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EXPLORING YOUNG CHILDRENS' WEB SEARCHING AND TECHNOLITERACY

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Abstract: Purpose – This paper reports findings from an exploratory study investigating the Web interactions and technoliteracy of children in the early childhood years. Previous research has studied aspects of older childrens’ technoliteracy and Web searching; however few studies have analyzed Web search data from children younger than six years of age.

Research Design - The study explored the Google Web searching and technoliteracy of young children who are enrolled in a ‘preparatory classroom’ or kindergarten (the year before young children begin compulsory schooling in Queensland Australia). Young children were video- and audio-taped conducted Google Web searches in the classroom. The data was qualitatively analysed to understand the young childrens’ Web search behaviour.

Findings - The findings show that young children engage in complex Web searches, including keyword searching and browsing, query formulation and reformulation, relevance judgments, successive searches, information multitasking and collaborative behaviours. The study results provide significant initial insights into young childrens’ Web searching and technoliteracy.

Implications - The use of Web search engines by young children is an important research area with implications for educators and Web technologies developers.

Originality/Value - This is the first study of young childrens’ interaction with a Web search engine.

Keywords: Web search, young children, Google

Article Type: Research paper

INTRODUCTION

As the Web continues to be used by increasing numbers of people world-wide, we are accumulating much scientific information about peoples' Web searching (Spink and Jansen, 2004; Spink and Zimmer, 2008). We know that children use the internet and interact with Web search engines. Today's generation of children were born into a world of digital technology and the Internet, leading some writers to describe them as the "net generation" (Tapscott, 1998) or 'digital natives' (Prensky, 2005). Households with children are more likely than others to have Internet access, with three-quarters of Australian households with children under the age of fifteen with an Internet connection (Australian Bureau of Statistics, 2006). Studies show that children as young as three have the technical competency to use computers and the Internet (Calvert *et al.*, 2005). The use of the Internet and Web search engines by young children is an important research area with implications for educators and Web technology developers.

However, despite the focus on the digital world of today's children, limited research has explored Internet use by young children (Buckingham, 2000). Few studies have examined young childrens' technoliteracy and their interaction with Web search engines. Little is known scientifically about how the Internet impacts on the daily lives of young children. This paper presents findings from a study addressing the research gap in our understanding of young childrens' Web searching. This interdisciplinary research draws upon studies and approaches from early childhood education and information science. The study produced interesting and important findings that have formed the basis of further research. In advancing the knowledge and understanding of young children's Web searching we hope to stimulate further research in this area.

The next section of the paper reviews the previous research literature on children and the Internet. The paper then provides the research questions, research design and findings from the study.

RELATED STUDIES

Childrens' Web Searching

Previous studies highlight the benefits of computer use for children's literacy and social, cognitive, and language development (Clements and Sarama, 2003; McCarrick and Li, 2007). However, these studies focus on the effects of computer and Internet use, rather than on children's everyday experiences. Descriptive accounts of children's use of Web technologies, the studies are limited to children older than six years or are an assessment of a specially set-up 'technology' lab or classroom (Hyun and Davis, 2005), or particular Web portals, Websites or interfaces (Nir-Gal and Nur, 2003; Pelletier, Reeve and Halewood, 2006). Limited studies have examined the everyday use of the Web searching by young children under the ages of six or seven (Turbill, 2001).

Our study addresses the critical need to investigate young children's sites of experience for Web searching in the pre-school context. The study draws on understandings that children actively and competently manage their social interactions with one other and with adults (Danby and Baker, 1998; 2000; James, Jenks and Prout, 1998). This is a particularly useful construction given the body of literature that points to children, even young children, using Web technologies if they have the opportunity (Calvert *et al.*, 2005). Despite the rapid increase in children use the Internet at younger ages (Wartella, Vandewater and Rideout, 2005), children under the age of six are often excluded from studies of children's Internet use. There is limited data on how children in this age group use Web search engines. Our study offers an empirically based account of Web searching by young children.

