

Information-Seeking Processes of Junior

High School Students: A Case Study of

CD-ROM Encyclopedia Use

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The purpose of this research was to examine the information-seeking processes employed by junior high school students from Inuvik, Northwest Territories, Canada when using CD-ROM encyclopedias. The study revealed that participants needed both instruction and practice to develop the skills and strategies needed for full-text searching of CD-ROM encyclopedias. The participants tended to use search terms only from the original question, had difficulty selecting topics and articles from the retrieved list, and did not read long articles as carefully as short articles. Instruction related to information-seeking skills and strategies should focus on generating search terms, selecting topics from a retrieved list, and skimming and scanning through text to find the answer.

Introduction to the Study

According to Chelton and Thomas (1999),

One of the challenges of teaching graduate students to work with children and youth in school and public libraries is to inform their approaches to instructional design and their understandings of how people use information technology through an examination of current research. The problems in so doing have been exacerbated by the scarce, fragmented, and sometimes flawed nature of past research in information and library studies dealing with youth issues in information seeking, (p. 7)

As a result, many teachers and teacher-librarians are unaware of the information-seeking strategies that will be most effective when using new technology, such as CD-ROM encyclopedias. Because such a large amount of information is available to students on a CD-ROM, the program in school libraries must deal with helping students recognize, select, and use information that most meets their needs (Baumbach, 1990). Schools and school curricula are being influenced by "the rapid development, application and uptake of interactive multimedia technologies" (Oliver & Oliver, 1996, p. 33).

This research examined the information-seeking processes that junior high school students at Samuel Heame Secondary School in Inuvik, Northwest Territories employed when using CD-ROM encyclopedias. In junior high, students' classroom work requires them to access much more information than at any time previously in their school career. Students at

this age can begin to gain some independence when searching for information. The study included junior high students with a range of experiences, academic abilities, knowledge of computers, and familiarity with CD-ROM encyclopedias selected by their core classroom teachers. The context in which the participants searched was explored through observations in the school and through interviews with the key informants in the school.

Review of the Literature

Information-Seeking

Many models to describe information-seeking behavior have been developed by researchers in various disciplines. Researchers have proposed several information-seeking models that have direct relevance to this study. Bates (1989) argued that her "berrypicking" model of information-seeking "is much closer to the real behavior of information searchers" (p. 407). This dynamic model stressed that real searchers, rather than finding information using one single search query, gather the bits and pieces of information in a "berrypicking" manner. Kuhlthau's (1983,1988,1991,1993) work presented another process approach to information-seeking. This Information Search Process (ISP) model included affective, cognitive, and physical aspects of the whole information-seeking process. The inclusion of all three aspects was, for Kuhlthau (1991), "necessary for a model to address a wider, holistic view of information use" (p. 362). Gross' (1999) work "emphasized that information seeking may be either self-generated (internally motivated by the personal context) or imposed (set in motion by someone else)" (p. 501).

Researchers have tried to determine what novice users do when accessing information in electronic environments (Fidel, 1984; Solomon, 1993; Tenopir, Nahl-Jacobovits, & Howard, 1991; Trivison, Chamis, Saracevic, & Kantor 1986). Oliver and Oliver (1996) suggested that new skills are needed to find information in these new environments, and the skills necessary are quite different from those needed when using traditional sources. The researchers also reported that these specific skills did not develop from personal exploration of the system. They suggested the three main problem areas in the use of multimedia and hypermedia applications in schools and school libraries are disorientation, navigation inefficiency, and cognitive overload.

Without intervention by a teacher or teacher-librarian, Fidel (1991a, 1991b, 1991c) found that novice users lacked the ability to form effective search plans and to select correct search keys. Trumball, Gay, and Mazur (1992) stated that novice users "have only impoverished strategies for synthesizing data into patterns" (p. 315). Pappas and Geitgey (1994) observed that novice users' information-seeking strategies might be at any point on the simple to complex continuum. Most students left on their own failed to progress to a more analytical search strategy.

