

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

Web [Images](#) [Videos](#) [Maps](#) [News](#) [Shopping](#) [Gmail](#) [more](#) ▼ [kirsten.butcher@gmail.com](#) | [iGoogle](#) | [Settings](#) ▼ | [Sign out](#)

Google

plate bound

[Advanced Search](#)
[Language Tools](#)

plate boundaries

plate boundary

plate boundary types

plate boundaries map

plate boundary zones

plate boundaries worksheet

plate boundary animations

plate boundaries powerpoint

plate boundaries are associated with

plate boundaries definition

Google Suggest offers
users a set of query
recommendations

[change background](#)

NSDL Keyword Search

The screenshot shows the NSDL website interface. At the top, there is a navigation bar with the NSDL logo and the text 'THE NATIONAL SCIENCE DIGITAL LIBRARY'. Below the logo are four colored boxes with the words 'EXPLORE', 'SHARE', 'LEARN', and 'CREATE'. A search bar is located in the center, containing the text 'plate boundaries'. A yellow callout box points to the search bar with the text 'Keywords are entered in the search box'. On the left side, there is a sidebar menu with categories like 'Home', 'Advanced Search', 'Browse', 'Resources for', 'News and Information', and 'Participate in NSDL'. Below the search bar, there is a section titled 'Highlights' with a link to 'Teaching History of Chemistry in National Chemistry Week, October 17-23, 2010'. To the right of this link is a small image of a group of scientists. Below the image is a paragraph of text starting with 'Chemistry, what a fascinating science discipline!'. On the far right, there is a box for 'NSDL Pathways' with a link to 'Learn More' and a small image of a blue archway with the word 'ensemble' below it. Below this image is a section titled 'Ensemble: Computing Pathway' with a paragraph of text.



THE NATIONAL SCIENCE DIGITAL LIBRARY



Larger Text

NSDL Home

- Home
- Advanced Search
 - General
 - K-12
 - Higher Education
- Browse
 - Science Literacy Maps
 - Science Refreshers
 - Math Common Core
 - Bilingual Resources
 - NSDL on iTunes U
 - NSDL Pathways
 - Collections
 - Resources
- Resources for
 - K-12 Teachers
 - Higher Education
 - Librarians
- News and Information
 - Expert Voices Blogs
 - New in NSDL
 - NSDL Wiki
 - Publications
- Participate in NSDL
 - Partnering with NSDL
 - Community Network Site

Search The National Science Digital Library

NSDL is the Nation's online library for Science, Technology, Engineering, and Mathematics.

Highlights

[Teaching History of Chemistry in National Chemistry Week, October 17-23, 2010](#)



Chemistry, what a fascinating science discipline! Isaac Newton, one the greatest scientists in history said in 1676: "If I have seen far, it's because I stood on the shoulders of giants". And you bet that's true for Chemistry, and for any other discipline as well. Chemistry was not built by one chemist, or two, it is in constant growth with the contribution of millions of scientists worldwide. Some of them achieve fame, others don't, but they are all necessary to advance our knowledge. They come from

different venues of life, they speak different languages, they use different talents, and they work in teams not to find "the right answer" but an

Keywords are entered in the search box



NSDL Pathways
Learn More

Ensemble: Computing Pathway
The Ensemble Computing Pathway will support computing education across the full range of computing communities: computer science, computer engineering, software engineering, information science, information systems

NSDL Science Literacy Maps



NSDL Science Literacy Maps

Helping teachers connect concepts, standards, and NSDL resources

[Home](#)
[Help](#)

Search for maps or

The Physical Setting > Changes in the Earth's Surface

[View Student Misconceptions](#)

[earthquakes](#) [volcanoes](#) [rates of change](#)

9-12

Horizontal Organization:
Grade Level

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

Arrows show logical
relationships

Learning Goals

Earthquakes often occur along the boundaries between colliding plates, and molten rock from below creates pressure that is released by volcanic eruptions, helping to build up mountains. Under the ocean basins, molten rock may well up

Scientific evidence implies that some rock near the earth's surface is several billion years old. But until the 19th

6-8

Sedimentary rock buried deep enough may be reformed by pressure and heat, perhaps melting and recrystallizing into different kinds of rock.