The most comprehensive research of young children survey studies of media use by children aged between six months and six years (Marsh *et al.*, 2005; Rideout and Hamel, 2006). Some 25-30% of children under the age of six use the Internet at home in the UK and USA, with the most popular Websites related to television programmes (Marsh *et al.*, 2005). A recent Australian survey of children's leisure activities, including Internet use, collected data from children over five (ABS, 2006), and a large study on Internet use in Australian homes only included children aged eight to thirteen (NetRatings, 2005). Children's Internet

use was examined in the United Kingdom (Facer *et al.*, 2003; Holloway and Valentine, 2003; Livingstone and Bober, 2004) but the children were over nine years of age. Downes (2002) included children as young as five in studies of computers in Australian homes, but the report does not specify younger childrens' usage.

Recent information and communication technologies (ICT) studies of early childhood education have focused on computer software use and 'new technologies' such as programmable toys and interactive whiteboards (Hayes and Whitebread, 2006). In the 1980s and 90s, ICT studies were about computers and various new technologies emerged. Studies examining young children's computer use and interaction in the classroom are largely restricted CD-ROMs use, including educational and creative programmes and games. A recent review of research into computers in early childhood settings barely mentions the Internet or Web (Yelland, 2005).

Some studies have discussed the potential of the Internet to benefit children in early childhood settings (Downes, Arthur, Beecher and Kemp, 1999; Gerzog and Haugland, 1999; Skeele and Stefankiewicz, 2002). Rather than report empirical research, these studies were discussions of age-appropriate Websites and Internet resources. Other studies aimed to assess or document cases of Internet use by presenting case studies of particular Web programs, interfaces or specific classroom projects (Hyun and Davies, 2005; Nir-Gal and Nur, 2005; Pelletier *et al.*, 2006; Turbill 2001; Yost, 2003).

Descriptions of children's everyday Internet use in preschool contexts are brief and offer little detail (Stephen and Plowman, 2003). While a small proportion of young children use the Internet to play games or Web searching (Marsh *et al.*, 2005; Plowman and Stephen, 2005), we know little about the specifics of that game playing or Web searching. Young children use the Internet at home and school is to find information (Marsh *et al.*, 2005) and yet research on *how* young children use the Web to find information is not evident.

Research has explored Web searching by older children and young people, mainly over the age of ten (Abbas, 2005; Bar-Ilan and Belous, 2007; Bowler *et al.*, 2001; Chen, 2003; Enochsson, 2005; Holmes, *et al.*, 2008; Hutchinson *et al.*, 2007; Kuiper *et al.*, 2005;

2008; Large, 2005; Large *et al.*, 2002, 2005; Madden, *et al.*, 2006; Raqi and Zainab, 2008; Scott and O'Sullivan, 2005; Sloan, 2003). Studies of older children highlight what children do when looking for information and web searching (Bilal, 1998, 2002; Bilal and Kirby, 2002; Cooper, 2002, 2004, 2005). In many studies children are asked to perform specific Web searches and use Web search engines designed specifically for children, such as Yahoo!igans. While these studies of older children show they prefer to browse rather than querying a Web search engine, the Web searching behaviours of young children are not known.

Some studies examined the developmental issues related to the Internet (Baumgarten, 2003; Yan, 2005). Younger children are not included in these studies, possibly because children under six often have developing reading and writing skills. Young children's ability to engage with hypertext, icons, etc shows their emerging multiliteracies and further research is needed examining how children develop their multiliteracy. To understand younger children's Web searching, we cannot extrapolate from studies of older children and treat them merely as 'less competent' children. We need to examine the unique competences of younger children as Web users in their own right.

Technoliteracy

The term "technoliteracy" is most often by researchers in reference to children's everyday technology engagement – often with home DVD players, stereo's, mobile phones, computer games, etc (Hill and Broadhurst, 2002). Technoliteracy is also related to the notion of a "technically literate generation" (Marsh, 2004, 2005). The term "digital literacy" often refers to the skills and practices demonstrated in technology use. Digital literacy is a term used in education studies and technoliteracy more common in cultural/media studies. The major themes of digital literacy research are literacy level measurement and how literacy is learnt (Kuhlemeier and Hemker, 2007). The notion of multiliteracies is used in discussion of technology use (Lee and O'Rourke, 2006). However, the literacies concept in information technology and the Internet is underdeveloped. The notion of "information literacy" has little

literature on how the concept applies to young children. Cooper's (2004) work on childrens' understanding of library classifications and use of information in books is the closest (most children in the study being seven or older and with some reading skills).

