August 2017

# Understanding Children's Help-Seeking Behaviors: Effects of Domain Knowledge

Hyejung Han
*University of Wisconsin-Milwaukee*

# UNDERSTANDING CHILDREN'S HELP-SEEKING BEHAVIORS: EFFECTS OF DOMAIN KNOWLEDGE

by

Hyejung Han

A Dissertation Submitted in

Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

in Information Studies

at

University of Wisconsin Milwaukee

August 2017

## ABSTRACT

**UNDERSTANDING CHILDREN'S HELP-SEEKING BEHAVIORS: EFFECTS OF DOMAIN KNOWLEDGE**

by

Hyejung Han

The University of Wisconsin-Milwaukee, 2017
Under the Supervision of Professor Iris Xie

This dissertation explores children's help-seeking behaviors and use of help features when they formulate search queries and evaluate search results in IR systems. This study was conducted with 30 children who were 8 to 10 years old. The study was designed to answer three research questions with two parts in each: 1(a) What are the types of help-seeking situations experienced by children (8-10 years old) when they formulate search queries in a search engine and a kid-friendly web portal?, 1(b) What are the types of help-seeking situations experienced by children (8-10 years old) when they evaluate search results in a search engine and a kid-friendly web portal?, 2(a) What types of help features do children (8-10 years old) use and desire when they formulate search queries in a search engine and a kid-friendly web portal?, 2(b) What types of help features do children (8-10 years old) use and desire when they evaluate search results in a search engine and a kid-friendly web portal?, 3(a) How does children's (8-10 years old) domain knowledge affect their help seeking and use of help features when they formulate search queries in a search engine and a kid-friendly web portal?, 3(b) How does children's (8-10 years old) domain knowledge affect their help seeking and use of help features when they evaluate search results in a search engine and a kid-friendly web portal?

This study used multiple data collection methods including performance-based domain knowledge quizzes as direct measurement**,** domain knowledge self-assessments as indirect measurement, pre-questionnaires, transaction logs, think-aloud protocols, observations, and post-interviews.

Open coding analysis was used to examine children's help-seeking situations. Children's cognitive, physical, and emotional types of help-seeking situations when using Google and Kids.gov were identified. To explore help features children use and desire when they formulate search queries and evaluate results in Google and Kids.gov, open coding analysis was conducted. Additional descriptive statistics summarized the frequency of help features children used when they formulated search queries and evaluated results in Google and Kids.gov. Finally, this study investigated the effect of children's domain knowledge on their help seeking and use of help features in using Google and Kids.gov based on linear regression. The level of children's self-assessed domain knowledge affects occurrences of their help-seeking situations when they formulated search queries in Google. Similarly, children's domain knowledge quiz scores showed a statistically significant effect on occurrences of their help-seeking situations when they formulated keywords in Google. In the stage of result evaluations, the level of children's self-assessed domain knowledge influenced their use of help features in Kids.gov. Furthermore, scores of children's domain knowledge quiz affected their use of help features when they evaluated search results in Kids.gov. Theoretical and practical implications for reducing children's cognitive, physical, and emotional help-seeking situations when they formulate search queries and evaluate search results in IR systems were discussed based on the results.

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# ACKNOWLEDGEMENTS

I would like to express my deepest thanks to Dr. Iris Xie, my advisor, for her insightful guidance and encouragement. This dissertation would not have been possible without her advice and research on help-seeking behaviors in IR systems. I would also like to thank my dissertation committee members, Dr. Dietmar Wolfram, Dr. Susie Lamborn, Dr. Laretta Henderson, and Dr. Dania Bilal, for their valuable advice and comments throughout my dissertation process.

I am grateful to the participants and their parents in my research. Children who participated in my research showed passion in sharing their search experiences and thoughts with me. In addition, their parents spent hours by bringing their children to the research lab at UWM and trusted me and the purposes of my research.

I acknowledge a Distinguished Dissertation Fellowship from University of Wisconsin-Milwaukee and a Doctoral Research Award Grant Opportunity (DRAGO) from the School of Information Studies at the University of Wisconsin-Milwaukee.

I would like to truly thank my father, mother, daughter, brother, sister-in-law, and niece for all their unconditional love and support.

# Chapter 1: Introduction

This dissertation seeks to understand children's information-searching process, particularly children's help-seeking behaviors and the effects of their domain knowledge on using help features in Information Retrieval (IR) systems. This study focuses on what difficulties children ages 8 to 10 face and what help they need when they search. It also investigates the effects of children's domain knowledge on their use of help and help-seeking in using IR systems (Google and Kids.gov) and applies information processing theory (IPT) to better understand children's help-seeking behaviors. IPT generally depicts the relationship between age and thought processes, and it is particularly applicable to understanding and explaining children's information behaviors, including help-seeking behaviors, because the theory covers "the flow of information through the cognitive system" (Miller, 2010, p. 266). In addition, cognitive development viewpoints deal with cognitive growth such as age-related and experience-related changes (Siegler & Alibali, 2005) and the impact of prior knowledge on information processing and the behaviors of humans.

## 1.1. Need for This Study: Problem Statement

Since Dervin and Nilan (1986) emphasized its importance, a user-oriented approach has been actively utilized in library and information science to identify ways to help users seek information more efficiently and effectively in IR systems. According to Cole (2013), the paradigm shift in information behaviors studies occurred with the advent of the Internet, as Internet and digital technology developments have helped a variety of user groups, including children, find and use information more and more freely. Children demonstrate their own unique information needs and information-seeking behaviors in IR systems.

Today children are considered "Digital Natives" (Prensky, 2001, p. 1), which refers to native speakers of the digital language of computers, video games, and the Internet. Most teachers believe that "today's students are more media savvy than previous generations" (Purcell et al., 2012). Preteens' access to digital environments where they play, socialize, create, and explore is a daily routine today, as Meyers (2009) pointed out. With the widespread use of the Internet and digital technology tools, children have increasingly engaged in information searching and use the tools to overcome their limited knowledge (Siegler & Alibali, 2005).

IR systems such as search engines, digital libraries, and web portals feature search support and are designed to help the keyword formulation and evaluation of the search results of users. For example, these days IR systems provide a variety of search help features such as "autocomplete", "Did you mean", and snippet text for users to get better search results.

However, children's effective information searching in IR systems is difficult because the designs of such systems, including search engines, digital libraries, and web portals, do not reflect the needs and searching behaviors of diverse user groups, including children. Studies of children's information searching and help seeking reveal several limitations.

Even though there are a number of models of information behaviors in library and information science, few models have been constructed to represent the information behaviors of children (Shenton & Dixon, 2003; Bilal & Sarangthem, 2008). Creating models for young users is important to better understand the patterns, characteristics, and difficulties of children's information behaviors. First, few studies have considered the various factors that influence children's information-searching and help-seeking behaviors. For example, Dinet, Bastien, and Kitajima (2010) found that the searching behaviors of children (Grade 5 to Grade 11) will vary according to typographical cuing (boldface versus no boldface) and domain knowledge when

they find information in the results pages of a search engine. However, existing results focusing on children's searching have not considered various factors such as children's domain knowledge. It is necessary to consider children's domain knowledge to effectively understand their information-searching behaviors because their domain knowledge influences their searching behaviors and success (Bilal, 2001; Gossen & Nürnberger, 2013; Hirsh, 1997).

Second, domain knowledge is considered one of the significant factors that affect children's information-searching behaviors. Bilal (2001; 2007) emphasized considering effective ways to measure children's domain knowledge. However, some studies (Hirsh, 2004) found difficulties in measuring domain knowledge factors that influence children's information behaviors due to the limitations of measuring domain knowledge by school academic performance.

Third, cognitive, physical, social, and emotional development impacts children's interaction with IR systems (Bilal, 2004; Cooper, 2005). Although Kuhlthau's (1991) Information Search Process (ISP) model emphasized the interrelationships of the cognitive, affective, and physical dimensions of information seeking, and Bilal (2000, 2001, 2002a) also explored the interplay of cognitive, affective, and physical dimensions of children's information seeking, many studies neglected these factors in children's information seeking. A holistic view of children's information seeking-process should be considered in future research on children's information-seeking and help-seeking behaviors.