Marchionini (1989) contended that users of information technology are required to deal with finding too much information and so need different

skills to deal with refining and selecting appropriate articles. Gross (1999), in her study of imposed queries in three school libraries, found that "in using resources, students had trouble finding answers when they had to search through a lot of text [and] when the resources did not use the same terminology they were given in class" (p. 513). Hirsh (1999) explored the relevance criteria and information-seeking of 10 grade 5 children using the OPAC, the Internet, World Book Encyclopedia, and SIRS magazine index. Participants reported that they relied on teachers, librarians, and peers for help in finding information. Librarians were asked for help with search terms, search strategies, and locating materials. Fidel et al. (1999) studied the searching behavior of grades 11 and 12 high school students on the Internet. Like Hirsh, Fidel et al. found that searching was a social and academic experience for students.

Bilal (2000) reported the results of the first part of a research project that looked at 22 grade 7 students' use of the Yahoooligans! Web Search for fact-based search tasks. Bilal found that those children who used only single or multiple concepts alone were more successful than those who used single or multiple concepts as well as natural language phrases. Scrolling, use of the back button, and navigating links were three important physical strategies that all students used.

Information-Seeking Research using Children and Adolescents as Participants

Research using children and adolescent participants can help to inform not only those who work in school libraries and young adult departments of public libraries, but also those who serve adults. Schools of library and information studies and faculties of education tend to use more easily available participants such as university undergraduates, graduate students, or faculty and staff members. However, some of the research studies relevant to this problem have used younger participants. Kuhlthau (1983), in her dissertation research, used participants who were gifted high school students. Pitts (1994) used a class of grades 11 and 12 science students who were working on a video documentary as her participants. McGregor (1993) also used high school students as her participants. Her research looked at information-seeking by students when working on English and social studies research papers.

Children and adolescents have been used as participants when looking at information-seeking in electronic environments in several relevant research studies (Akin, 1998; Anderson-Inman, Homey, Chen, & Lewin, 1994; Bilal, 1999, 2000; Bilal & Watson, 1998; Borgman, Hirsch, Walter, & Gallagher, 1995; Davidson-Shivers, Shorter, & Jordan, 1997; Large & Beheshti, 2000; Large, Beheshti, & Breuleux, 1998; Large, Beheshti, Breuleux, & Renaud, 1994a, 1994b 1995, 1996; Large, Beheshti, & Moukdad, 1999; Liebscher & Marchionini, 1988; Perzylo & Oliver, 1992; Schacter, Chung, & Dorr, 1998).

Children and adolescents are an interesting population to study, and the

research cited above has contributed to our overall understanding of how children and adolescents engage in information-seeking and learning.

Methodology

Qualitative Research

This research was conducted within the qualitative paradigm as it was concerned both with process and meaning. The qualitative researcher is involved in fieldwork and uses multiple methods to gain an in-depth understanding of the research problem and the specific research questions. The use of multiple methods adds "rigor, breadth and depth to the investigation" (Denzin & Lincoln, 1998,p.4).

In this research, junior high students and members of the school community from Inuvik, Northwest Territories, Canada, who could help inform the context were asked to participate. Of special importance were the core subject classroom teachers who recommended the 12 participants. The participants were selected by the teachers to represent different reading abilities, language and travel experiences, ethnic and Aboriginal backgrounds, and a fairly equal gender split. The participants ranged in age from 11 to 15. Six participants were male and six were female. The participants varied in their levels of school achievement, with several being at the top of the class and several being identified with special needs. Eight of the participants were Aboriginal: one was Cree, two were Gwich'In, and five were Inuvialuit. Six were born in the Northwest Territories, four were born in other parts of Canada, and two were born in other countries (South Africa and the United States). Pseudonyms are used for the participants. A grade 7 core subject teacher, a grade 8 core subject teacher, the grade 9 mathematics/junior high computer teacher, and the library assistant were the key informants. Discussions were carried out with one key informant on a regular basis to ensure that the interpretation of interviews and observations were correct.