In summary, limited studies have examined Web use and technoliteracy by young children.

RESEARCH OBJECTIVES

The broad aim of our research is to:

- Investigate young childrens' Web interactions as lived experience at home and in the classroom context;
- Increase fundamental knowledge of young children's Web searching and information behaviour in their daily lives;
- Develop models for curriculum and research direction in Web interaction and information behaviour for use in education contexts.

The specific objective of the study reported in this paper is to:

- Explore young children's Web searching in the preparatory year classroom context.

We are conducting further studies in both the classroom and home context for young childrens' Web interactions.

RESEARCH DESIGN

Data Collection

Study Participants

The study reported in this paper included one classroom of twelve children in a Preparatory Year Program (Prep) class located in Brisbane, Australia. The Prep Year Program includes young children aged between five and six years of age, and is designed to help children make the transition to Year 1 or Kindergarten. The Prep class in this study included young children from a mixed demographic background of lower and middle income

neighborhoods. The Prep curriculum aims to make connections between the children's prior experiences in preschool and childcare, home and school.

The Prep classroom is situated within an elementary school and follows the timetables of the usual school day. Each classroom includes two computers with Internet connections situated on a low table beside one another against a wall by the classroom front door. Each Prep classroom computer had at least two chairs placed in front (and more as needed). During our study the computers were used for the childrens' work on Prep class projects that followed the children's interests. The children in the Prep class also had computer classes run by the Primary School information technology teacher that were held in a computer laboratory using networked computers, Word, PowerPoint and Paint, but not Web search engines.

Ethics Permissions

We obtained ethics permission to conduct the research from the Queensland University of Technology University Human Research Ethics Committee. Informed voluntary consent was also obtained from the participating school and teachers, study participant parents and children. Information sheets and consent forms were provided to the school principal, teachers and teacher aides, and parents and children involved in the study. Each child received an information sheet with pictures that parents read through with them, and the children ticked a box and wrote their name if they wanted take part in the study. Consent for study participation was received from thirteen of some seventeen young children. In one case, parental consent was given but the child did not want to participate and indicated this on the consent form. Parents were given the option of having the visual records distorted to ensure anonymity in presenting the data and this option was taken up by one parent.

Classroom Activities

The twelve children in the study were video and audio recorded in the classroom over a week when using the classroom computers for Web searching on class projects. In the Prep class children choose computer interaction or other activities such as painting or puzzles. In total, nearly four hours of video and audio taped recordings were collected. The

researcher was invited into the classroom between lunch and second break period (noon until 1.30pm) on three days over the course of a week. During this time the children could Web search on class projects or engage in other activities such as wooden blocks and puzzles. Teacher aide support was available during this period.

The children were doing a class project, and were discussing and making posters about environmental issues. Each child had proposed a message they wanted to show on a poster ranging from “Don’t Be a Litterbug” to “Don’t Chop Down Trees”. Some children were designing and illustrating these posters or using the Google Web search engine to find information to help them create their posters. The teacher worked to establish who would be doing what activity and also invited students to Web search. To avoid computer access crowding by the young children, each day one child was invited to Web search, but other children came to observe this computer use or to use the other computer. The children were to a large extent free to take part in Web searching if they chose and equally free to opt out of Web searching if they preferred.

Video-Recording

Video-taping was used to record the Web searches conducted in the Prep classroom to capture the children’s interactions as the computer screen and Web search activity. Few studies have provided empirical observations of the everyday Web searching experiences of young children in classroom contexts. The researcher Dr Carly Butler visited the classroom at times suggested by the teacher when children had the opportunity to Web search.

Dr Butler used two video-cameras to record the childrens’ interactions with the computer. One video-camera was placed behind the computers to capture the students’ faces, and another camera was handheld to capture the on-screen activity, keyboard and mouse actions. In addition, an audio recorder on the computer desk captured the children’s talk over the background classroom noise. Each Web search session lasted just over one hour and was recorded in its entirety. The video-recordings show children working alone or with other children, and with the teacher and teacher aide sometimes at the computer. Within the classroom context, the software program Camtasia was used to capture the Web

searching, including the screen and search pathways. This data collection, in combination with the video records of children's interaction, created a rich corpus.