Finally, although several studies ((Bilal, 2003, 2007; Burdick, 1996; Druin et al., 2009; 2010; Hirsh, 1997; Jochmann-Mannak et al., 2010; Laplante, 2014; Large et al., 2006; Madden et al., 2006) of information-searching behaviors in IR systems unveiled issues that children experienced with existing or lack of help features, there is no specific research focusing on

children's help-seeking behaviors. Particularly, Druin et al. (2010) emphasized the importance of providing help at the right time for children, and recommended that new interfaces should be developed that go beyond traditional "help," "agents," or "tutorials" because children need help and support when they do not know where or how to start a search, or when they get lost or distracted in a search. These limitations inspired this study. This dissertation explored children's help-seeking situations and use of help features, particularly when they formulate search queries and evaluate results and the effects of children's domain knowledge on their help-seeking behaviors when using IR systems.

### 1.2. Research Purposes

The purposes of this dissertation are twofold. First, it aims to understand children's help-seeking behaviors and their desired help features in using IR systems. The exploratory study focuses on the help-seeking behaviors of children ages 8 to 10 when they formulate queries and evaluate search results. Second, it investigates the influences of children's domain knowledge on help-seeking situations and use of help features. This examination is based on human development theories and perspectives, in particular information processing perspectives, to better understand the relationships between help-seeking behaviors and children's domain knowledge in using IR systems, particularly Google and Kids.gov.

### 1.3. Research Questions and Hypotheses

#### 1.3.1. Research Questions

Children's difficulties in formulating keywords, including problems of typing and spelling (Bilal, 2002a; Bilal & Gwizdka, 2016; Gossen, Hempel, & Nürnberger, 2013, Gossen, 2016;

Hutchinson, Bederson, & Druin, 2006) and in selecting appropriate results (Druin et al., 2009), are considered main challenges when children search. Moreover, children encounter difficulty in understanding and evaluating information on the results pages due to the level of their cognitive abilities (Druin et al., 2009). Hence, this research explores children's help-seeking behaviors and the relationships between children's domain knowledge and their help seeking at two stages, particularly when children formulate search queries and evaluate search results. In order to better understand children's help-seeking behaviors in IR systems, this dissertation identifies what difficulties children encounter and how system help features in IR systems support their searching, particularly when they formulate search queries and evaluate search results. Also, this study examines how children's domain knowledge affects their help seeking and use while formulating search queries and evaluating search results. This dissertation addresses the following research questions:

1. What are the types of help-seeking situations experienced by children (8-10 years old)
   a) when they formulate search queries in a search engine and a kid-friendly web portal?
   b) when they evaluate search results in a search engine and a kid-friendly web portal?
2. What types of help features do children (8-10 years old) use and desire
   a) when they formulate search queries in a search engine and a kid-friendly web portal?
   b) when they evaluate search results in a search engine and a kid-friendly web portal?
3. How does children's (8-10 years old) domain knowledge affect their help seeking and use of help features
   a) when they formulate search queries in a search engine and a kid-friendly web portal?
   b) when they evaluate search results in a search engine and a kid-friendly web portal?

### 1.3.2. Hypotheses

In the experimental method, the dependent variable refers to the one that is observed to assess the effect of the treatment; the independent variable is defined as the variable that is manipulated by the researchers (Gravetter & Wallnau, 2011). Associated hypotheses are developed for research question 3 to test the effects of domain knowledge on frequencies of help-seeking situations and the use of help features.

H1:

A. Levels of children's domain knowledge affect the frequency of occurrence of help-seeking situations when they formulate search queries in Google.

B. Levels of children's domain knowledge affect the frequency of occurrence of help-seeking situations when they formulate search queries in Kids.gov.

H2:

A. Levels of children's domain knowledge affect the frequency of help feature use when they formulate search queries in Google.

B. Levels of children's domain knowledge affect the frequency of help features use when they formulate search queries in Kids.gov.

H3:

A. Levels of children's domain knowledge affect the frequency of occurrence of help-seeking situations when they evaluate search results in Google.

B: Levels of children's domain knowledge affect the frequency of occurrence of help-seeking situations when they evaluate search results in Kids.gov.

H4:

A. Levels of children's domain knowledge affect the frequency of help feature use when they evaluate search results in Google.

B. Levels of children's domain knowledge affect the frequency of help feature use when they evaluate search results in Kids.gov.

### 1.4. Theoretical Framework: Information Processing Theory (IPT)

The application of IPT has been effectively used to understand children's cognitive development with "a more rigorous experimental approach than Piaget's and a more cognitive approach than learning theory" (Miller, 2010, p. 266). This study used IPT to understand how children process information in using IR systems and to explain developmental considerations for children who are 8 to 10 years old.

First, IPT addresses the complex organization of human thought and tries to specify a variety of cognitive processes (Miller, 2010). Thus, IPT is helpful for studying individual differences and age differences in information-seeking and help-seeking behaviors in digital environments.

Second, one of IPT's strengths is the precise analysis of performance and change. In other words, information-processing theorists attempt to be more explicit about how children use their cognitive skills in a given situation (Miller, 2010). The perspective of information processing emphasizes information-processing limitations, strategies for overcoming these shortcomings, domain-specific knowledge about tasks, and specific behaviors involved in the process of change on a particular task (Miller, 2010). Therefore, various factors such as memory capacity, the use of strategies in problem-solving or spelling, and knowledge base influences on

children's thinking can be applicable to address children's help seeking in IR systems. For instance, how a knowledge base influences children's help seeking while searching information in digital libraries and search engines can be investigated.

Finally, information-processing theorists emphasize that experience plays an important role in thinking and cognitive development (Shaffer & Kipp, 2010; Siegler & Alibali, 2005). The more children experience, the more they know about any domain and the more they can learn and process information easily. This study attempts to test the emphasis of information-processing theorists and apply their perspectives to develop further understanding of children's help-seeking behaviors.

### 1.5. Research Design

Both quantitative and qualitative research methods were selected to answer the research questions in this study. Thirty children who are 8 to 10 years old were recruited for the empirical study. The participants each completed a performance-based knowledge quiz and self-assessment identifying domain knowledge. Also, they each conducted two search tasks in Google, which is the most frequently used search engine nationally and globally (Alexa.com, 2017) and Kids.gov, which has been selected as one of the great websites for elementary-aged children (Great websites for Kids sponsored by Association for Library Service to Children [ALSC] , 2017). Multiple data collection methods—including pre-questionnaires, think-aloud protocols, transaction logs, observations, and interviews—were used in this research. Through open coding, qualitative data were analyzed. Additionally, quantitative analysis through descriptive statistics and inferential statistics, specifically linear regression, was used to explore

the effects of children's domain knowledge on help seeking and use of help features in IR systems.

### 1.6. Significance of the Study

This study is significant in terms of exploring help-seeking behaviors of children who seek, find, and select information from multiple sources made available to them via search engines. Cole (2013) suggests, "multiple information sources require sophisticated information behaviors and skills in terms of selecting and evaluating the authority and appropriateness of these information sources for the child's task at hand." This research not only demonstrates how elementary school-aged users seek and use help when they formulate search queries and evaluate information in IR systems, but also provides practical implications for the universal access of IR system design for children.

Domain knowledge has been considered one of the influential factors in help seeking in digital environments (Bartholomé, Stahl, Pieschl, & Bromme, 2006; Wood, 2001; Wu, 2011; Xie & Cool, 2009). In addition, users' domain knowledge affects their query formulation, selection of search results, and search success (Bilal, 2001; Dinet, Bastien, & Kitajima 2010; Gossen & Nürnberger, 2013; Hembrooke, Granka, Gay, & Liddy, 2005; Hirsh, 1997; Wildemuth, 2004). Search support features such as query suggestions, spelling suggestions, and related searches are required when users create queries and evaluate search results (Hirsh, 1997; Jochmann-Mannak, Huibers, Lentz, & Sanders, 2010; Madden, Ford, Miller, & Levy, 2006; Sahib, Tombros, & Stockman, 2012; Zeng, Crowell, Plovnick, Kim, Ngo, & Dibble, 2006). However, few studies to date have investigated the effects of domain knowledge on children's help seeking and use of help features in using IR systems. Bilal (2001; 2007) emphasized the consideration of domain

knowledge variables, and Hirsh (2004) suggested the need for alternate measures of domain knowledge due to the limitations of measuring domain knowledge by school academic performance for researchers investigating children's searching effectively in digital environments.