Data Collection

To ensure a rich description and understanding of the complex phenomenon of junior high students' information-seeking processes when using CD-ROM encyclopedias, a variety of data collection procedures were used (Branch, 2000). A triangulation of data collection methods included verbal protocol analysis (Think Alouds and Think Afters), interviewing, observation, and videotaping.

In this study, participants were asked to think aloud while searching, and this talk was recorded. After the search, participants watched a videotape of their searches and were encouraged to add any comments about their information-seeking processes at that time. These Think Alouds and Think Afters were recorded using audiotapes. Two tape-recorders were set up to record the voices of the researcher and the participant. The researcher used the audiotapes and the videotapes to create the most complete written transcript

possible. The transcripts were used as the primary source of data. The Think Alouds and Think Afters were transcribed verbatim from the participants. Additions to the transcripts were made from the videotapes. Anything the participant was doing was written in parentheses. This included what search term was being typed in and what the participant was looking at or clicking on when making a statement.

Videotaping the computer screen provided a simple way to replay the search for participants so that we could discuss their information-seeking processes. The video camera was positioned behind the participant's left shoulder and only videotaped the screen during searches. The video camera was attached to a large television so that the participant and the researcher could watch a replay of the search during the Think Afters.

The research setting was a small classroom located at a quiet end of the school where there would be few disruptions. A computer work station on a movable cart, a television, and a tripod with the video camera were added to the room. The participants were seated at the computer work station during the searches. The computer had a Pentium processor, with a 12x CD-ROM drive, a color monitor, and speakers.

Each participant was given a general introduction to the CD-ROM encyclopedias. The participants explored the search features and the navigation features of each encyclopedia. Any symbols that might be confusing were explained. Microsoft Encarta Encyclopedia Deluxe 2000 was chosen because it is a popular encyclopedia and earlier versions of this encyclopedia were located in the school and public library as well as some of the classrooms. 1999 World Book (Deluxe) was selected because it has more Canadian content and because the school and public library had multiple sets of the World Book print encyclopedia. None of the participants had prior experience with the CD-ROM version of World Book Encyclopedia. Participants mentioned using other CD-ROM encyclopedias including Grolier and Compton's. Older participants seemed to be more familiar with CD-ROM encyclopedias and computers.

Findings of the Study

Search Session 1

Participants were introduced to the CD-ROM encyclopedias during the first session. All 12 participants answered the same four search questions:

1. Who was the first woman in space?
2. Describe the cardinal, a bird.
3. Who was the first man in space?
4. Describe the boxer, a dog.

Questions 1 and 3 were determined to be complex searches with four terms in the query, and questions 2 and 4 were determined to be simple searches with one term in the query.

Most of the participants had difficulties finding the answer to the first Question, *Who was the first woman in space?* Eric's search was interesting. He used the term *woman in space* and got a large number of articles containing those search terms. To narrow the search, he added *first* to the search term to create *first woman in space*. He clicked on several of the names on the list, methodically working alphabetically from top to bottom. In the Think Afters, Eric talked about narrowing down his search after getting "lots" of articles to go through.

For the second question, most of the participants began with the initial search term *cardinal*. After typing in the search term, a list of topics including cardinal (bird) came up in the topics list. Most of the participants read the article aloud to me rather than looking at the picture to answer the question.

All the participants did look at the picture or click on the picture and listen to the call of the cardinal. One participant with a different approach was Paul, who typed in *bird* as his initial search term. He had a lot of background information about the cardinal and felt that "birds would be better [as a search term] because it might get the Cardinals baseball players."

Seven of the participants used the initial search term *first man in space* to find the answer to the third question. Sue searched *Microsoft Encarta Encyclopedia Deluxe 2000* and got a long list of articles and tried several names including Karl Joseph Bobko and Frank Borman. She was clear in the Think Aloud that she was "trying to find out if there's any little clues to find out who the first astronauts in space are." With so many names and on the list of topics she found it "confusing ... because for typing in first man in space it came up with all the different astronauts." It was here that Sue was quite different from other searchers. She found out that the first American orbited the earth in 1962 and that "the first piloted Mercury mission was in May 1961." She then read that "Vostok training started again in 1960 and Vostok was launched in March 1961." Her next search term was *Vostok I* and she immediately located Yuri A. Gagarin in the article.