Data Analysis

The video-recorded Web search and audio-recorded verbal data were qualitatively analysed by the researchers. Drawing on sociological understandings of childhood and ethnographic description, this study works from a theoretical position that children engage in interpretative competence of their worlds (Cromdal, 2008; Hutchby and Moran-Ellis, 1998; Mackay, 1991). This approach aims to understand how children learn how children enter into, and participate in, Web searches by examining their practices in situ.

The video recorded data were coded by Butler and Spink to identify key aspects of the childrens' Web searching, including instances of query formulation and reformulation, and other Web search behaviours identified in other Web searching studies such as multitasking, successive searching, relevance judgments, etc (Spink and Jansen, 2004). Video coding, and conversation analysis and membership categorization were used to identify the categories that people invoke in their descriptions and interactions in relation to Web searching and to "make sense of people and events" thorough their interactions (Silverman, 1998, p. 88).

This paper reports results from the classroom data analysis exploring aspects of the children's interactions with the Google Web search engine.

RESULTS

Young Childrens' Web Searching

The study participants used the Google Web search engine on Days One and Two to primarily seek and use visual information. On Day Three they searched Google for answers to questions and searching for games. The study data showed that the young children engaged in the following behaviours previously identified in Web searching studies, including browsing and using keywords, creating and reformulating queries, making relevance

judgments, conducting successive (related) Web searches over time, and engaging in multitasking and collaborative behaviour. Our results provide significant insights into the Web search behaviour of young children.

The section below provides examples of each aspect of the children's' Web search behaviour.

Creating Web Queries and Spelling

The young children were not fully literate in the English language and had emerging spelling skills. However, our study participants created Web queries and read the words they recognized on the computer screen. Entering the Web search queries was one of the most time consuming aspects of their Web searching as the young children had an emerging level of spelling skills. In most instances the teachers encouraged the young children to have a go at writing the words and using their developing skills in sounding out words phonically during their Web searching.

For example Student 5 attempted to type the words "endangered animals' and, with the teacher's help, entered "ndanged anemls". This episode is a good example of conventional literacy practices being worked into the young childrens' Web searching. The consequences of spelling practices are however quite different when entered into a Web search engine. As the teacher aide explained after Student 5 entered "ndanged smemls" – "This is going to be tricky, we're gonna look for this one but I know we're – the computer might not understand exactly how we spelt it but we tried to sound it out we did a really good job so press on this search there and let's see what it comes up with and if it might say we didn't spell it the right way so we can try again". When the results screen came up it asked, "Did you mean: endangered animals?".

The teacher aide then explained this to Student 5 saying "Do you know what? The computer (said) that what we looked for, it didn't quite match but it thinks that that what these words and this word actually are the ones we want. It spelt it the right way for us. So it says did you mean endangered animals and we did didn't we?" So we can click on those blue letters.

Browsing

Studies of older children's Web searching emphasize their preference for Web browsing over creating Web queries (Large, 2005). This was a result we also expected to find with the younger children. We did observe the young children engaging in browsing behaviour. For example, during a Web search about "endangered animals", two children browsed the search results and followed various navigational links. While browsing, Student 2 showed Student 1 how to scroll down the screen and go to different pages of Web results. However, unlike to studies of older children, we observed the younger children creating Web queries in addition to browsing, including query formulation and reformulation.

Query Formulation and Reformulation/Advanced Search Features

Many studies have been conducted into Web formulation and reformulation by adults (Spink and Jansen, 2004) and older children (Bilal, 1998; Bilal and Kirby, 2002). Research shows that most adult Web searching includes 2-3 queries per Web search and 2-3 words per Web query with limited use of advanced search features or lengthy query reformulation (Spink and Jansen, 2004).

We observed instances where young children formulated and reformulated Web queries and entered them into the Google Web search engine. Two examples are documented below.

Example 1

When an appropriate answer to a question query "how does a speedgun work" was not found in the retrieved Websites, Student 6 suggests rewording the question query to another, more refined question query:

Student 6: Maybe it does () Maybe what does the speed gun worked?

Teacher: So you think maybe we need to change the question?