This dissertation is significant because it examines the effects of children's domain knowledge on their help seeking and use of help features in using IR systems with measurements of domain knowledge through direct (e.g. a performance-based knowledge quiz) and indirect (e.g. self-assessment) assessments. Ross (2006) found a reliable assessment technique produces consistent results across items, tasks, and contexts. Also, performance-based assessment uses one or more approaches for measuring student knowledge, skills, or behaviors (Cohen & Spenciner, 1998). Methods to improve reliability and validity of performance-based assessments include knowledge of the purpose of the assessment and maintenance of a written record (Cohen & Spenciner, 1998). The purpose of the performance-based assessment used in this study was to measure children's domain knowledge directly by maintaining written records.

Moreover, children's limited cognitive, emotional, and physical abilities influence their information needs and information-seeking behaviors in digital environments. While adults' information-seeking and help-seeking behaviors have been frequently investigated, the information seeking and help-seeking behaviors of children have not been actively examined.

This research fills a gap in the literature by applying human development theories. In particular, proponents of IPT have examined developmental differences in several important aspects of children's thinking and of children's information processing that influence all types of thinking. Therefore, this study increases our understanding of children's information behaviors, including help-seeking behaviors in digital environments. This study informs researchers

investigating children's information behaviors, librarians, parents, teachers, and IR system designers who consider effective searching of diverse user groups including children. For a better design from children's perspective, the findings of this dissertation provide practical implications, suggesting help features based on children's help-seeking situations for children with different levels of domain knowledge. Difficulties to be addressed include: limited visibility of major features, spelling errors, difficulty in formulating queries, size of the search box, anxiety while formulating queries, mismatched reading level, comfortability based on prior experience, negative effect from lack of domain knowledge, too many irrelevant results, too-small fonts, navigational confusion, confusion by similar pronouns, frustration with poor system performance, and anxiety from system error messages.

### 1.7. Definitions of Major Terminology

Major terms used in this dissertation were defined to better understand this study, as seen in Table 1.1.

Table 1.1

*Definitions of Key Terms*

| Term | Definition | References |
|---|---|---|
| Children | Persons of ages up to and including 14 | Association for Library Service to Children (ALSC) |
| Information processing | The flow of information through the cognitive system | Miller (2011) |
| Domain knowledge | Domain knowledge is the searcher's knowledge of the search subject or topic, and is conceptually distinct from knowledge of searching techniques. | Wildemuth (2004) |
| Information need | A recognition that your knowledge is inadequate to satisfy a goal that | Case (2007) |

| | | |
|---|---|---|
| | you have. | |
| Information Behaviors | Totality of human behaviors in relation to sources and channels of information, including both active and passive information seeking, and information use. | Wilson (2000) |
| Information-seeking behaviors | Purposive seeking for information as a consequence of a need to satisfy some goal. In the course of seeking, the individual may interact with manual information systems (such as a newspaper or a library) or with computer-based systems (such as the World Wide Web). | Wilson (2000) |
| Information-searching behaviors | Micro-level behaviors employed by the searcher in interacting with information systems of all kinds | Wilson (2000) |
| Help seeking | A need for assistance from IR systems or a human to solve problems derived from different situations in the information-searching process. | Xie & Cool (2009) |
| Information Retrieval Systems | Four types of information retrieval systems can be identified: OPAC, online databases, digital libraries and web-based information services, and web search engines | Chowdhury (2010) |
| Search engine | A software program that searches the Internet (websites) based on the words that the searcher designates as search terms (query words). | Seymour, Frantsvog, & Kumar (2011) |
| Web portals | Web-based front-end applications that provide an integrated gateway into a website; these include functions such as robotic crawlers that dynamically push categorized information onto the web page. | Gant, Gant, & Johnson (2002) |
| Search support tools | Designed to help users make their queries more specific and reduce the size of the retrieval set. | Vakkari (2003) |

| | | |
|---|---|---|
| | In this study, the definition of search support tools is considered the same with one of "help features" and "search support features". | |

### 1.8. Summary of Dissertation

Chapter 1 demonstrated the problem statement and research purposes for this study. In this chapter, three research questions and hypotheses were proposed to explore children's help-seeking behaviors and use of help features in IR systems. This chapter also discussed research design, significance of the study, and definitions of key terminology. Chapter 2 discusses literature on information behaviors and human development theories. It also outlines literature regarding children's information behaviors and their help-seeking behaviors as well as the effects of domain knowledge. Chapter 3 explains the methodology used for this dissertation. Chapter 4 presents the study's qualitative and quantitative results. Chapter 5 discusses the theoretical, practical, and methodological implications of this dissertation and its limitations. Finally, Chapter 6 summarizes the findings of this dissertation and highlights directions for further research.

# Chapter 2: Literature Review

In this chapter, previous literature about information behaviors and human development theories and models are reviewed analytically. This chapter also outlines the literature regarding children's information behaviors and help-seeking behaviors in a wide range of contexts. Overall, six research areas are reviewed in Chapter 2: 1) information behaviors, 2) children's information behaviors, 3) children's help-seeking behaviors in IR systems, 4) children's help-seeking behaviors in learning environments, 5) domain knowledge factors affecting children's information-searching and help-seeking behaviors, 6) other factors related to children's information searching and help- seeking behaviors, and 7) human development theories.

## 2.1. Information Behaviors Research

The shift from a system-centered approach to a user-centered approach has helped researchers in library and information science (LIS) develop theoretical models and concepts. Widely used and applied to studies on children's information behaviors theories and models, Kuhlthau's Information Search Process (ISP) model (1991), Belkin's Anomalous State of Knowledge (ASK) model (1982), Ellis' Model (1989), the Big6 approach (1990), the Berrypicking model (1989), and Dervin's Sense-Making methodology (1996) were selected for review in this study. In addition, implications of the theories and models for studies of children's information searching behaviors will be summarized in this section.

### 2.1.1. Theories and Models of Information-Seeking and -Searching Behaviors

*Information Search Process (ISP) MODEL*

Kuhlthau's (1991) Information Search Process (ISP) model can be applied to study children's information seeking because the ISP model was developed from the user's perspective and considered the notion of interrelationships between information seeking and cognitive, emotional, and physical dimensions. On each of six stages, she reflected on the affective (feelings), cognitive (thoughts), or/and physical (actions) aspects revealed by users while they are searching and using information. The six stages are initiation, selection, exploration, formulation, collection, and presentation. At the initiation stage, users feel uncertainty characterized by general and vague thoughts. This is followed by feelings of optimism at the selection stage by choosing the task. Users' exploration is characterized by feelings of confusion, frustration, and uncertainty. The main action occurring during exploration is seeking relevant information. Kuhlthau stated, "Formulation is the turning point of the ISP when feelings of uncertainty diminish and confidence increases" (p. 367). In the collection stage, users feel confidence by selecting information relevant to the topic. Finally, in the presentation stage, users feel either satisfaction or disappointment depending on how the search ended. The ISP model contributed to studies on information-seeking behaviors by emphasizing cognitive, affective, and behavioral viewpoints of the information-seeking process. The ISP model emphasized the interrelationship of the cognitive, affective, and physical dimensions of information seeking and how the search process leads to uncertainty, anxiety, and frustration (Kuhlthau, Heinström, & Todd, 2008).

