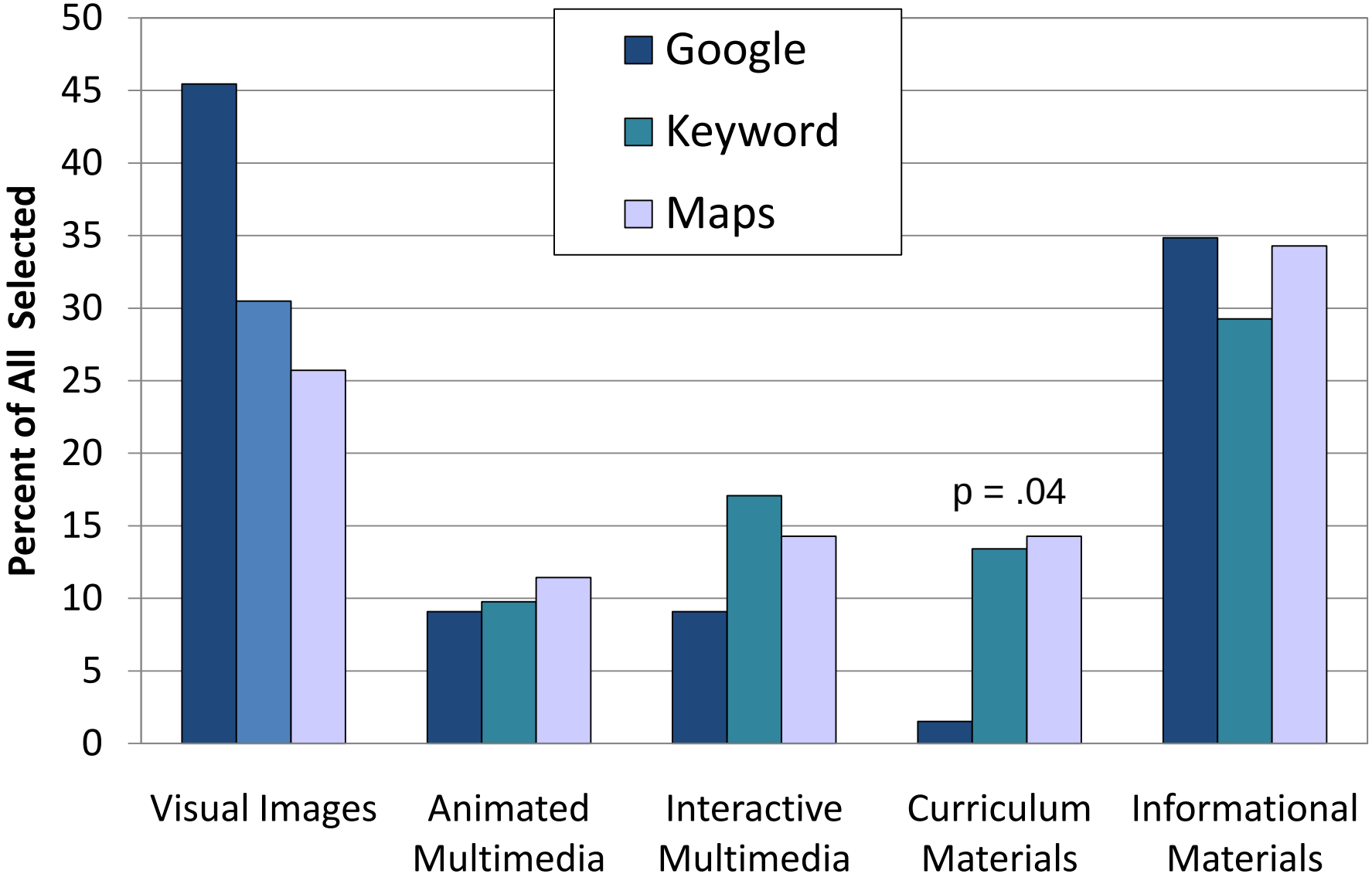


Analysis of **D**igital **M**aterials **I**n **R**esources for **E**ducation (ADMIRE)

Category of Educational Content	Examples
Static Visuals	Diagrams, Photographs
Animated Visuals	Video, Animations
Interactives	Simulations, Interactive Tools
Curriculum Materials	Lesson Plans, Discussion Questions, Hands-on Labs, Quizzes
Informational Materials	Text summaries, definitions, articles

Interrater Coding: Kappa = .78

Educational Content: Accepted Resources



Conclusions

- NSDL **reduces the cognitive effort** dedicated to analyzing the sponsors of digital resources
- **NSDL promotes the deep analysis of the scientific content** in digital resources during search and evaluation
  - Especially true for NSDL Science Literacy Maps
- Overall, NSDL helps teachers to select more resources with reusable curriculum materials

Researchers/Contributors

- Kirsten Butcher
- Robert Zheng
- Anne Cook
- **Ashley Crockett Mazal***
- **Sarah Davies***
- **Aaron Dewald***
- **Lisa Ferarra***

*Thank-you to our wonderful and efficient graduate students!

Questions?

Zion National Park: October 11, 2010