Example 2:

Student 6 suggested a query reformulation as the teacher suggested that they should just try again tomorrow as they would need to find another Website. While the teacher suggests abandoning the Web search, Student 6 persists by suggesting a query

reformulation. Another example of this is when the teacher asked the two children sitting at the computers what they want to search for, and they formulate their own questions verbally first. For example, a teacher asked two students what they wanted to search for next. Student 1 suggests 'what eats crocodiles', and Student 2 suggests 'what do tadpoles eat'. Student 1 next suggests 'what do puppies eat', but then watches as Student 2 searches for "what do tadpoles eat?".

Relevance Judgments

Relevance and relevance judgments, including the criteria for and levels of relevance judgments, are a major area of research within Web studies (Spink, Greisdorf and Bateman, 1998; Spink and Jansen, 2004). Relevance judgments have been observed in many studies as searchers make judgments on the information they retrieve from Web search engines. In our study we observed the young children making judgments and talking about their relevance judgments related to the relevance of retrieved items during their Google Web searching.

Example 1

For example, after entering a Web query related to endangered animals, Student 1 touches the screen and points to an image saying "go on that one that's a really good one". This statement reflects that the young child was making a cognitive relevance judgment and had decided to give the retrieved item a high level of relevance to the information problem. Student 2 then clicked on the retrieved picture of a donkey.

Example 2

In another example, when one student was made aware that another student was doing a poster on whales, she realized the relevance of some of her earlier Web search results and scrolled back through the pages to find pictures of whales that would be of relevance to the other student. This example reflects the association skills of the child to relate their retrieved information to the information needs of the other child for pictures of whales.

We are only beginning to understand the cognitive abilities of young children during Web searching. Cognitive abilities, such as relevance judgments, are an important element of any theoretical models of young childrens' interactions with search technologies.

Information Multitasking

Multitasking is the human ability to handle the demands of multiple tasks. Multitasking behaviour involves the ordering of multiple tasks and switching between tasks. Studies show that people often multitask when using Web search engines as they seek information on more than one information problem over single or multiple search episodes (Spink, Ozmutlu and Ozmutlu, 2002; Spink, Park and Jansen, 2006; Spink, Park and Koshman, 2006). While Facer *et al.*, (2003) describe multitasking activity during Web searches by an older child, limited studies have examined if young children engage in information multitasking during their Web searching. in our study we observed young children engaging in multitasking behaviours.

Example 1

For example, Student 4 wanted to enter the Web query – “how does a speed gun work”, but instead enters the query “how does is a sdee”. Student 4 then decides to switch his search topic serendipitously to find out how many zeros infinity has. He types “Haw men e zrooz does infindhv”. The teacher then corrects his spelling in the Web query.

Example 2

Other examples of multitasking include a child paying attention to what was happening on the other computer screen while working on their own computer. Also, the young children displayed the ability to switching between different tasks such as the information on the screen and telling stories about their experiences (e.g. seeing dolphins with one's family), or being asked questions by a teacher.

Successive Web Searching

The study of successive searching, or users' searches in digital environments over time, related to the same or evolving information problem, is developing as an area of research. A growing body of studies is beginning to investigate and characterize aspects of

the successive searching process (Spink, Bateman and Greisdorf, 1999; Spink, Wilson, Ford, Ellis and Foster, 2002). We observed two students conducting the same search on two different days, and the same results were coming up. Most of the Websites retrieved and visited on Day Two had been retrieved on Day One.

Collaborative Behaviour

Analysis of the videotaped data reveals instances where the young children collaborated with each other on their Web search tasks.

Example 1

For example, Student 1 and Student 2 turned on the computers and logged in. Student 1 asked Student 2 for help/advice on the security settings. Student 1 then helps Student 2 spell “prep” to logon. Student 2 asks Student 1 “what do I do?” and they help each other to create Web queries. Similar to the day before, the two students start to search for images of endangered animals on Google. The two students talk about what pages and images they saw yesterday. One student explains to the other that each Google result page (represented by numbers at the bottom of each page) was a “different level”. Another student shows another the ‘back’ button in the browser.

Example 2

In another example, Student 2 first enters the query with the teacher. Then, with Student 1, the two collaboratively browse and analyse the results. Student 1 points to an image and they visit that Website. When they return to Google Image results – Student 2 is controlling the mouse. Student 1 suggests that they go “back and back and back”. Student 2 clicks back and then scrolls up to the top of the results page. Student 1 half stands to point to an image of a whale at the end of the first row and says “whales!”. Student 2 has her cursor on the first picture in the first row – also of a whale, and the first image she had clicked on in this search. She says “we’ll go on this one first”. She clicks on this image. As the page starts loading Student 2 lets go of the mouse and sits back in her seat. As a large picture of a whale’s tail appears on the screen, Student 2 looks at Student 1 with a little smile on her face.