For the final question in Search Session 1, most of the participants had little difficulty finding the answer. Participants who tried *boxer* or *boxer dog* easily located the article on the list of topics and clicked on the article. They all read from the article rather than using the picture to answer the question. Even those participants with background knowledge did not use the picture although most clicked on the picture to enlarge it.

The participants had an overall average time of just over 5.5 minutes to answer the questions in Search Session 1. The participants used a variety of search terms, and some spent a long time just staring at the screen. Navigation in the CD-ROM encyclopedias was a frustrating problem during the first searches. The participants struggled with article outlines and the list of retrieved topics. They had trouble clicking back and several times became lost or ended up back at the initial search page. Some of the participants used huge strings of terms together to try to locate the answer.

Search Session 2

Participants began searching immediately and did not have a refresher course in the CD-ROM encyclopedias. The grade 7 participants answered the following questions:

1. How long is the Alaska pipeline?
2. Who designed the flag of Alaska?
3. What was the population of the capital city of Alaska in 1996?
4. In what year did Alaska have a huge earthquake?

Participants searched for the answers to questions 1 and 2 on *1999 World Book (Deluxe)* and questions 3 and 4 on *Microsoft Encarta Encyclopedia Deluxe 2000*. Questions 2 and 3 were determined to be the most complex, and Questions 1 and 4 were determined to be the simple searches.

Eric was the only participant to type in *Alaska's pipeline* as the initial search term for question 1. This search term resulted in the article on Alaska coming up. The section called The Discovery of Oil displayed with the word pipeline highlighted in red. Eric found the answer right away. All the other participants started with the initial search term *Alaska*, yet they found the answers in quite different ways.

Three of the participants found the answer to the second question quite quickly. Carol found the article by typing in *Alaska* as her initial search term. She checked the list of topics looking for flag, but there was no such topic, so she then clicked on the article outline. She found the flag and seal of Alaska in the article outline, clicked on it, and then scanned the section of the article near the picture. Carol then clicked on the picture and read the caption that went with the flag.

The third question was the most complex and difficult in Search Session 2 for participants. Carol began with *Alaska population* as her initial search term. Her Think Aloud reveals that she had enough background knowledge to find the answer quickly, "I am thinking it is going to be under Alaska population. Population chart. Okay. Alaska. Mm. Okay so Juneau." Like Carol, Paul located the capital city of Alaska right away. He commented right away, "Wow, what's the capital? We did that last year all year." His first search term was *capital of Alaska*. He scanned the list of topics and quickly saw Juneau.

The fourth question was easy for the participants. The answer was located on the list of topics, and the participants did not even need to read an article. Two participants used *Alaska* and *earthquake* in their initial search term and two participants began with *Alaska*. For Eric, *Alaska's earthquake* found the answer on the list of topics.

The grade 8 participants answered the following questions:

1. What is the official language of Egypt?
2. During what years did Ramses II reign?
3. What is the origin of the word pharaoh?
4. Find the flag and the national anthem of Egypt.

Participants searched for the answers to questions 1 and 2 on *Microsoft Encarta Encyclopedia Deluxe 2000* and questions 3 and 4 on *1999 World Book (Deluxe)*. Questions 2 and 3 were determined to be the simple searches, and Questions 1 and 4 were determined to be the complex searches.

The first question was the most difficult for participants, and two were unable to find the answer. Abby was hesitant from the beginning. She said, "Egyptian's language. This is a hard one. I am thinking what to put in. Egyptian's language. Um. I have no clue." Abby tried *Egyptian's language* and then *Egyptian language*. An article entitled Egyptian Language immediately came up on the screen. She read most of the article and followed links to Afro-Asiatic Languages, African Language, Coptic Language, and Traditional Music of Nigeria.