Rationale for Cognitive Impact

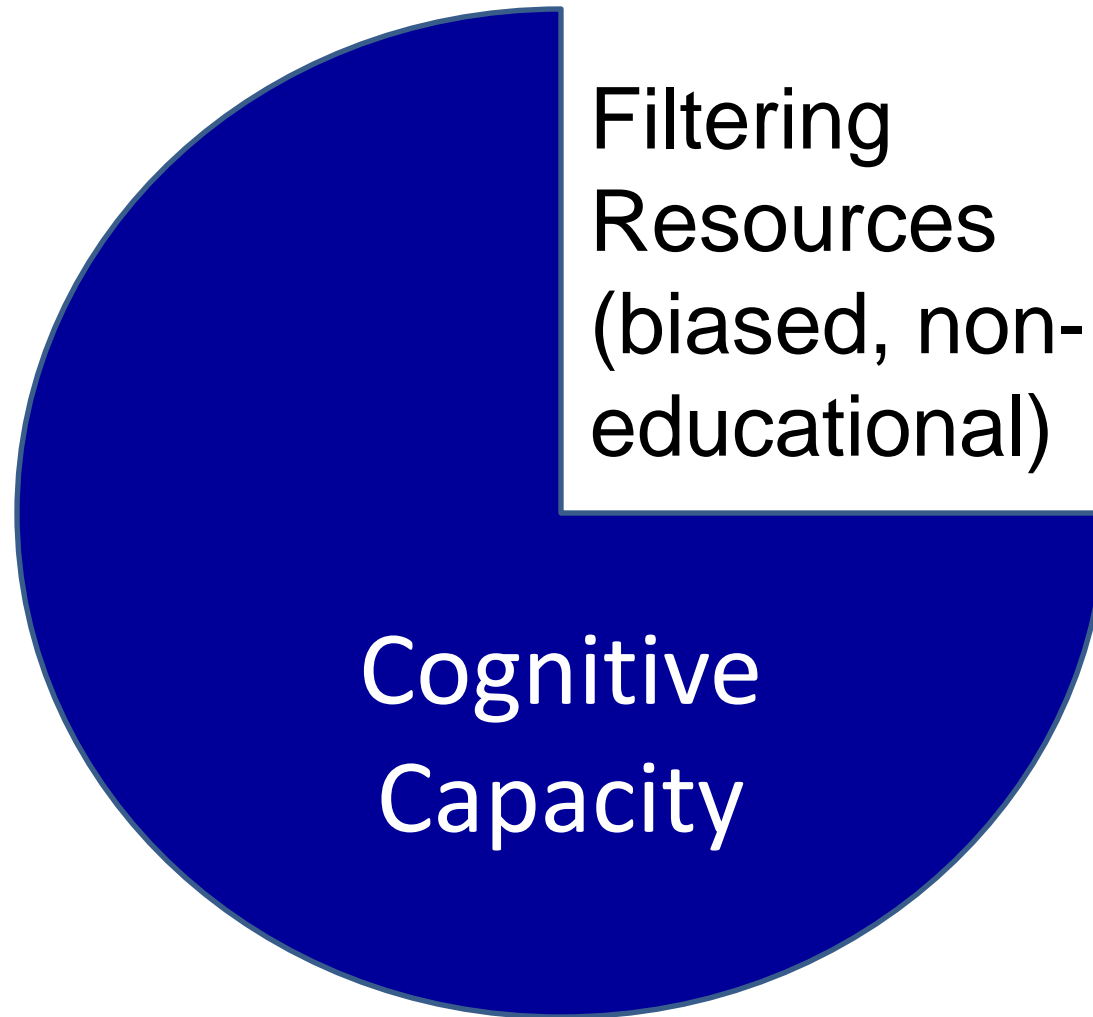
Cognitive Load



Cognitive
Capacity

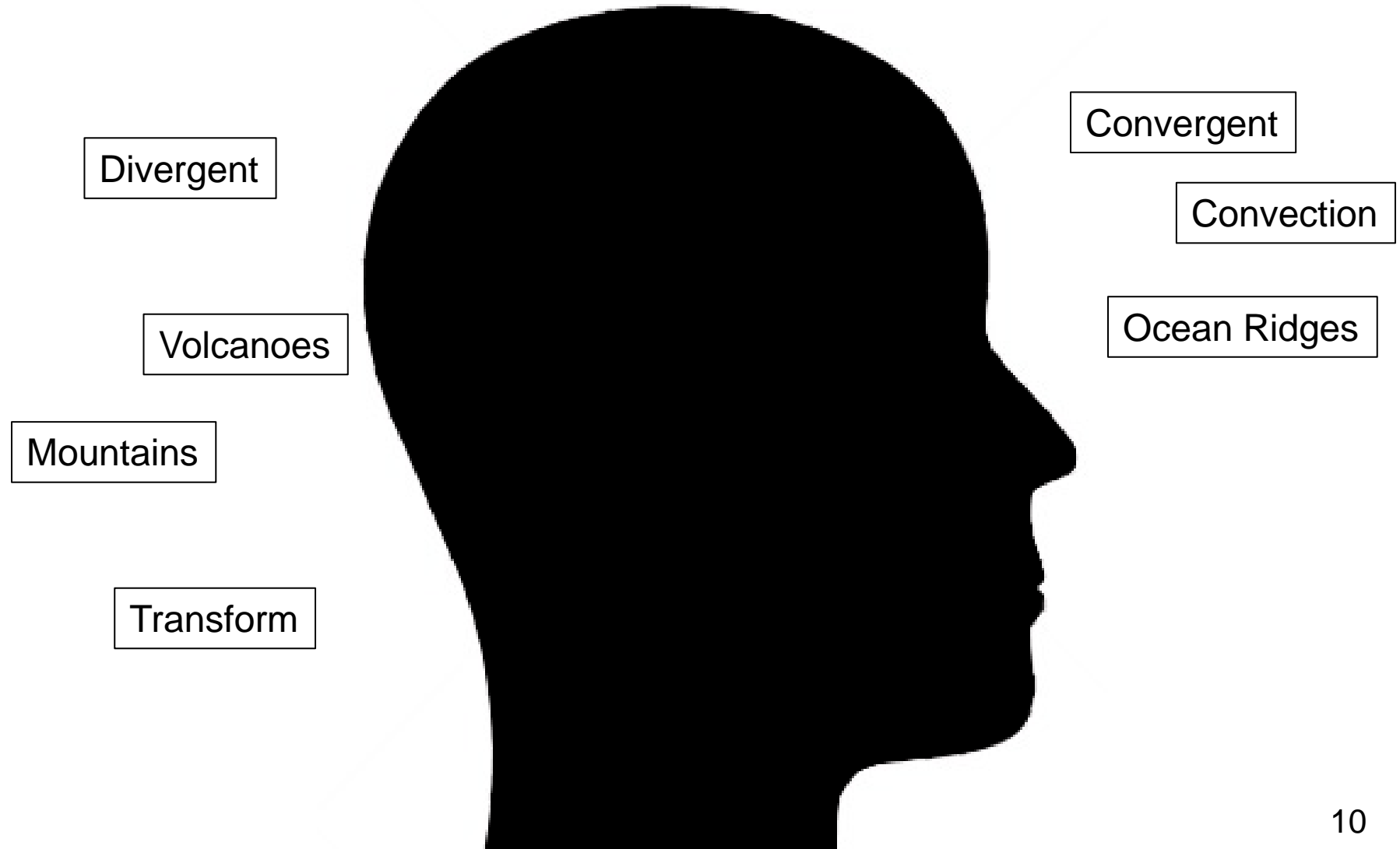