Managing Web Search Results

The young children engaged in processes to manage the results they retrieved from the Web search engine. After entering a Web query and, if necessary, clarifying the “meaning or intent” of the Web search, the next step by the young children was to select a results page. Web searching for images was straightforward as the young children showed that they could simply click on a picture to bring up a Webpage. In this sense the young children selected Webpages on the basis of what images interested them and their relevance judgments. However, it was different with text-based Web searches as the young children were faced with a Webpage of text. They entered Web queries, clarified the meaning or intent of the Web search, and selected Websites to view.

The young children knew to click on the “blue words” to access a Webpage or use the “back arrow” to access a previous Webpage. They also often scrolled several Web results pages. It was a matter of knowing which of those blue words would take them to an interesting Website. When the teacher was present she would sometimes look through the results and tell the students which one to click. The young children were also observed selecting their own click choices. Often the Web search engine presented them with the “STOP” sign as the Website was blocked by the school’s security setting. The young children were also interested in scrolling not just within a page of results in Google Image, but in several pages of image results.

For example, on Day Two Students 7, 8 and 9 managed the search results after they entered a Web query. They were interested in the different ‘levels’ of the search results pages. Going quickly through the results pages they engaged in some of the highest levels of visual attention and engagement with the Google Web search engine. Once the students found an image that interested them, they clicked on the link. They would scroll down until they found the image they had initially clicked on and then returned to the results page. Often they might show the image to another student, share “Websites” with other students or state that they had seen the image before in a previous Web search. Blocked Websites would engender laughter and non-blocked Websites some excitement. On one Website they found

the graphic image of a computer game. However, when trying to click on the computer game Website they were met with a “STOP” sign. They were able to successfully interpret icons while managing their Web search results.

Young Childrens' Understanding of Web Searching

The young children’s Web search activities varied from day to day. They had a sense that the Google Web search engine served as a big “answer machine” that could answer anything. The young children viewed “false drops” as human errors on their part rather than the limitations of the Internet. Over the Web search sessions the young children’s Web search skills were being developed. The young children approached the Web search engine as inquirers and problem solvers. Despite their frustration with spelling, they enjoyed doing the typing, helping each other, findings things and showing that they could remember which words or letters to use.

Teacher – Student Interactions

There were differences in the teacher – student interactions across days, and between teachers and students. The interplay between students, teachers and the computer flowed from Web search topic to Web search topic – from crabs to dolphins to whaling and speed guns.

The computer area was much quieter and restrained when a teacher was present. The students expected that the teacher would sometimes tell them what Websites to visit and they would sit and wait. However, the students also used their own initiative to select Websites when lots of clicking was apparent. The teachers did encourage the students to engage in a higher level with the Website than the student would do independently. The teachers stimulated the children by asking questions, explaining the text and scaffolding their understanding of Websites and their Internet use in general.

Young Childrens' Technoliteracy

The young children who participated in our study previously had computer/information technology lessons with a specialised teacher once per week in a computer laboratory. Here they used networked computers and learnt about using program such as Word, Power Point and Paint. Thus the children had some skills through their participation in this formal teaching. At times the teachers would make reference to these computer classes and the skills developed through them in the course of the young children's Web use. In an interview with the teacher, the teacher referred to the experiences of the young children brought from their homes and older siblings.

The young childrens' 'technoliteracy' was observable in their competent use of the mouse to move the cursor and the point and click, through scrolling, clicking in boxes, finding the keys, the use of the enter button, recognizing a hyperlink, and so on. This technical competency was in many ways precursory to other competencies used during Web use. In addition to their formal training put into practice, the young children also were observed being taught and learning more technical skills while they were using the Web.

For example, on one occasion a teacher aide showed a child that, in addition to using the scroll bar to scroll down the page, they could also use the down arrow at the bottom of the scroll bar. When it came to altering Web search queries (e.g., changing "what do crabs eat" to "what eats dolphins"), a teacher reminded the children how to use the cursor and backspace to just change parts of the Web query rather than start all over again. Thus there was evidence of practical literacy being brought to, and developed through, Web use. This type of literacy is perhaps best described as "literacy about technology/the Web".