The second question was not too difficult for the participants once they managed to spell Ramses II correctly. Several different search terms worked at locating the appropriate article. Dave used a variety of natural language strings to try to find the answer to the question. He tried *when was ramses the second pharaoh*, *ramses was the*, *Ramses the second was king* and then *Ramses*. He clicked on Ramses II when the list of spelling options came up and located the answer right away. Both Abby and Lynn also found the answer to the question after several different search terms.

Locating the answer to the third question was quite easy for most of the participants. Lynn used *origin of the word Pharaoh* as her initial search term. Abby already had the Egypt list of topics on the screen and then clicked on search to type in *pharaoh*. She read the first paragraph in the article silently and then said, "It came from two Egyptian words. I can't pronounce them. Means great house." Ken's search was exactly the same as Abby's. Dave used the initial search term *what did pharaoh mean* and then *pharaoh*. He used his background knowledge to try to answer the question. He stated, "It was title for kings of Ancient Egypt. They used it for a title for kings of Egypt."

Ken and Lynn located the answer to the final question quite quickly, but Abby and Dave had more difficulty. Dave began by typing in *flag of Egypt* and then went to *Egypt*. He clicked on the article outline. He scanned the list looking for the word *flag* or *national anthem*. He looked through the article and went right past the flag. In the Think Afters, he said he saw the flag but thought "it was a symbol or something." After a few minutes of searching through the Egypt article, he said, "I just got an idea in my head." He typed in *flags and national anthem*. This search term gave him the Olympic Games. With my help, he tried to search by word using *flag*, *anthem*, and *Egypt*. In the list of topics, he clicked on Symbols of Egypt. Initially, he was not sure that it was the flag and even clicked back to the list of topics. After several seconds though, he clicked back to the flag and played the national anthem.

The grade 9 participants answered the following questions:

1. What is the lift of the Welland Canal?
2. Name a country through which the equator passes.

3. Into what body of water does the Nelson River flow?
4. Name a country through which the Tropic of Cancer passes.

Participants searched for the answers to questions 1 and 2 on *Microsoft Encarta Encyclopedia Deluxe 2000* and questions 3 and 4 on *1999 World Book (Deluxe)*. Questions 2 and 4 were determined to be the most complex, and Questions 1 and 3 were determined to be the simple searches with less than three search terms.

Sue was the only participant who had any trouble at all with the first question. She encountered problems immediately with *Microsoft Encarta Encyclopedia Deluxe 2000* and trying to type in *Welland Canal lift*. She found Welland, the city, right away and skimmed the article. On the list of topics there was also Welland Ship Canal, but she did not click on it. She tried several other search terms such as *Welland Canal (lift)* and then *Welland Canal*. She clicked on the article and skimmed through it, but missed the answer. At this point, she was quite frustrated because, "the words Welland Canal and lift do not appear anywhere together." Sue tried *Welland Canal lift* next, but found no topics. She clicked back onto the Welland Ship Canal article, read it again, and located the answer. The rest of the participants found the answer quickly using search terms *Welland* or *Welland Canal*.

The second question was the most difficult of Search Session 2 for participants. Chris had the most difficulty, but his search was interesting. Chris knew exactly where the equator was and that it went through Africa. What he did not know were the names of any of the countries in Africa. In his Think Aloud, Chris talked about his background knowledge and also his frustration with the CD-ROM encyclopedia.

I think it goes through Africa. Oh, okay. Countries. That is how you spell countries, right? How can I get a picture of the world? How can I see what these countries are? I need a country. I have to go up more. (looking at map) Is it Asia?

At this point in the search, Chris knew that there was a country in Africa through which the equator passes but he could not get there in any reasonable way. He located a map of Africa, but it was divided into sections such as Western Africa and Northern Africa. He asked, "Are these countries?" Chris found the country Tunisia and tried that as a search term. He found a map of Tunisia and said, "Ah, there we go. That is better, much much better. I got to go down but how?" Then he continued, "Is it Namibia? Sahara? Algeria?" With the map, Chris was able to see a list of places arranged alphabetically.