Rationale for Cognitive Impact

Cognitive Load

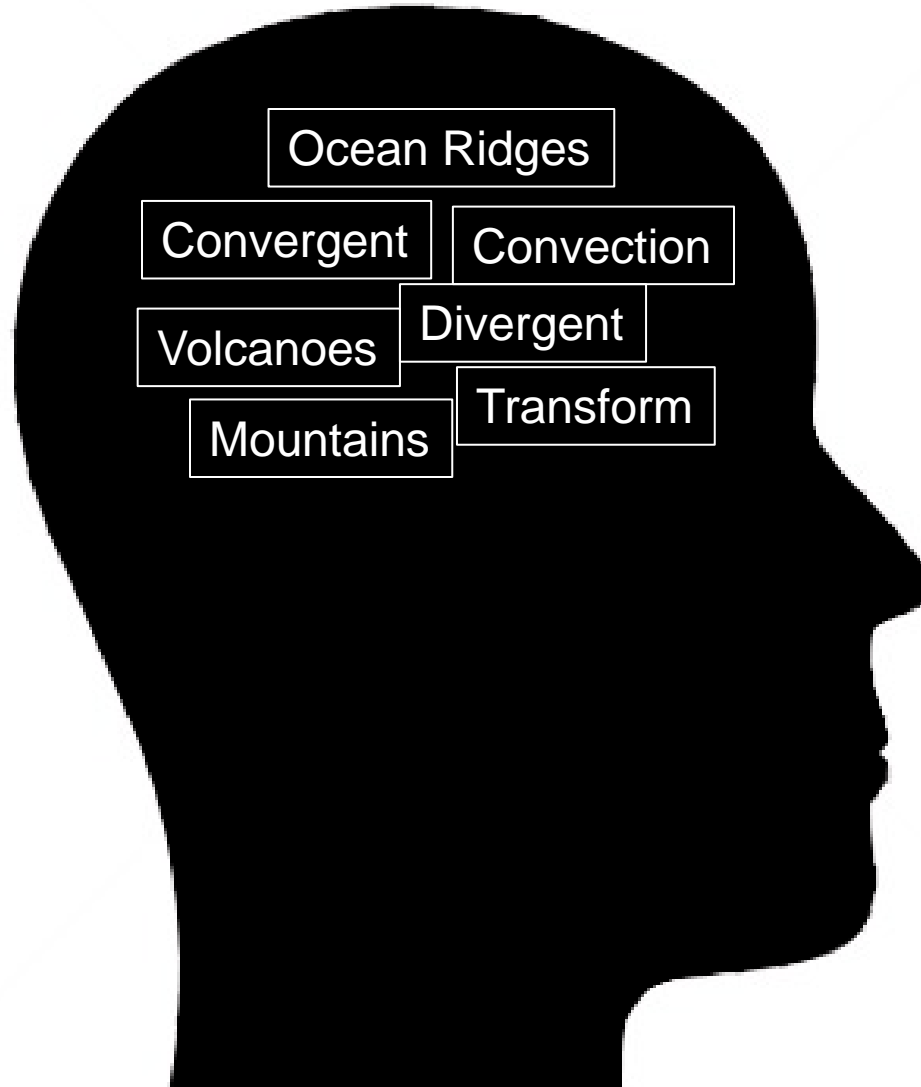


e.g., Sweller