*Anomalous State of Knowledge (ASK) Model*

Belkin's (1982) "Anomalous State of Knowledge (ASK) hypothesis is what was known as the cognitive viewpoint" (Belkin, 2004, p. 46). The cognitive viewpoint rests on the concept

of knowledge structure and focuses on the way an individual thinks and behaves with regard to information needs in information behaviors studies (Pettigrew, Fidel, & Bruce, 2001). The ASK hypothesis suggests that an information need arises from a recognized anomaly in the user's state of knowledge regarding some topic or situation and that the user is unable to specify precisely what is needed to resolve that anomaly (Belkin, Oddy, & Brooks, 1982a, p. 61). Belkin (2004) demonstrated that the anomaly was used to indicate that the state of inadequacy could be due to lack of knowledge as well as many other problems, including uncertainty. Thus, the concept of ASK can be applied to children's information behaviors studies because the ASK model is concerned with users' knowledge structures, and "children have a smaller stock of knowledge and experience on which to base a question that will satisfactorily relate their information need" (Cooper, 2005, p. 289). The ASK hypothesis contributed to information behaviors research and user-oriented studies in that it focused on the cognitive viewpoint. Moreover, the ASK hypothesis proposes a specific reason explaining why people engage in information-seeking behaviors and tries to understand how that reason can be answered by a user's interaction with information. Finally, the ASK hypothesis helps design interactive information retrieval systems that should be based on the underlying information needs of users (Belkin, Oddy, & Brooks, 1982b).

*Ellis' Model of Information-Seeking Behaviors*

Ellis (1989) examined the information-seeking patterns of academic social scientists. Ellis, one of the primary proponents of a "user-centered approach" in information-seeking behaviors research, developed a behavioral model of information-seeking behaviors by focusing on individual behaviors rather than a cognitive viewpoint. He emphasized that "the principal

theoretical premise of the study was that behavior offered a more tractable focus of study than cognition and that a behavioral approach to user modeling would be more feasible than the prevailing cognitive approaches in IR research" (Ellis, 2005, p. 138). Ellis' model does not address cognitive or affective aspects of information seeking (Ellis, 1993; 2005; Xie, 2010).

Ellis' model of information-seeking behaviors consists of six types of activity: starting, chaining, browsing, differentiating, monitoring, and extracting. Starting is the initial search for information, and chaining is described as following chains of citations or referential connections between materials. Browsing is a form of semi-directed searching, and differentiating is the act of filtering based on the nature and quality of material examined. Monitoring includes maintaining awareness of developments by keeping track of sources. Finally, extracting involves systematically working through a particular source to find material of interest. Ellis' model contributed to information-seeking behaviors research in that it proposes a behavioral approach to identify the information-seeking patterns of different user groups. With the original model, Ellis developed studies of information-seeking behaviors, which he extended to physicists and chemists (Ellis, Cox, & Hall, 1993) and engineers and research scientists (Ellis & Haugan, 1997). Hence, the behavioral approach of Ellis' model across the range of different groups can be a widely applicable method of modeling the information-seeking behaviors of researchers in academic and industrial research environments (Ellis, 2005).

### *Big6 Skills*

The Big6 approach of Eisenberg and Berkowitz (1990) is used as a framework for information problem-solving. Even though the Big6 model was developed and applied for information literacy studies, "the model holds potential for the study of human information

behaviors" (Lowe & Eisenberg, 2005, p. 66). Also, Nesset (2014) explained the differences and similarities between models of information seeking behaviors and information literacy. The difference involves the fact that information seeking models focus on behaviors and process whereas the models of information literacy rely on metacognitive steps. However, similarly "both make use of models to present best practice and can be used to modify and predict behaviors" (p. 45). The Big6 model guides students (K-12) who encounter many information problems through higher education (Eisenberg, 2008). Furthermore, the steps in the Big6 model help "students engage in metacognitive practices" (Bowler & Nesset, 2013; Nesset, 2014).

The Big6 is comprised of six steps: (1) task definition (defining the information problem and identifying the information needed); (2) information-seeking strategies (determining possible sources and selecting the best sources); (3) location and access (locating sources and finding information within sources); (4) use of information (engaging and extracting relevant information); (5) synthesis (organizing the information from multiple sources and presenting information); and (6) evaluation (judging effective results and efficient process) (Eisenberg, 2008). The Big6 model contributes to information-seeking behaviors studies in that it proposes best practices on information problem-solving, and it can be used to predict user behaviors in the six steps. Through the Big6 model, people learn how to recognize their information needs and how to progress to solve information problems effectively and efficiently (Eisenberg, 2008). Furthermore, it is a nonlinear model so there is no worry about "the anomalous patterns and missed stages of information behaviors of the linear model" (Forster, 2005, p.257).

*Berrypicking Model*

Bates's (1989) Berrypicking model differs from the traditional information-seeking models in that it proposed that users' queries and search terms used are continually evolving. According to Bates (1989), berrypicking is a process in which a user engages in an evolving search with retrieval occurring a bit at a time. The user may find useful information and references with each different conception of the query at each stage. Bates described six information-seeking strategies that are widely used. The strategies include: (1) footnote chasing (following up footnotes found in books and articles of interest and moving backward in successive leaps through reference lists); (2) citation searching (finding out who cites a source by looking it up in a citation index and leaping forward); (3) journal run (identifying a central journal in an area and locating the run of volumes of the journal and searching straight through relevant volume years); (4) area searching (browsing the materials that are physically collocated with materials located earlier in a search); (5) subject searches in bibliographies and abstracting and indexing services (using document representation); and (6) author searching (searching by author in contrast with searching by subject) (Bates, 1989).

The Berrypicking model contributes to the studies of information searching by pushing the limitations of traditional IR systems that assume "information searching is static" (Xie, 2010) and typical search queries are static (Bates, 1989). Also, the Berrypicking model, based on the research on information seeking, provided suggestions for the design of interactive search interfaces. Bates found that users of online databases gather information in bits and pieces rather than in one grand retrieved set during their information-seeking activities and that searchers use a wide variety of search techniques. This finding helps us understand information-seeking behaviors in IR systems as dynamic instead of simply linear.

*Dervin's Sense-Making*

Dervin's Sense-Making methodology has been "a dominating force in recent research on information behaviors," which is "the effort of people to make sense of many aspects of their lives through information seeking and use" (Bates, 2010, p. 2382). Researchers in Library and Information Science (LIS) have been interested in the Sense-Making methodology because the methodology helps "understand contexts and processes of information need, seeking and use" (Tidline, 2005, p. 114), which are basic concepts of information behaviors. The central concepts of the Sense-Making methodology are time, space, movement, gap, step-taking, situation, bridge, and outcome (Dervin, 1998, p. 39). Also, Dervin emphasized that Sense-Making is a metaphorical framework, and the metaphor offers guidance for thinking about people, talking to them, asking questions of them, and designing systems to serve them (Dervin, 1998).

Dervin's Sense-Making approach includes three elements: situations in time and space, gaps, and outcome and bridge. According to Dervin (1992), situations consist of time-space contexts in which sense is constructed. Gaps are where the individual sees something missing in his or her sense. When a person sees a gap, a bridge (or a new sense) is created. Case (2007) stated that the Sense-Making approach reveals the problems that people experience in life and how they face those gaps (p. 158). Dervin's Sense-Making methodology contributes to information-seeking behaviors research by allowing LIS researchers to transcend simple classification and achieve a holistic understanding of information seeking and use (Tidline, 2005). In addition, the qualitative technique of Sense-Making enlarged the perspective of the whole sub-discipline of information behaviors (Bates, 2010).

### 2.1.2. Implications on Research of Children's Information-Seeking Behaviors

General information behaviors theories and models have been applicable to and have influenced children's information behaviors studies.

First, Kuhlthau's ISP emphasized the interrelationships of cognitive, affective, and physical dimensions of information seeking, and Bilal (2000; 2001; 2002a) explored the interplay of cognitive, affective, and physical dimensions of children's information seeking. Bilal (2000) examined children's cognitive, affective ,and physical behaviors by studying what happens when they use a search engine to find information in fact-based search tasks. Children's cognitive behaviors were observed during keyword searching and browsing activities. Their physical behaviors were identified while they did backtracking, scrolling, and navigation. Children's affective states were revealed in their motivation, confusion, and frustration during their search processes. Bilal's findings are consistent with the holistic view of the information-seeking process, which encompasses the user's affective experience as well as cognitive constructs (p. 659). Bilal (2005) pointed out that little attention had been paid to the study of the affective dimension in children's information behaviors.

