Connecting with Educators: Science Teachers and Interactive Video Retrieval

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Abstract
Given the prevalence of digital resource use in education, it is critical to understand teachers' interactions and perceptions when retrieving digital video for instructional purposes. The overarching objective of the present study was to examine how user-centric measures varied between different groups of science teachers, formed on certain user characteristics. An experimental methodology, including a set of interactive search experiments with actual users, was employed to explore these research objectives. Findings showed influences in interactive video retrieval tied to user characteristics, such as gender, age, and educational context. Examining teachers' use and perceptions of digital video provides system designers and information professionals understanding that can contribute to more effective resources.
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1 Introduction and Review

Interactive video retrieval is an area of research that examines how users dynamically need, seek, and select digital video while interacting "in the loop" with user interfaces to video retrieval systems. A variety of defined domains and contexts have previously served as the basis for interactive visual information retrieval experimentation. Huurnink, Hollink, van den Heuvel, and de Rijke (2010) examined system logs from a large audiovisual Dutch cultural heritage digital archive to assess how media professionals searched content. Christel (2007) utilized both experimental and qualitative methods to investigate exploratory searching, video summarization, and browsing using professional situation analysts.

Digital video, as a learning resource, enriches student learning by enabling students to comprehend, visualize, and explain difficult concepts, otherwise difficult to portray in the classroom (Barker, 2010; Mardis, 2009; Perrault, 2007). Yet, a majority of teachers agree that it is difficult to find needed resources (Common Sense Media, 2013; Mardis, ElBasri, Norton, & Newsum, 2012). Given the quantity of digital video available online and use in education today, it is important to understand teachers' perspectives and interactions when retrieving digital video that fulfill instructional needs.

2 Research Questions

The overarching objective of the present study is to examine how the interactions and perceptions of science teachers varied between different user groups, based on certain demographics, in a video retrieval context. User-centered factors as part of interactive video retrieval research warrant examination, as the interactive process involves needs, actions, and assessments that can be supported by different features and influenced by contextual factors. This study is an exploratory analysis with the primary research questions:

RQ1. Are there variations between different groups of science teachers when interacting with science educational video using an experimental video retrieval system?
RQ2. What are the variations among the perceptions of an experimental video retrieval system, in terms of its ability to support educational needs and tasks, between different groups of science teachers?

3 Methodology

These research questions were examined using an experimental methodology comprising a set of interactive search experiments with actual users. K–12 science education was the experimental domain, and the target audience included future science teachers and current or former teachers who, at one point, taught science as a subject. The end result was a user pool of 28 unique users, consisting of 23 former or current science teachers and 5 upper-level science education majors, each performing a full search experiment.

A pre-experiment questionnaire was given to collect preliminary information, including age group, gender, and primary grade level taught. Based on responses of the pre-experiment questionnaire, researchers were able to form different user groups based on these demographics to examine the research questions. A prototype video retrieval system designed to retrieve video clips from the *NASA K–16 Science Education Programs* was used for the study. The NASA collection comprised several series including *NASA Connect*, *NASA SciFiles*, *NASA Why?Files*, and *Destination Tomorrow* with production dates ranging from 2000-06. The interface features enabling different types of search and browse, as measured for the present study, are included in Table 1. Each user completed six experimenter-developed search topics, which accurately reflected actual needs of science teachers based on assessment through a pilot study. Sequencing of the search topics was precise, each being given equally in every position in the rotation in order to prevent skew. The experimental design reflected that of prior years of the TRECVID interactive search task.

In order to examine RQ1, the researchers monitored the search experiments, and all measures as reported in Table 1 were manually recorded and also captured through system logs. RQ2 was assessed after each attempted search topic through a "post-search" questionnaire where users to rated (1-5) satisfaction with the measures in Table 2. *T*-tests and ANOVA tests were used to compare all of these measures between different user groups of science teachers.

Keyword searching	**Video title browsing**	**Search results page browsing**	**QBE (visuals)**	**Clip details requests**	**Number of user actions**	**Topic durations**	**Errors**	**Topic Completion**
Gender $t(110)=2.287$, $p<.05$	Not significant	*Gender* $t(166)=2.171$, $p<.05$	Not significant	*Age* $F(3,164)=3.24$, $p<.05$	Not significant	Not significant	Not significant	Not significant

Table 1. Mean comparison results among primary user interactions and the variations between the different user groups by age, gender, highest level of education, and grade levels taught.