(1988); Paas, Renkl, & Sweller (2004)

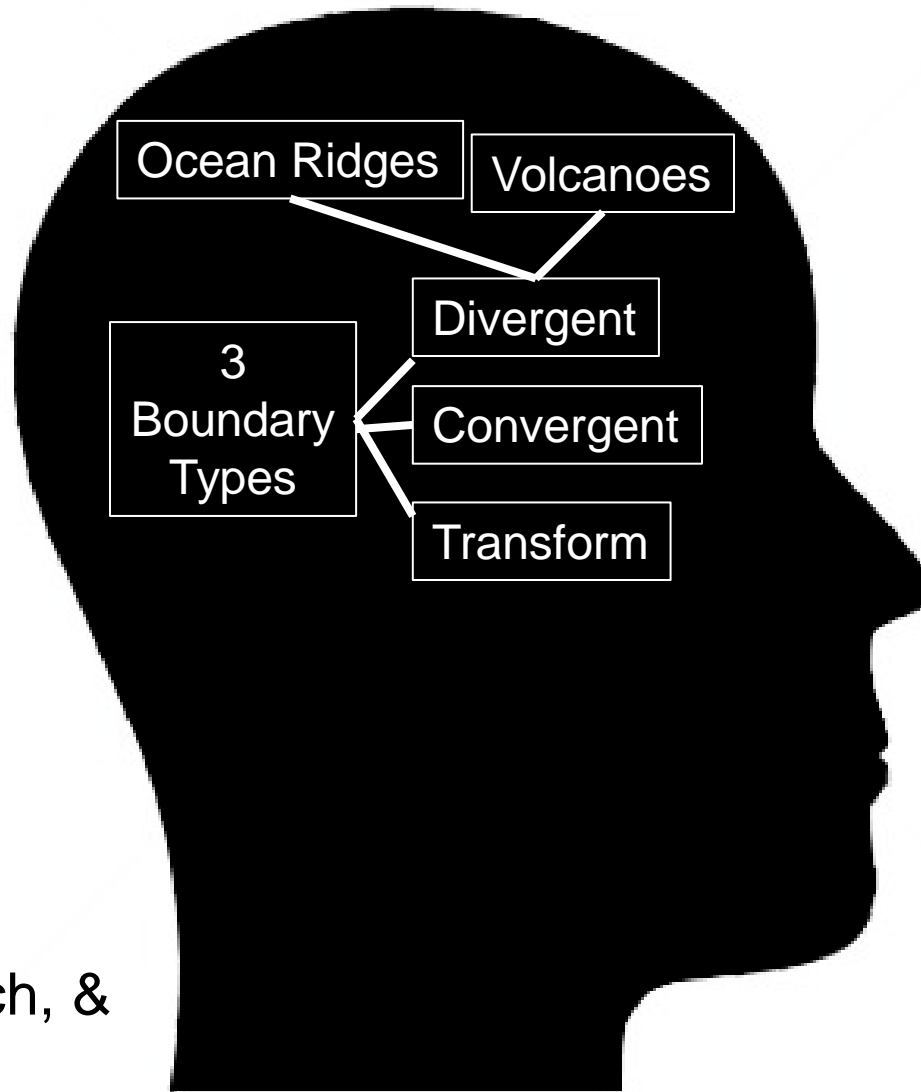
Rationale for Cognitive Impact: Conceptual Knowledge Structures