Kuhlthau (1993) described that uncertainty causes affective states, such as discomfort and anxiety, which in turn influences the articulation of a problem and judgments of relevancy (p. 364). Hence, Bilal emphasized the importance of understanding children's affective states during web interaction to best understand children's successful information seeking. She found that joy and motivation during information seeking on the web increased children's persistence and patience in information seeking. On the other hand, when children get zero results or cannot find relevant information, they experience frustration or confusion. Bilal suggested the notion of emotional design of IR systems for children's effective information seeking. Nesset (2014)

presented the Beginning, Acting, Telling (BAT) model for elementary school students that integrates features identified by research into information-seeking behaviors and information literacy. She applied Kuhlthau's ISP approach as a theoretical framework in which to situate the BAT model. Nesset identified that few models that have been developed using empirical evidence from studies of children's holistic information-seeking behaviors.

Most of the existing studies focused only on the search task. Nesset developed a holistic model similar to the ISP model for understanding the intersection between information-seeking behaviors and the information literacy of children. Nesset believed that the ISP model integrates elements from research into the areas of information-seeking behaviors and information literacy. The BAT model of Nesset has three stages: the beginning stage, the acting stage, and the telling stage. The beginning stage is a general form of inquiry; in this stage, it is important to create activities for students' searching information. This stage is similar to the concept of the formulation stage of the ISP model. The acting stage mainly involves searching for information. This stage is similar to the concept of Ellis's behavioral approach. The telling stage involves the interpretation, integration, and presentation of the information that students have searched for. Furthermore, Nesset believed that both the affective and cognitive behaviors of children play important roles in information seeking.

She identified three stages of children's affective behaviors. First, the beginning stage has three affective states: anticipation, curiosity, and incomprehension. Anticipation and curiosity are related to uncertainty identified from the ISP model of Kuhlthau. In the acting stage, seven affective states are predominant: happiness, diversion, curiosity, irritation, disappointment, frustration, and distraction. Finally, Nesset found that five affective states are associated with the telling stage. Those include pride, relief, satisfaction, dissatisfaction, and boredom. Cognition is

also an important part of children's information seeking. Nesset emphasized that "including learning within the cognitive behaviors signifies that what is learned during the execution of the three stages may be re-applied to an information seeking event in the future" (p. 58), and this learning is facilitated and improved by metacognition. The metacognition concept is from the Big6 model, which relies on a set of steps or skills to encourage metacognition practice for children.

Druin et al. (2010) investigated search roles children display using Internet keyword search interfaces. They believed the Big6 and the ISP models described information seeking as systematic, orderly, and procedural, and that those models are not concerned with interface development for children's information seeking. However, children's information seeking using a keyword search interface on the web can lead to uncertainty with a search process that can be repetitive, complex, and end in frustration (p. 413). The Big6 and the ISP models described the stages of the search process, implying that if students learn these models, they will be successful in understanding their information needs. Even though the ISP model is linear and progresses in a straightforward way, Druin and her colleagues believed that the holistic view of the ISP model can be applicable to looking at children's information behaviors using new interfaces.

Bilal and Kirby (2002) investigated differences and similarities of information seeking on the web between children and adults. They explored children's and adults' cognitive, affective, and physical dimensions in information seeking on the web and compared cognitive, affective, and physical behaviors between children and adults when they engage in information seeking on the web. They found that children browsed and looped searches more often than adults due to children's lower cognitive recall. Finally, most children in the study experienced affective states by being motivated to use the web, while some children felt frustration and confusion in using

the web. Bilal and Kirby emphasized the importance of learning the cognitive processes, actions, and affective states of information seeking to get a holistic view about the user's behaviors. Belkin's cognitive viewpoint from the ASK approach; Kuhlthau's ISP model that was associated with cognitive, affective, and physical dimensions; and the behavioral approach of Ellis' model of information-seeking behaviors helped researchers obtain a holistic view about children's information-seeking behaviors.

Kuhlthau's ISP stages help understand children's information seeking on the Internet. Spears and Mardis (2014) investigated the relationship between broadband access and children's information seeking in the United States. Spears and Mardis believed that the robust connectivity of broadband enables children to personalize their approaches to learning; however, inadequate and unreliable Internet access make children distracted from the information search process and feel frustrated. Also, insufficient access leads to a lack of persistence that may cause poor task definition, weak search strategy, or failures in information seeking. On the other hand, positive Internet access experiences contribute to children's sense of success and accomplishment of learning. Spears and Mardis used the six stages of the ISP model to report their findings. They believed that "the ISP model is a useful framework for designing, framing, and analyzing the investigation of information seeking behaviors in complex tasks and has been validated in a number of contexts" (p. 235).

Meyers, Fisher, and Marcoux (2007) explored information behaviors of tweens (ages 9-13). They pointed out a problem that no adequate holistic approach exists that focuses on children. They emphasized the holistic view—including tweens' cognitive, social, and physical developmental attributions—for youth information behaviors studies. Meyers and colleagues incorporated into their study several theories of information seeking for everyday life, situations

including Dervin's Sense-Making. With the notion of Sense-Making, Meyers and colleagues developed research questions: what types of everyday information tweens perceive themselves as needing, how tweens seek everyday information, and what barriers tweens encounter in seeking and using information. By introducing a novel approach to tweens' everyday information seeking, Meyers and colleagues outlined key features of a holistic youth information perspective that is associated with cognitive, social, and physical dimensions in the study.

Koh (2011) applied Dervin's Sense-Making methodology (SMM) to investigate youth information behaviors in the digital age. She conducted a group interview because she believed that the group interview has potential to obtain deep and honest data efficiently and dialogically. According to Koh, SMM helps focus interviewing practice on queries that address how informants see themselves bridging gaps from one situated sense-making instance to another. She also believed that SMM has been widely applied in various areas, particularly information behaviors.

Koh described the unique aspects of the SMM group interview as follows: 1) disciplined communication with prescribed talking and listening turn-takings and; 2) limiting spontaneity in order to constrain the impact of powerful interests and habitual communication patterns (p. 45). In addition, in a study of children's touch-based device use, general theories are applicable for the theoretical framework. Agarwal (2014) used Dervin's Sense-Making methodology to develop understanding of toddlers or preschoolers' sustained engagement with touch-based devices. The three communication approaches were used in the study: 1) it is possible to design and implement communication systems and practices that are responsive to human needs; 2) it is possible for humans to enlarge their communication repertoires to pursue this vision and to

discipline their communicating to achieve these possibilities; 3) achieving these outcomes requires the development of communication-based methodological approaches (p. 11).

Belkin's ASK hypothesis considers the cognitive viewpoint that rests on the concept of knowledge structure and focuses on the way an individual thinks and behaves in response to information needs. As with the cognitive viewpoint of ASK, Borgman, Hirsh, Walter, and Gallagher (1995) described the notion that children are active problem-solvers with an evolving information need in information seeking. Cooper (2005) demonstrated that "Belkin's ASK may be more felt by children because they have a significantly smaller stock of knowledge and experience on which to base a question that will satisfactorily relate their information need" (p. 289). Cooper believed that children's cognitive, physical, social, and emotional development influence their ability to interact with a digital environment, and she addressed the developmental considerations and design responses supportive of children's information-seeking behaviors. When she asked the participating children to identify an aspect of the topic they pursued, Bilal (2002a) confirmed that a number of children experienced the anomalous state of knowledge, in which a user may not be able to specify precisely what information he or she needs in the initial stage of information.