Chris stated,

That's Africa. Okay. I don't know any African countries. Africa countries. I don't know any countries in Africa. That's why I was trying different ones in order to uh. How do I spell that? (typed Tunisia)

Using the map, Chris began to scroll down the list of places beginning with T. His Think Aloud tracked the progress, "That is on the other side. (Taiwan) Tupelo, Mississippi. Turin, Turkmenistan, Turks ... Oh, that looks

pretty low. Is it Kenya?" Unbelievably, he found a city in Kenya using this method. Chris did not seem to become frustrated at all throughout the long search, but at the end of the Think After he said next time he would use an atlas to find the answer.

The participants found the answer to the next question quite easily. Bob, Mary, and Sue all typed *Nelson River* as the initial search term, located the article, and read the first paragraph of the article to find the answer. Chris typed in *rivers, Nelson* and found no topics. His Think Aloud was interesting, "What was that river called again? Nelson River. Is it in Canada? So rivers wouldn't do. Maybe river. How big is the river? What is this?" Eventually he typed Nelson River and read out the answer, "It flows into Hudson Bay." In the Think After, Chris stated, "Well I thought since it's different I would try river. Nelson like in a dictionary but then I tried Nelson River and I got it."

All the students found the answer to the last question quickly. Chris, Bob, and Mary all typed *Tropic of Cancer* as their initial search term. Bob stated that he knew that the Tropic of Cancer was "north." In his Think After, Bob stated that he "skimmed the first paragraph. It was like telling where it is." Mary, on the other hand, "read the whole thing" to find the answer. Chris said, in his Think Aloud,

I am typing in Tropic of Cancer because it might give me more information about what is on the Tropic of Cancer than Encarta. Countries. North of the equator. Okay. Is Mexico a country?

Participants discovered that simple search terms were the most effective way of finding the answers to the questions during Search Session 2. It also became apparent that background knowledge helps when searching for questions about countries, rivers, and geography. The participants moved through the encyclopedias purposefully and spent little time sitting and thinking about search terms. For the most part, they just jumped right in and were willing to make adjustments to search terms as needed.

Search Session 3

Participants were given a form at the end of Search Session 2 so they could write down their questions for Search Session 3. Several of the participants forgot or lost their question sheets, so time was given at the beginning of the session to write down four questions. Not all participants had four questions.

The participants were able to choose which encyclopedia they would like to use to search for each question.

Search Session 3 provided some interesting approaches to information-seeking on CD-ROM encyclopedias. All the participants generated questions that were important to their personal lives and interests. Most of the questions were those that could be found in an encyclopedia. Abby spent the most amount of time finding the answers to her questions, whereas Eric and Lynn spent the least amount of time. The mean amount of time needed to answer their self-generated questions was just over six minutes.

Eric used natural language sentences when searching for most of his answers. This was a departure from the way he had previously searched. Paul continued to search in the same way during his final search session. He was interested in information in general and was not looking for specific answers. Paul felt free to explore the information and was not worried about finding the answer right away. Fran continued to be easily frustrated when the answer was not found immediately after typing in an initial search term. Carol still typed in general search terms to find answers to her questions. This made it difficult for her to make her way through the large number of retrieved topics.

Dave used general topics for search terms as well. This worked well for him compared with his earlier searching when he was typing in the whole question. Ken used the whole question as an initial search for each of his final questions. He did not do this during the first two search sessions. Lynn continued to be an effective searcher. She was confident and found all but one of the answers easily. Lynn also enjoyed exploring some of the features of the encyclopedia. Abby chose questions that were difficult to find in an encyclopedia. She did not really have a sense of what kind of information might be in an encyclopedia.