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**.

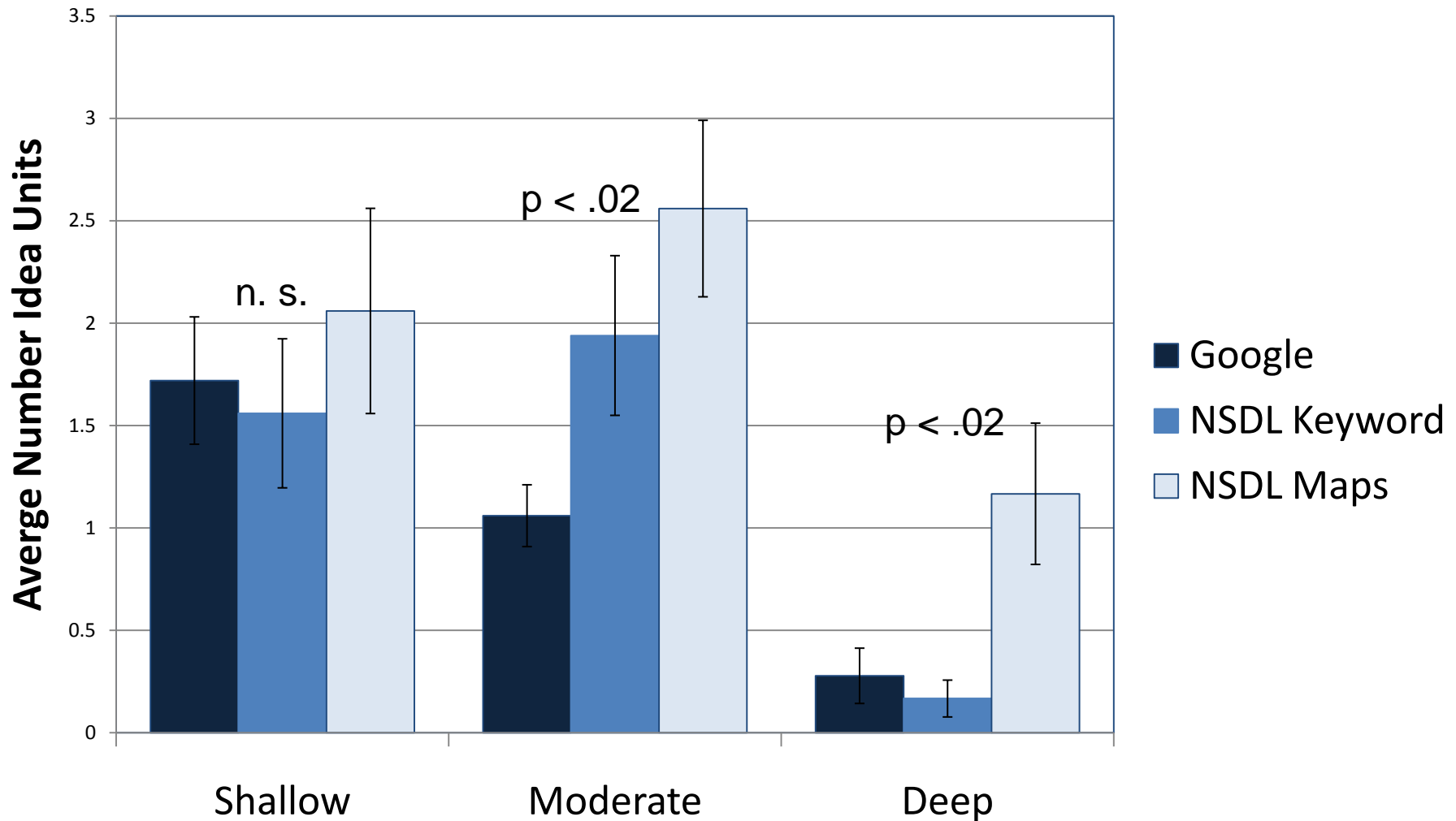
Verbal Analysis