Although Bates' Berrypicking model proposed the concept of evolving queries and search terms and has been cited in the literature widely, it is difficult to find research applying the model in the areas of children's information behaviors. In order to find the reasons, some assumptions can be addressed here. First, the Berrypicking model focused on the searching behaviors of adult users instead of children. Most IR systems are designed to fit adult users, and there are differences between children and adults in information-searching and behaviors (Backhausen, 2012; Bilal & Kirby, 2002). Furthermore, children browsed in ways other than just

using keyword searches on the web (Bilal & Kirby, 2002), and prefer browsing to searching by keyword (Borgman, Hirsh, Walter, and Gallagher, 1995; Druin et al., 2009; Hutchinson, Druin, & Bederson, 2007). However, Bates (1989) stressed that Berrypicking and browsing are not the same behaviors, and that Berrypicking behaviors involve the use of a wide variety of techniques. In addition, the Berrypicking model was observed in the users of an online database, so it is difficult to generalize the model to information behaviors in different IR systems.

General theories are applicable as frameworks for children's information behaviors research; however, general theories or models have to be validated with children (Bilal & Sarangthem, 2008). In addition, Shenton and Dixon (2003) pointed out that little research on children's information behaviors has been conducted despite the development of models in LIS. They developed models of children's information behaviors that are comprised of four types: instructional, grounded, narrative, and synthesized. Instructional models are related to the development of skills instead of actual behaviors. These models are idealized and make no attempt to represent the "reality" of how youngsters find information. The grounded models evolved directly from research and differ from the instructional models in that these models aim to represent behaviors. The grounded models are comprised of several phases that convey actions sequentially. The narrative models are similar to the grounded models. The stages of the narrative model emerge from the data collected. Last, synthesized models are derived from analysis of past work. The synthesized models are different from the grounded and narrative models, which are both associated with research undertaken.

Bilal and Sarangthem (2008) also developed task-based models of children's information seeking behaviors in digital libraries (DLs). The models involve seven steps: 1) start; 2) recognize; 3) browse; 4) differentiate; 5) read; 6) explore; and 7) finish. After recognizing an

information need, a child begins a task by scanning, and the resulting action is selecting. In the recognize step, a child scans a menu and selects from the menu. In the third step, directed and semi-directed types of browsing were observed. Directed browsing involves viewing and verifying information. Semi-directed browsing includes examining the information found. In the fourth step, two types of discrimination behaviors were observed. The first is directed differentiation consisting of viewing, and the other is undirected differentiation that is characterized by sweeping. In the fifth step, two types of behaviors were involved. Directed reading includes viewing and engaging in reading a digital collection, and undirected reading consists of flipping digital book pages. The sixth step, exploration, occurs throughout information seeking but is more prevalent during digital book reading. The sixth step is comprised of navigating and backtracking. In the final step, a child finishes a task and moves to another one or has completed all tasks and stops.

The information behavior theories and models have contributions to be applied for children's help-seeking studies. For example, the ISP model found the interrelationship of the cognitive, affective, and physical dimensions of information seeking. Cognitive, physical, and affective dimensions of children's help seeking in using IR systems can be examined. The ASK hypothesis helps design interactive information retrieval systems for children, and the behavioral approach of Ellis' model can be applied to identify children's help-seeking patterns.

However, there are limitations in these information behavior theories and models when applied to children's help-seeking research. First, the ISP model is a linear process (Druin et al., 2010; Foster, 2005; Weiler, 2005), and it does not consider the anomalous patterns and missed stages of information behaviors, such as nomadic thoughts occurring during the information search (Foster, 2005). Second, applicability of the ASK hypothesis to IR system design can be

challenging. For example, Belkin and his colleagues (1982b) uncovered the difficulties in applying the ASK model to IR system design due to the variety of ASKs. Third, the Big6 model relies on a set of steps or skills rather than a process to encourage metacognition in students (Bowler & Nesset, 2013). Hence, the Big6 model is considered as a model of information literacy rather than a model of information-seeking behaviors. Finally, as the Berrypicking model has never been validated empirically (Knight & Spink, 2008), it is difficult to apply it to the research of children's information seeking and help seeking.

## 2.2. Children's Information Behaviors in IR Systems

*Children's Information Searching*

Prensky (2001) referred to children today who are all "native speakers" of the digital language of computers, video games, and the Internet as "Digital Natives" and believed that the "Digital Natives" think and process information fundamentally differently from their predecessors (p. 1). Beheshti, Bilal, Druin, and Large (2010) also refer to children who were born after 1989 and are well versed in using such computer games as **"**Digital Natives." A number of studies have been undertaken to understand today's children's information-seeking and help-seeking behaviors in digital environments. Dresang (2006) identified many studies investigating youth information-seeking behaviors in digital environments focused on children's encountered challenges in using digital media including IR systems and the Web.

*Children's Information Searching in Using Search Engines*

Kafai and Bates (1997) examined children's web searching for the development of effective web-searching instructions for children. Children tend to spend more than a few

minutes at any one site, and they prefer sites with colorful pictures and graphics. Also, computer-savvy sixth grade children were able to master the most sophisticated searching techniques by using combinations of search terms. Schacter, Chung, and Dorr (1998) investigated elementary school students' information seeking on the Internet and found some uniqueness in children's information-seeking behaviors there. First, children are reactive searchers who do not systematically plan or engage in elaborate analytic search strategies. Second, children overwhelmingly rely on browsing strategies to seek information. Third, children do not use sophisticated analytic search techniques, such as using Boolean search terms, adjacency indicators, exact term searching, or truncation. Finally, some children used a full sentence as a search query.

Bilal (2000; 2001; 2002a) examined children's information-seeking behaviors on a search engine. Children showed a pattern of moving back and forth between searching and browsing by using natural language, visiting sites, browsing under subject categories, and searching by keyword. Bilal (2000) also found that children were "divergent thinkers," "creative," and managed to negotiate different search strategies (p. 653). Children negotiated different strategies and composed queries with abstract concepts when concrete keywords did not produce relevant results (Bilal, 2001). In the initial search, children tended to perform keyword searches using one or two terms in their search statements (Bilal, 2002a).

Bilal and Kirby (2002) also examined children's information-seeking behaviors compared to those of adults. In their study, when children searched for information on the web, they did not use advanced search syntax, and they used browsing and searching nearly equally. Children scrolled through the returned results less often than adults. Furthermore, children looped searches and hyperlinks, and backtracked much more often than adults. Children were not

able to recover quickly from "breakdowns" caused by keyword searching. Finally, most children deviated from any designated target while adults did not deviate from the target during search.

Madden, Ford, Miller, and Levy (2006) also investigated children's-information seeking behaviors on the Internet. Children's search strategies involved using URLs, refining searches, using supplementary tools such as spell checker, using operators and punctuation, and evaluating sites. Lastly, Jochmann-Mannak, Huibers, Lentz, and Sanders (2010) studied children's searching behaviors using search engines. Children used more keyword searching than browsing and experienced problems in judging the relevance of search results when using the search engines.

*Children's Information Searching in Using Online Library Catalog and Digital Libraries*

Borgman, Hirsh, Walter, and Gallagher (1995) studied children's searching behaviors using the Science Library Catalog. Children had little difficulty navigating the hierarchical structure of the online catalog. Also, they were able to use the two-keyword systems of the online catalog more effectively and more quickly than the researchers expected. Children tended to abandon searches more readily in the keyword search systems when they experienced difficulty in spelling or generating appropriate search terms. Hirsh (1997) investigated information-searching behaviors in using the Science Library Catalog. Children who used a keyword search were perfectly successful on every task in the online Science Library Catalog. Children who used browsing were most successful when they had a good understanding of the bookshelf headings. Children appeared to benefit from using both the keyword and browse search options for finding bibliographic information.