Chris continued to use simple search terms to locate information. Two of his questions were difficult to answer using an encyclopedia. Bob had difficulty with one question. The rest of the questions he found easily. He continued to use general search terms to find the answers. Mary found the answers to her first three questions easily. The fourth question was not specific and, therefore, it was difficult for her to find an answer. Instead, she just spent time reading about a lot of racecar drivers rather than finding one famous racecar driver. Sue's questions were based on her interest in science. She found the answer to her first question quickly, but the next two took much longer. She was interested in the topic and spent a lot of time reading about the disintegration of stars and exobiology.

Discussion

Participants in this study all began their search by typing something into the search box. The search term either retrieved a list of topics or gave the message "no topics found." The latter caused some participants to be frustrated or confused. Some of them asked for help in generating a new search term. When the participants retrieved a list of topics, most skimmed through the list looking for a topic that seemed relevant. When they did not find such an article, some of the participants used a top to bottom strategy.

Once in an article, participants either skimmed or read the article depending on its length. Several of the participants used highlighted terms as a guide to locate the answers. Once in the appropriate article, the participants usually found the answer. The participants tended to perform three main processes. They entered search terms, skimmed through the list of retrieved

topics to find a relevant article, and read, skimmed, or scanned through article outlines and articles to find the answer. The information-seeking processes were the same over the three search sessions. Navigation and confidence improved over time.

Factors that influenced the information-seeking processes of junior high students were gathered using information from key informants, participants, and the observations of the researcher. These factors included finding the right key word or phrase, knowing when to narrow or broaden the search term, and having time, patience, and persistence when searching. Other factors included previous computer experience, asking questions of others, reading ability, skimming and scanning skills, and having an understanding of information contained on a CD-ROM encyclopedia.

The findings from this study indicate that there is a need for teachers and teacher-librarians to work with junior high students to help them learn to access information efficiently and effectively. The information-seeking processes observed in this study are consistent with more general information-seeking models. The findings support the work of Bates (1989) who presented a berrypicking model of information-seeking. Participants in this study used a variety of techniques to find the answers. They browsed, used the key features of the search by word and search by topic, used the electronic world atlas feature, tried related articles, asked questions of the researcher, looked at animations and pictures, scrolled through photographs of dogs, and so forth.

The Think Alouds and Think Afters provide support for the findings of Kuhlthau (1991) and her Information Search Process model. Across all searches, and in individual searches, participants followed the affective stages of the model. These feelings included uncertainty, confusion, frustration and doubt, clarity, sense of relief, and satisfaction. Support for the Tenopir et al. (1991) basic cycle of search behavior was found in the observation, video-taping, and the Think Aloud data from this study. Participants followed the basic cycle, and comments from the Think Alouds provided support for the steps, which included seeking assistance, rehearsing instructions, executing instructions, interpreting consequences, emoting to result, and setting a sub-goal. Some of the more complex searches demonstrated each of the steps several times. In the simple searches, only a few of the steps were apparent in the Think Alouds. Findings from this study also supported the work of Tenopir et al. (1991) and Bilal (2000) who noted that participants tended to use the same strategies during searching and that those participants who tended to use simple search terms continued to do so throughout the searches.

The findings of this study also supported the work of Oliver and Oliver (1996), who noted that participants tended to prefer one strategy to others and that those with more computer experience used more options. Most of the participants did not make use of advanced search features. This was in

keeping with Hirsch's (1999) work. Participants in this study had trouble finding answers when they had to search through a lot of text just as in the work of Bilal (2000) and Gross (1999). Hirsch (1999) and Fidel et al. (1999) found that participants were frustrated when results were not as expected, and this study confirmed that finding. Participants tended to look for the lines in articles that would answer the question and to move quickly between the article, article outline, and search box.

Implications and Conclusion

This study found that students need teaching to make them better searchers. Teachers and teacher-librarians need to examine how they prepare, facilitate, and evaluate/reflect on the information-seeking processes of their students in both print and electronic environments. The following recommendations are made in the hope that they assist teachers and teacher-librarians.