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

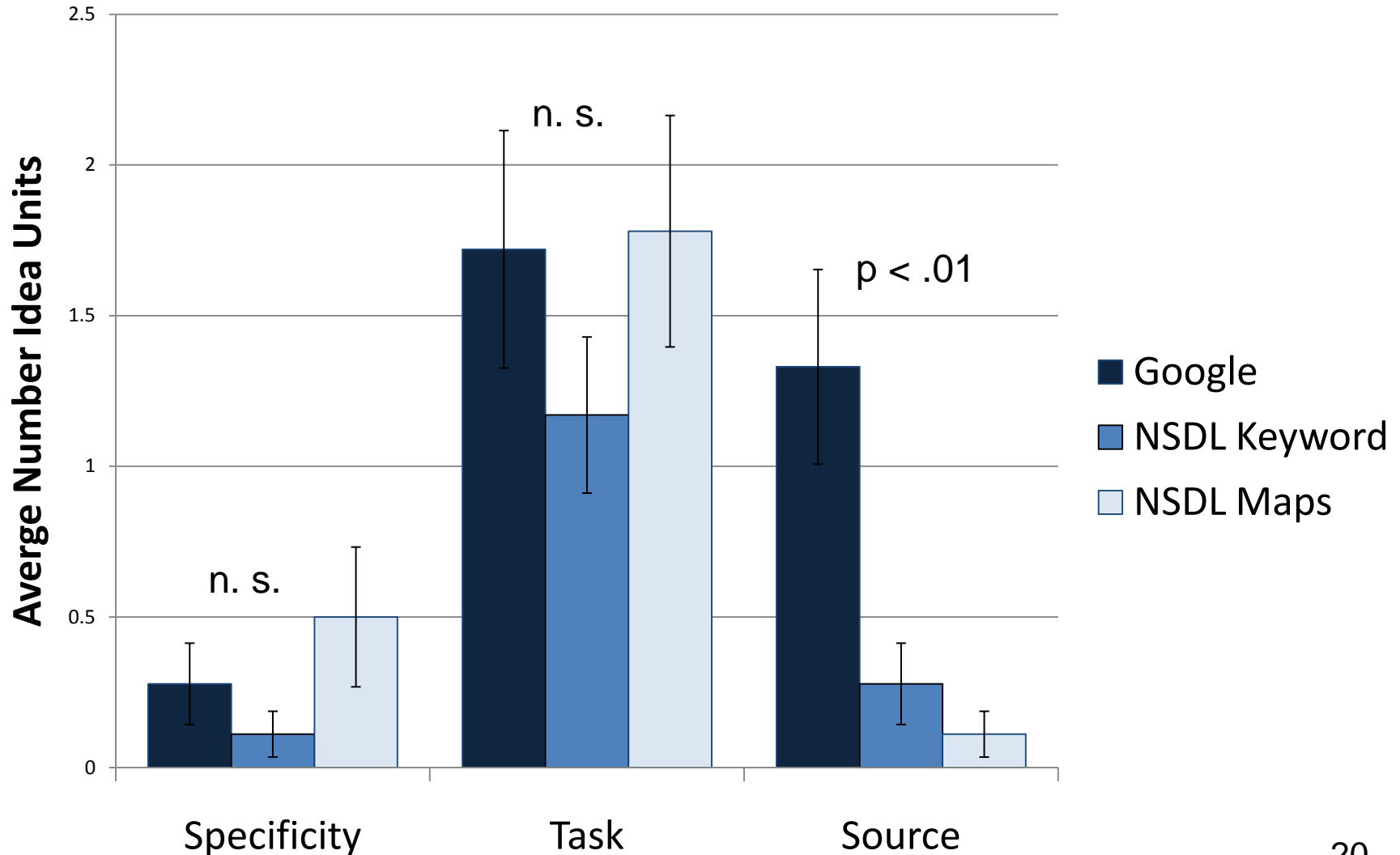
NSDL Promotes Deeper Analysis of Science Content