Hutchinson, Bederson, and Druin (2006) studied the design of the International Children's Digital Library (ICDL) for effective support of children's information searches. When children engaged in browsing, they created more Boolean queries using the ICDL flat interface. Older children comprehended that they were creating a conjunctive Boolean query more often than younger children. Bilal, Sarangthem, and Bachir (2008) studied the information-seeking behaviors of Arabic-speaking children ages 6 to 10 in using the ICDL. Children's information behaviors in the ICDL consist of seven modes of nonlinear iterative activities. The seven modes are: start; recognize (scanning and selecting); browse (viewing, verifying, and examining); differentiate (viewing and sweeping); read (viewing and flipping); explore (navigation and backtracking), and finish (ending a task or stopping). Reuter and Druin (2004) studied children's digital book-searching behaviors in the ICDL. First grade children enjoyed browsing search results to find appropriate digital books, while fifth grade children tended to conduct multiple queries to seek suitable search results. Most children searched for books based on topics or genres and physical characteristics. Older boys tended to show a strong preference for genres, whereas younger children and older girls had only a little preference for the genre. In addition, boys preferred searching by book characters, and girls searched by book color in order to find digital books in the ICDL.

### 2.3. Children's Help-Seeking Behaviors in IR Systems

Help seeking is considered as an information-searching process. According to Vakkari (2003), the process of information searching is cyclical and can be broken down into five components, as follows: the kind of information that is needed and searched for; the query formulation processes; search tactics; the use of search support tools; and relevance and utility

judgments about the retrieved information. Thus, the use of search support tools is the same concept of using search help features such as "autocomplete," "spell-check," or "showing results for" feature in IR systems.

Druin et al. (2010) identified seven search roles of children ages 7 to 11 years old: developing searcher; domain-specific searcher; power searcher; non-motivated searcher; distracted searcher; visual searcher; and rule-bound searcher. Of particular interest are the developing searchers and non-motivated searchers. The developing searchers often displayed knowledge of helpful search support features such as auto-complete text or spelling correction, whereas non-motivated children usually did not ask for help when confronted with difficulties in searching information.

Furthermore, children used supplementary tools, such as the spell checker or "Did you mean" suggestions, when they attempted to refine their searches, misspelled a word, or made a mistake in search formulation (Madden, Ford, Miller, & Levy, 2006). Some children were familiar with Google's "Did you mean" suggestions, while some children failed to notice the supplementary tools. Hirsh (1997) addressed the characteristics of children's help seeking in an online library catalog. Some children benefited from more help and instruction in formulating and articulating appropriate search queries for search systems (p. 742). Jochmann-Mannak, Huibers, Lentz and Sanders (2010) also revealed that children took advantage of tools such as the spelling correction, "Did you mean," and the query suggestion tool that appeared in a drop-down box while typing a query. Druin et al. (2009) found that some children used the "related searches" feature after scanning through the list of results. Since the "related searches" feature helped with children's keyword creation and encouraged them to continue the search, Druin and her

colleagues believed this finding confirms the usefulness of a tool that assists users with keyword creation and selection by displaying potential synonyms and other related words (p. 95).

Children recognized that online help for web searching is important (Bilal, 2003). When children were asked to design interfaces for a web search engine, a help feature appeared twice in their drawings, indicating its importance. Children asserted unanimously that "help features would only be useful if they could provide concrete advice on how to find the information being sought" (Large, Beheshti, Nesset, & Bowler, 2006, p. 20). Furthermore, Bilal (2000; 2002a) found that while searching in search engines, children explored and moved to online help to solve problems and perform tasks. Bilal (2007) emphasized the importance of the development of information systems that support users cognitively and affectively for effective information searching and help seeking by children. She offers some suggestions for providing corrective feedback, such as spelling suggestions, recommendations for search refinement, and context-driven help to recover from breakdowns. As the number of social network sites (SNSs) increases, SNSs are used to obtain the information and the help youths need.

Laplante (2014) studied how SNSs are used and perceived by youths for academic help seeking. Although most adolescents had a personal social network, they did not fully benefit from the resources in the SNSs. Most youths preferred to ask the help of strong ties instead of weak ties. The poor social skills of adolescents and the difficulty of using connections through SNSs to seek instrumental help from classmates make it less likely that youths will find the help they need in their SNSs.

## 2.4. Children's Help-Seeking Behaviors in Learning Environments

Studies about children's help-seeking behaviors in learning environments have been investigated since the 1980s. According to Nelson-Le Gall and Glor-Scheib (1985), help seeking in elementary classrooms may emerge from different underlying motives depending on the child and the task situation. In learning environments, children's help seeking is considered fundamental for problem-solving, enhancement of their knowledge state, and learning skills. Learners may seek help from others to effect changes in the individual's knowledge state and skill range (Nelson-Le Gall, 1985).

Nelson-Le Gall (1981) developed a model of children's help-seeking process based on a task analysis of the help-seeking process that identifies both cognitive and behavioral activities that are essential to learning and achievement. The heuristic model Nelson-Le Gall suggested consists of five main components: awareness of need for help, decision to seek help, identification of potential helpers, employment of strategies to elicit help, and reactions to help-seeking attempt(s). Once the decision of help seeking has been made, the child tries to identify potential helpers and employs strategies to elicit help. Finally, the child evaluates the success or failure of the help-seeking attempt, that is, whether the help was effective.

Moreover, some studies (Nelson-Le Gall, 1987; Newman, 1990, 2000) investigated age- and grade-related differences in children's help seeking in learning environments. Newman (1990) investigated the help-seeking behaviors of children at grades 3, 5, and 7 in classroom environments and found grade-related differences between third and fifth and seventh grade in help-seeking behaviors. Children at grades 3 and 5 were likely to depend on the teacher for help, while seventh graders tried for help independently. Newman (2000) believed that students ask for help in classroom environments to achieve several different goals including learning goals

and performance goals. Nelson-Le Gall (1987) examined the task-related help seeking behaviors of third and fifth graders in classrooms to explore age-related differences in help seeking employed by children. She found that children who had low academic performance records requested more help than their high-ability counterparts. She also found that participants in the third and fifth grades preferred indirect help (e.g., hints) to direct help (e.g., answers). She found that children's help seeking in formal and informal learning environments is related to their motivation and achievement goals.

## 2.5. Domain Knowledge Factor Related to Information Searching and Help-Seeking Behaviors

Domain Knowledge has been identified as a crucial factor that influences information search success, information seeking behaviors (Bilal, 2001; Hirsh, 1997, 2004; Hsieh-Yee, 2001; Marchionini, 1995;Willoughby, 2009), and help-seeking behaviors in IR systems (Xie & Cool, 2009).

### *Domain Knowledge Factor related to Children's Information Searching Behaviors*

Hirsh (1997, 2004) found that domain knowledge influences children's search success on tasks and found that children with high domain knowledge performed better in information-searching tasks than children with low domain knowledge. Hirsh (2004) also emphasized that domain knowledge affects children's searching behaviors. She found that children with high domain knowledge were able to refine their search queries based on the retrieved results. Furthermore, children with low domain knowledge preferred using browsing over keyword search, while children with high domain knowledge used the keyword search rather than

browsing. Dinet, Bastien, and Kitajima (2010) found that children's visual strategies for search engine result pages differ depending on their domain knowledge levels.

The limited domain knowledge of children causes difficulties in formulating queries (Gossen & Nürnberger, 2013). Bilal (2001) investigated whether children's domain knowledge influences their information-searching behaviors. However, the influence of children's domain knowledge was not significant. The results showed that children with adequate domain knowledge were partially successful in performing information-seeking tasks, while children with higher domain knowledge were unsuccessful in the tasks. Wood and Wood (1999) investigated the relationship between preteens' help seeking in computer-based tutoring systems and domain knowledge. The result showed that children with less domain knowledge sought help more frequently than their peers with more domain knowledge. However, their findings demonstrated that children with more domain knowledge made fewer errors and were more likely to self-correct their errors. Thus, children with more domain knowledge were also more likely to seek help for their self-corrected errors, and they tended to exert effective help-seeking behaviors.