Practitioners should become familiar with the work of Tenopir et al. (1999), Kuhlthau (1991), and Bates (1991) and other research about the information-seeking processes of children and young adults. Familiarize students with these models and provide opportunities for practice. To prepare for information-seeking situations in classrooms and libraries, practitioners must be prepared to deal with the need of searchers to ask questions, to address the affective behaviors that may occur during searching, and to acknowledge with their students that searching for information can be frustrating, confusing, upsetting, exciting, and challenging. Encourage students to ask others for help when they encounter new vocabulary. Help students to develop strategies and skills to deal with the affective stages of the ISP, that is, uncertainty, optimism, confusion, frustration and doubt, clarity, sense of direction, confidence, and relief/satisfaction or disappointment. Give students the opportunity to search for information of a personal nature. Provide CD-ROM encyclopedias and other materials with a variety of reading levels so that all students can successfully locate information. Before beginning a research project, introduce the topic and new vocabulary to students to ensure adequate prior knowledge. Demonstrate and give time to practice using skimming and scanning techniques, including the use of highlighted search terms as a guide for their scanning/checking, article outlines, indexes, headings, and subheadings. Explain to students the differences between databases, indexing and abstracting services, CD-ROM encyclopedias, and the Internet.

When acting as a facilitator for information-seeking, provide opportunities for small-group and whole-group discussions about search terms and search strategies, as this may provide new techniques and ideas that are unique to one searcher but may be useful for all. Encourage students to engage in self-talk, talk with peers, and talk with teachers and teacher-librarians during their searches. Allow students with low literacy levels extra time to locate information, and expect students to need different amounts of

time to find information. Provide opportunities for students to develop skills that will help them with the three main steps in searching, that is, generating search terms, selecting topics/articles from a retrieved list, and reading/skimming/scanning to locate information. Support students when they feel overwhelmed, confused, frustrated, and full of doubt, and provide opportunities for students to use information technologies so that their confidence can improve.

Focus on the three domains of human behavior (Tenopir et al., 1991). The first is the affective domain, which controls goal selection; the second is the cognitive domain, which determines the strategies necessary to reach goals; and the third is the sensorimotor domain, which implements the physical actions necessary to reach goals. Make sure to provide opportunities for students to learn and practice skills and strategies that they can apply at each step in this cycle. It is also important to focus on the three main search tasks, that is, generating search terms, selecting topics from a retrieved list, and skimming and scanning through text to find the answer. Teach skills and strategies to students to help them generate search terms in a variety of different situations and with a variety of different information sources.

When evaluating and reflecting on information-seeking, use observation and research to inform practice. Support, and encourage others to support, research projects in local school districts, schools, and school libraries. Making elementary, middle, junior, and senior high school settings available to researchers can enable them to carry out studies of importance to teachers and teacher-librarians. Write and report about the interesting observations, strategies, and ideas that are happening in schools and school libraries.

Researchers need to continue work in the area of information literacy research in schools and school libraries. Studies are needed that compare the information-seeking processes of junior high students as they access information from other reference tools, both print and electronic. Studies are needed that explore students' experiences as they complete real assignments, projects, and reports as selected by the teacher, teacher-librarian, or the students, and that use a natural group setting in the library or a classroom away from a laboratory setting. It is important for researchers to observe students as they interact with others as they would normally do. There must also be an effort to continue to test information-seeking models and theories in real-life settings with school-aged participants who come with a variety of backgrounds, experiences, and abilities.

This research study provided support for many of the earlier findings of researchers working in the area of information-seeking in electronic environments. The information-seeking processes of children and adolescents should be interesting to all who work in classrooms and school libraries. In recent years, more research in the area of information-seeking has been carried out with younger participants. As a researcher interested in children and adolescents as information seekers, I hope to see this trend continue.

The role of this research has been to explore the information-seeking processes of junior high students as they access information using CD-ROM encyclopedias. Researchers are encouraged to extend the study by using similar methods in different contexts, with different information sources, and with small and large groups of participants over an extended period. It is hoped that this case study suggests to the readers general and specific ideas for use in similar situations. It attempts to provide a starting point for the development of information literacy programs that deal specifically with CD-ROM encyclopedia searching and with information-seeking in electronic environments more generally.

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