The next section of the paper interprets the key findings of the study.

DISCUSSION

Our study produced important findings and insights into Web searching by young children in a preparatory school context. Previous studies (Bilal, 1998; Bilal and Kirby, 2002) show older children preferred browsing and did limited querying. Our results show children

who are 4-5 years old interact with Web search engines by both browsing and creating Web queries. The young children also created Web queries in question format and reformulated their Web queries. The findings of our exploratory study show that young children were sometimes performing complex Web search interactions at the level of some adult Web searchers. The young children also used some cognitive abilities such as relevance judgments, multitasking, successive searching and collaborative behaviours, at the level of some adults Web searchers.

Our analysis showed that the young children were seeking information on complex information problems such as endangered species. In addition, the young children searched on multiple problems during a single search session or over multiple related sessions – successive searching. This information problem batching process included priority/ordering of information problems and was influenced by their level of personal interest and the classroom curriculum.

Technoliteracy

The young children's technoliteracy was observable in their competent use of the mouse to move the cursor and to point and click, through scrolling, clicking in boxes, finding the keys, using the enter button, and recognizing and navigating hyperlinks. They also exhibited many cognitive skills that are specific to Web searching and finding information. These skills are related to their information behaviors and level of information literacy. During the class, the young children were scaffolded by the teaching staff into using the Web search engine to find information. They created Web queries, but entering those Web queries was one of the most time-consuming aspects of the Web use as their spelling skills made this procedure difficult. In most instances, the teachers encouraged the young children to have a go at creating their own Web queries using their emerging skills in sounding out the words phonetically.

The Web search process in our study is an instance of the relationship between literacy and technology, and how this relates to young children's information behaviour. It

also demonstrates some practices through which the computer and its activities are described. Here the computer is constructed by the young children as some kind of mind-reading machine where it “thinks” about what the young children want, and interprets meaning from the young childrens’ spelling practices. Note the other instances of anthropomorphizing when the teacher says the computer “might not understand”, and the references to what the computers “says”.

Teacher – Student Interactions

Another interesting aspect of the young childrens’ Web searching was the differences between the presence and absence of the teacher during their Web search process. When the teacher was present, the young children were more constrained in their Web searching activities. The students appeared to be quieter and less competent in their Web searching in the teacher’s presence. By contrast, when two students were working alone without the teacher, there was more opportunity for them to display their competences, to “teach” another student. The teachers encouraged the young children to be independent and interactive searchers, and our observations confirm that different kinds of competences are required in the teacher’s presence and when working without the teacher. The degree to which young children at this age can develop competent searching behaviours without adult support is still open to further investigation. While some young children are able to work competently when the teacher is present, other young children, in the teacher’s absence, just sat and waited for the teacher to return if they felt stuck.

Findings from this study have implications for our understanding and modelling of young children’s Web search behaviours. Web search engines normally used by adults are being used by young children in more complex ways than often exhibited by some adults. The current study is in need of replication and expansion to help build cognitive models of young childrens’ interaction with Web technologies.

Although this study was conducted in Queensland Australia, we feel that the results are generalisable to most industrial countries where young children attend a class when

aged 4-5 years old. However, further studies are needed to replicate our study in other countries.

In addition, this study is an important beginning for understanding the level of information behaviour abilities displayed by young children. We have limited models of how information behaviour develops over a human lifetime (Spink & Cole, 2005). How young children differ in information behaviour abilities from older children, adolescents and adults is a major area of future research.

CONCLUSION AND FURTHER RESEARCH

The findings reported in this paper provide significant insights into the Web search behaviours of young children and form a strong basis for further studies. Young children do engage in complex Web searches beyond keyword Web queries, including more advanced cognitive abilities than previously thought. Their Web search behaviours appear to be different from the behaviours of older children. Further comparative studies are needed to more fully develop models of childrens' Web searching behaviour.

We are conducting further studies of young childrens' Web searching and information behaviours. Further research is critically needed to begin to fill out a more life-time view of how people's information behaviours develop and evolve. We are also currently conducting further analysis of the study results from a pedagogy perspective to determine implications for classroom practice.

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