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?
Google Suggest offers users a set of query recommendations.
Keywords are entered in the search box.
NSDL Science Literacy Maps

Vertical Organization:
Major “Strands” or subtopics of the domain

Horizontal Organization:
Grade Level

Arrows show logical relationships

Nodes provide key learning goals
Rationale for Cognitive Impact
Cognitive Load

Cognitive Capacity
Rationale for Cognitive Impact

Cognitive Load

Filtering Resources (biased, non-educational)

Cognitive Capacity

e.g., Sweller (1988); Paas, Renkl, & Sweller (2004)
Rationale for Cognitive Impact: Conceptual Knowledge Structures

- Divergent
- Volcanoes
- Mountains
- Transform
- Convergent
- Convection
- Ocean Ridges
Rationale for Cognitive Impact: Conceptual Knowledge Structures

Ocean Ridges
Convergent
Convection
Volcanoes
Divergent
Mountains
Transform
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
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

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

Averaging Number Idea Units

- Shallow
- Moderate
- Deep

Google
NSDL Keyword
NSDL Maps

n.s.
p < .02
p < .02
### Digital Resource Characteristics

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

![Bar chart showing the average number of idea units for Specificity, Task, and Source, comparing Google, NSDL Keyword, and NSDL Maps.](chart)

- **Specificity**: n.s.
- **Task**: p < .01
- **Source**: n.s.
## Analysis of Digital Materials In Resources for Education (ADMIRE)

<table>
<thead>
<tr>
<th>Category of Educational Content</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Visuals</td>
<td>Diagrams, Photographs</td>
</tr>
<tr>
<td>Animated Visuals</td>
<td>Video, Animations</td>
</tr>
<tr>
<td>Interactives</td>
<td>Simulations, Interactive Tools</td>
</tr>
<tr>
<td>Curriculum Materials</td>
<td>Lesson Plans, Discussion Questions, Hands-on Labs, Quizzes</td>
</tr>
<tr>
<td>Informational Materials</td>
<td>Text summaries, definitions, articles</td>
</tr>
</tbody>
</table>

Interrater Coding: Kappa = .78
Educational Content: Accepted Resources

<table>
<thead>
<tr>
<th>Visual Images</th>
<th>Animated Multimedia</th>
<th>Interactive Multimedia</th>
<th>Curriculum Materials</th>
<th>Informational Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google</td>
<td>Keywords</td>
<td>Maps</td>
<td>p = .04</td>
<td></td>
</tr>
</tbody>
</table>
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

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Questions?