4 Results

RQ1. Table 1 presents the mean comparisons that produced significant differences between the interactions across the different groups. First, variations by gender showed that female teachers searched by keyword significantly more (M=2.81) than males (M=2.11) and subsequently browsed further search results (M=2.17 compared to M=1.18). Results also demonstrated that the youngest user group requested more details about the clips on average than older user groups; Tukey post hoc tests showed that the 20 year old group requested significantly more details than those from users in their 30s and 40s, at (M = 1.421, 95% CI [0.22, 2.62]) $p < 0.05$ and (M = 1.321, 95% CI [.25, 2.39]) $p < 0.05$, respectively.

RQ2: A number of statistically significant differences occurred across various perceptions on the post-search questionnaire between age groups (Table 2). To briefly summarize the trend, older users rated certain aspects of the system and other experimental factors higher (where significant scores indicated in Table 2). The primary grade level taught was the other factor producing significant differences among users' perceptions, including perceived usefulness of visual searching and self-assessed topic completion. Elementary teachers rated these two measures on the post-search survey significantly lower than others.

	Ease of search	**Search results satisfaction**	**Usefulness of user interface**	**Usefulness of keyword search**	**Usefulness of visual search**	**Usefulness of video browse**	**Self-assessed topic completion**
$F(3,164)=$	*Age* 6.45,*p<.01*	*Age* 7.36, *p<.01*	*Age* 4.17,*p<.01*	--	*Age* 6.15, *p<.01*	*Age* 9.40, *p<.01*	*Age* 9.28, *p<.05*
$F(3,164)=$	--	--	--		*Grade taught* 6.49, *p<.01*	--	*Grade taught* 8.46, *p<.01*

Table 2: ANOVA tests of users' post-search perceptions and the variations between the different user groups by age, gender, highest level of education, and grade levels taught.

5 Discussion and Implications

Understanding teachers' interactions when seeking digital video provides insights for system developers, interface designers, and information professionals on how to better support the needs of K-12 educators. Results of this study showed several variations among different groups of science teachers in terms of how they interacted with a video retrieval system. Mean comparisons produced differences in search and

browse behaviors (Hupfer & Detlor, 2006; Singer, Norbisrath, & Lewandowski, 2012). Female teachers search by keyword more than males and are more thorough and persistent in browsing search results.

Also, users' expectations about the information needed in an interactive video retrieval process varied between age groups, with younger teachers requesting and viewing more information about video clips than older teachers. As younger teachers enter the profession, they demonstrate different expectations, tendencies, and preferences when seeking information, such as the expectation of instant access and understanding of information (Taylor, 2012). The differences in terms of the users' requests for clip details reflect similar findings from prior research from an interactive information retrieval context which motivate further research about how to best present video information, specifically, to teachers throughout an interactive process (Barker, 2010; Singer et al., 2012; Taylor, 2012). Developers can utilize these findings to evaluate features across a range of searching fluencies and experiences in order to develop search and display options for users.

The context, in this case science education, is an important factor to consider in examining the perceptions of teachers, as their information needs and tasks are specific to instructional purposes (Barker, 2010). Researchers can help design more useful retrieval systems that can be tailored to address educators' needs and expectations. Research finds that educators underutilize digital video systems to find instructional resources, even though they are aware of the importance; this illustrates that teachers are in need of professional development instruction for locating and identifying digital content, including videos, to enhance student learning (Common Sense Media, 2013; Diekema & Olsen, 2012; Mardis, 2009; Perrault, 2007). If systems are not taking into account users and their context, there can be a mismatch between the needs of the user and their ability to find usable video from a collection, which will lead to low perceptions and thus further underuse of digital resources by teachers. Information professionals can connect with educators by taking into account varying perspectives of users in order aid and instruct teachers with locating and employing digital video to meet their instructional needs (Mardis et al., 2012; Perrault, 2007).

In conclusion, this research finds there are influences in interactive video retrieval across users interactions and their perceptions tied to the type of user in an educational context. Therefore, investigations of interactive video retrieval in this context are warranted, as science teachers are in search of quality, free, and up-to-date digital teaching resources to engage students.

6 References

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