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”

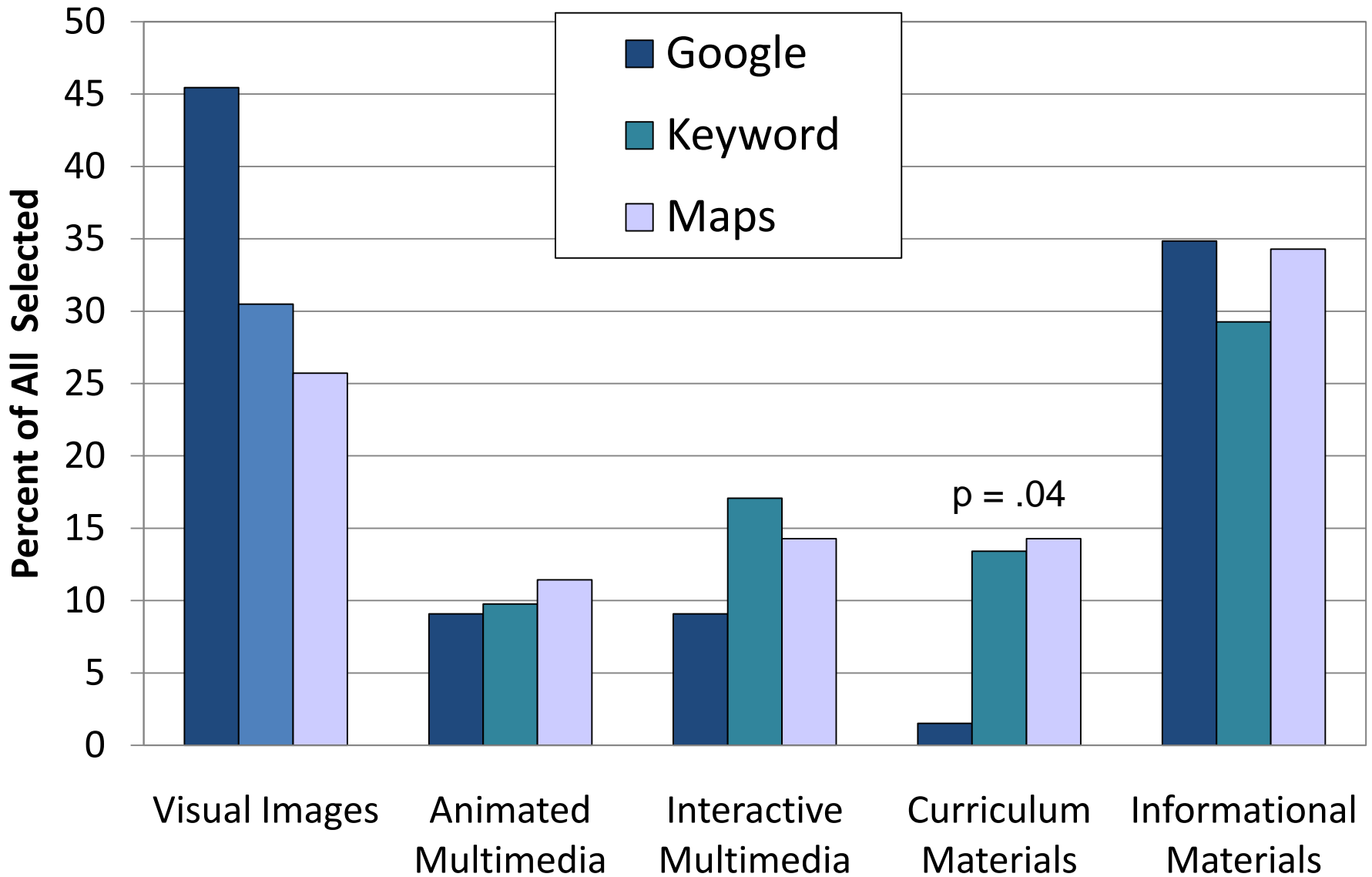
NSDL Reduces Burden of Source Evaluation



Analysis of Digital Materials In Resources for Education (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

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