Enhancing Learning through Deep & Broad Searching: Developing New Measures to Assess Searching as Learning

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MOTIVATION

Traditional Perspective: Search Systems as Retrieval Tools

- Search systems are designed to provide relevant content, facts, or answers.
- Search technology has focused on improving the effectiveness of search results to match search queries.
- The evaluation criteria has centered on relevance and usefulness of search results.

Alternative Perspective: Searching as Learning

- Search systems can be reconceptualized as learning technologies to support human learning by providing rich online content.
- Factors influencing the association of searching and learning need to be identified and articulated.
- search processes need to be developed.

RESEARCH QUESTIONS

1. Which search condition – single search query, multiple search queries, intrinsically diverse search queries – best supports human learning outcomes and experiences?
2. What measures and indicators demonstrate learning outcomes and experiences in web searching?
3. To what extent are searchers’ perceived learning outcomes and experiences co-related to their search patterns?

RESEARCH DESIGN

Experimental study in a laboratory setting using Between-Subject Design. Participants were randomly assigned to one of three conditions:

- Search conditions were manipulated:
  - C1: Single Search Query
  - C2: Multiple Search Query
  - C3: Intrinsically Diverse Search Queries

Data Collection:

- Background questionnaire
- Pre-search questionnaire
- Search interaction logs
- Written summaries in response to six learning-type questions
- Post-search questionnaires

Characteristics of participants:

- 44 participants
- 14 males and 30 females; Mean age: 26 (Age range: 19-38)
- 52% use search engines more than 10 times a day
- 24% are frequent searchers (more than twice a day)
- 32% are infrequent searchers (once a day or less)
- 66.7% use search engines more than 3 times a day

Data Analysis:

- Statistical analyses of background and post-search questionnaires
- Content analysis of written summaries (6 categories; 7 levels of knowledge; 42 coding categories)

CODING SCHEME FOR PRE- & POST-SEARCH WRITTEN SUMMARIES

<table>
<thead>
<tr>
<th>Learning Level</th>
<th>Pre-Search</th>
<th>Post-Search</th>
</tr>
</thead>
<tbody>
<tr>
<td>Know facts or concepts</td>
<td>Recall principle elements</td>
<td>Name particular communities</td>
</tr>
<tr>
<td>Demonstrate advanced vocabulary</td>
<td>Identify communities with reasoning</td>
<td>Name specific concepts</td>
</tr>
<tr>
<td>Include specific details such as knowledge of events or people</td>
<td>Demonstrate viewpoints</td>
<td>Demonstrate conceptual viewpoints</td>
</tr>
<tr>
<td>Show the knowledge of categories, principles, or relationships between elements</td>
<td>Relate multiple principles to each other</td>
<td>Relate multiple communities to each other</td>
</tr>
<tr>
<td>Interpret principles</td>
<td>Identify multiple themes</td>
<td>Identify multiple dimensions</td>
</tr>
<tr>
<td>Explain a procedure, techniques, or methods</td>
<td>Predict or project the future</td>
<td>Predict or project the future</td>
</tr>
</tbody>
</table>

RESULTS

CHANGES IN COGNITIVE LEARNING FROM PRE- TO POSTSEARCHING

ANALYSIS OF PERCEIVED LEARNING EXPERIENCE (POSTSEARCH)

| Learning School of Information |
|-------------------------------|-----------------|
| HIGHER COGNITIVE LEARNING     | 60%             |
| LOWER COGNITIVE LEARNING      | 10%             |
| NO CHANGE                     | 30%             |

ANALYSIS OF PERCEIVED LEARNING AND SEARCHING OUTCOMES (POSTSEARCH)

<table>
<thead>
<tr>
<th>Learning Level</th>
<th>Productivity</th>
<th>Development of new ideas or perspectives</th>
<th>Exploration of relationships among concepts</th>
<th>Ease of system usability</th>
<th>Cohesion of information</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGHER COGNITIVE LEARNING</td>
<td>66.2</td>
<td>71.9</td>
<td>71.8</td>
<td>65.7</td>
<td>62.1</td>
</tr>
<tr>
<td>LOWER COGNITIVE LEARNING</td>
<td>67.1</td>
<td>72.2</td>
<td>70.9</td>
<td>65.9</td>
<td>62.2</td>
</tr>
</tbody>
</table>

KEY TAKEAWAYS

- Adapted Bloom’s Revised Taxonomy to assess learning in web search.
- Demonstrated occurrence of learning from pre- to post-search written summaries.
- Intrinsically Diverse Queries increased searchers’ perceived learning and searching outcomes.

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