Understanding Web Search via a Learning Paradigm

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ABSTRACT

Investigating whether one can view Web searching as a learning process, we examined the searching characteristics of 41 participants engaged in 246 searching tasks. We classified the searching tasks according an updated version of Bloom's taxonomy, a six level categorization of cognitive learning. Results show that *Applying* takes the most searching effort as measured by queries per session and specific topics searched per sessions. The lower level categories of *Remembering* and *Understanding* exhibit searching characteristics similar to the higher order learning of *Evaluating* and *Creating*. It appears that searchers rely primarily on their internal knowledge for *Evaluating* and *Creating*, using searching primarily as fact checking and verification. Implications are that the commonly held notion that Web searchers have simple information needs may not be correct. We discuss the implications for Web searching, including designing interfaces to support exploration.

Categories and Subject Descriptors

H.3.3 [1] Information Search and Retrieval – *Search process*.

General Terms

Experimentation, Human Factors

Keywords

Information searching, Bloom's Taxonomy

1. INTRODUCTION

A common paradigm for analyzing Web searching is problem solving or decision making. Much information and Web searching research is intertwined with this view of searching as a decision making process. However, there is little empirical evidence supporting the relationship between information searching and problem solving [3]. We therefore explored other possible paradigms in which to view Web searching namely as a learning activity. In the following, we present a brief literature review, research questions, preliminary results, and implications for future Web searching systems. We conclude with our upcoming research aims and directions.

2. REVIEW OF LITERATURE

There is information searching literature that refers to an on-going learning process while a person is engaged in information searching. However, there has been little research into how or

even if learning explicitly manifests itself in the searching process.

Bloom's Taxonomy may be a method for investigating Web search as a learning process. Bloom's Taxonomy is a primary classification of learning in the cognitive domain [2]. An updated version, Anderson and Krathwohl's Taxonomy, redefined Bloom's original classification [1]. Anderson and Krathwohl's Taxonomy is a six-tiered model for classifying learning according to cognitive levels of complexity.

3. RESEARCH QUESTIONS

Our research question is: *Is a learning paradigm effective for analyzing information searching?* In order to analyze this question, we used Anderson and Krathwohl's re-design of Bloom's taxonomy of learning in the cognitive domain to develop searching tasks for each of the six taxonomy's categories. We then analyzed the exhibited searching characteristics to detect if there were differences in exhibited searching behavior.

4. METHODS

We devised searching scenarios for each of the six levels of Anderson and Krathwohl's Taxonomy, with each scenario correlated to one of the classifications. The scenarios were pilot tested twice before we used them in the laboratory study. The six classifications with definitions [1, p. 67-68] and searching scenarios are shown in Table 1.

Over the course of a week, 41 participants engaged in a laboratory study. Each participant engaged in six searching scenarios and instructed to address the scenarios, verify their answers. Each participant had access to an individual computer with Internet access. All user interactions with the computer were logged using a non-inclusive logging software package. We analyzed participant interactions in accordance with standard characteristics of information searching using transaction log analysis as the methodological approach.

5. RESULTS

We investigated whether or not there would be a significant difference in (1) the *number of queries* and (2) the *number of topics per session* among the classifications in Anderson and Krathwohl's Taxonomy. A topic is the information focus of one or more queries. A searching session may have several topics.

Using a one-way ANOVA, our results indicate that there is a significant difference among the groups $(F(5) = 4.175, p < 0.01)$ in terms of queries per session. *Applying* was significantly different then the classifications of *Remembering*, *Understanding*, *Analyzing*, and *Evaluating* $(p < 0.05)$. *Applying* was not significantly different in number of queries per session than *Creating*.

| Table 1. Anderson and Krathwohl's Taxonomy with Searching Scenarios		
Classification	**Definition**	**Scenario**
Remembering	Retrieving, recognizing, and recalling relevant knowledge from long-term memory	List 5 movies directed by Steven Spielberg.
Understanding	Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining	Give a brief plot summary of the TV show, Veronica Mars.
Applying	Carrying out or using a procedure through executing, or implementing	What are some possible characteristics of a person who would enjoy trip-hop music?
Analyzing	Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing	A certain television show contains intense violence and coarse language. Which rating should it receive?
Evaluating	Making judgments based on criteria and standards through checking and critiquing	Create a list of pros and cons for the new iPod Shuffle. Based off of this, would you purchase it (assuming you had the money)? Why or why not?
Creating	Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing	Which do you think will have better overall sales -- the XBox 360, the Nintendo Wii, or the Playstation 3? Why?
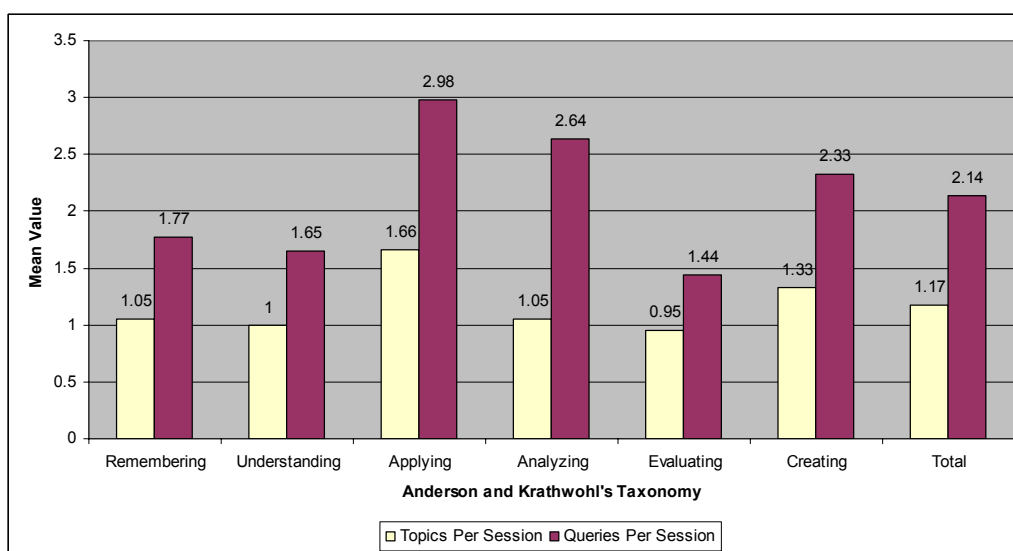
Figure 1. **Queries per Session and Topics Per Session.**

Concerning topics per session, an ANOVA analysis indicate that there is a significant difference among the groups ($F(5) = 6.869$, $p < 0.01$). *Applying* was significantly different then the classifications of *Remembering*, *Understanding*, *Analyzing*, and *Evaluating* ($p < 0.05$). *Applying* was not significantly different in number of topics per session than *Creating*.

6. CONCLUSION

Searching as learning is an appropriate paradigm to view Web searching. The implications of this study are that commonly held notions of Web searchers having simple information needs may be incorrect. Simple searching expressions may be supportive of higher-level information needs at the *Evaluating* and *Creating* levels of learning. With this view, the goal of systems design shifts to one of not closing this uncertainty too quickly but instead accommodating exploring and formulating. We consider this an exploratory study to investigate whether learning is an appropriate paradigm to study Web searching. Along with further analysis of the existing date, we aim to conduct larger scale studies from to focus on required system design changes.

7. ACKNOWLEDGMENTS

8. REFERENCES

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