### *Domain Knowledge Factor Related to Adults' Information-Searching and Help-Seeking Behaviors*

Domain knowledge affects adults' information-searching and help-seeking behaviors in using IR systems. Wildemuth (2004) investigated the effects of university students' domain knowledge on their online searching behaviors and found that there were more search moves when participants' domain knowledge was very low. Zhang, Anghelescu, and Yuan (2005) explored the impact of users' domain knowledge on database-searching behaviors. Their findings show that users tend to do more searches and use more terms when they formulate search queries

as users' levels of domain knowledge increase. Willoughby et al. (2009) found that domain knowledge is one of crucial factors affecting users' Internet searching behaviors. They examined the effect of domain knowledge on undergraduate students' information searching. Their results show that domain knowledge is a critical factor in users' successful information retrieval and use of Internet information. White, Dumais, and Teevan (2009) also explored the influence of users' domain knowledge on their searching and found that people with high domain knowledge search differently and more successfully compared to ones with little or no domain knowledge.

Users' domain knowledge is also an important factor in help-seeking behaviors in digital environments. Bartholomé, Stahl, Pieschl, and Bromme (2006) observed the effect of users' domain knowledge on their help-seeking behaviors and found that university students who have low domain knowledge used context-sensitive help more often and more effectively in computer-based interactive learning environments than ones who have high domain knowledge levels. The findings of Xie and Cool (2009) indicate that users' lack of domain knowledge affects their help-seeking situations, particularly their inability to start the search process. However, the result of Wu (2011) shows that users' domain knowledge is not significantly related to help-seeking behaviors in using Microsoft Word.

Previous studies emphasized that domain knowledge is one of the significant factors in users' information-seeking and help-seeking behaviors, but no empirical research that investigated the influence of children's domain knowledge on their help-seeking behaviors in IR systems has been conducted. This dissertation fills a gap in the literature by examining the effects of elementary school-aged children's domain knowledge on their help seeking and use of help features in IR systems by using reliable assessment techniques to measure children's domain knowledge.

## 2.6. Other Factors related to Children's Information-Searching and Help-Seeking Behaviors

According to Marchionini (1995), information seeking relies on interactions among several factors including the particular information seeker, task, search system, domain knowledge, setting, and search outcomes (p. 32). Bilal (2004) emphasized attention to factors that influence children's information seeking on the web, including their cognitive style, navigational style, mental models, web experience, domain and topic knowledge, reading ability, level of research skills, and academic achievement. Factors that influence children's help-seeking or information-seeking behaviors will be discussed in the following section.

### *Tasks*

A task is an activity to be performed to accomplish a goal, and the performance of a task includes physical and cognitive actions (Vakkari, 2003, p. 416). Xie (2009) also found that the task is one of the leading factors to cause individuals to search for information. Hsieh-Yee (2001) thought that the nature of a search task influences information seeking. In other words, information seeking depends on whether a task is fact-based, open-ended, object oriented, and so on. Schacter and colleagues (1998) found that the task structure has effects on children's information retrieval. They found that children searched and performed more effectively on ill-defined tasks that have vague goals, many possible solutions, and no clear directions rather than on well-defined tasks that had clearly defined goals. Hirsh (1997) found that task complexity influences children's information-seeking success in an online library catalog, specifically the Science Library Catalog. Hirsh divided the participants into two groups to investigate the relationships between task complexity and search success. One examined browsing task complexity and the other examined keyword task complexity. Children were most successful in

finding results on the simple-browsing task. In the complex-browsing task (did not contain words matching the bookshelf or topic headings), children felt the most difficulty and showed a lower success rate. However, the results related to keyword task complexity were reported only with descriptive statistics due to a lack of balance in the topics.

Children's search success levels varied between research tasks and fact-based tasks. The research tasks required children's critical thinking skills, while the fact-based tasks dealt with questions for which answers were identified by the researcher prior to the experiment (Bilal, 2001). Children experienced more difficulty with the research task than the fact-based task because the research task involved a complex topic that required the use of their domain and topic knowledge (Bilal, 2001). In a later study that expanded on this, Bilal compared self-generated tasks with research tasks to further investigate children's cognitive and physical behaviors in their information seeking. Children were asked to choose topics of interest to search in the Yahooligan site for the fully self-generated task. Children performed more searches on the fully self-generated task than the research task (Bilal, 2002a). Also, children made the highest number of web moves, such as hyperlink activation, backtracking, looping, and exploratory moves, on the fully self-generated tasks.

*System Design*

Interface design, information organization, and the presentation of IR systems affect children's information-seeking or help-seeking behaviors.

Jochmann-Mannak et al. (2010) studied whether interfaces of search engines support children's information seeking effectively. They found that task success varied by the types of interface. Although Google is designed for general users instead of children, children performed

tasks better on the Google interface than on the selected interfaces designed for children, as indicated by spending less time and having fewer mouse clicks on Google. According to Jochmann-Mannak et al., spelling errors and typing query mistakes are major obstacles for children's searching, but most children used search support features like the "Did you mean . . . " and "autocomplete" features found in Google and in one interface designed for children. These features not only help children find information effectively but increase search success. Also, the search support features encourage children in help seeking in IR systems as well as allow them to overcome obstacles in searching information.

Because children's cognitive and motor skills are not fully developed, it is important to design kid-friendly interfaces to support children's information seeking effectively. Gossen, Hempel, and Nürnberger (2013) found that most search engines designed for children do not provide observable advantages compared to Google and lead to children's frustration during the search. They provided interface design criteria to be more effective for the information seeking of children. The criteria for supporting children's cognitive skills include a combination of browsing and keyword search tools, support of backtracking, and presentation of search results with large font size, pictures, or multimedia. They also suggested incorporating large button sizes and short page lengths as a way of addressing children's motor skills.

Theng et al. (2000) believe that it is important to design usable and useful children's digital libraries to satisfy children's information needs, and they worked with children as design partners and testers for the development of a children's digital library (DL). Theng and colleagues found that children prefer three different interface designs. First, children loved the use of bright color, graphics, and audio for screen display. Second, children preferred simple design with easy access to help in the form of a helpdesk/librarian. Finally, children wanted links

to other relevant sources and typing aids. The results showed the importance of interface design in supporting children's cognitive and motor skills, as well as children's help seeking.

Hutchinson et al. (2004) thought that designing a children's DL system for multi-lingual, multi-cultural, and multi-generational users is important for disseminating information and helping the information seeking of children who are culturally diverse. With Arabic-speaking children as a culturally diverse group, Bilal and Bachir (2007) investigated whether they understand the ICDL interface's design in support of an international and multi-lingual collection. Bilal and Bachir believed an "international user interface should be understood by culturally diverse users regardless of language" (p. 49) to help them access and use the site easily and effectively for information seeking. Bilal and her colleague found that younger Arabic-speaking children did not recognize any of the representations embedded in the interfaces of the ICDL due to their lack of experience in using the Internet, lack of cognitive preparation, and the language of the interface. Thus, Bilal and Bachir suggested for younger children who are culturally diverse an interface design providing a simple visual interface that is enhanced with meaningful and noticeable icons along with audio in order to help them understand the meaning of the ICDL representations and to help effective information seeking.

According to Jochmann-Mannak, Huibers, and Sanders (2008), children's searching behaviors can be strongly influenced by the interface design of IR systems. Moreover, complex interfaces have influenced children's information-seeking behaviors (Bilal, 2004). Hutchinson, Bederson, and Druin (2006) investigated whether different types of interface design influence children's search performance. For their study, they created two types of interfaces, one that is flat and another that is hierarchical. The flat interface was equal to the other interface except for keyword and language search options, and the hierarchical interface used a two-level category

structure. The results showed that children performed searches faster on the flat interface than the hierarchical interface, and children felt it was easier to use the flat interface than the hierarchical one.

*Prior Experience*

Prior experience in using computers and the web has been considered one of the important factors that influences information-seeking behaviors (Bilal, 2000; Hirsh, 2004; Hsieh-Yee, 2001; Madden et al., 2006) and help-seeking behaviors (Wu, 2011; Xie & Cool, 2009).

Bilal (2000) examined whether children's prior experience in using the Internet and search engines influences their success in finding desired information in a search engine. The findings revealed that children who had more experience in using the Internet and search engines performed more successfully than less experienced children. However, Bilal (2001) also found that prior experience in using the web did not have a significant effect on children's search success due to an unequal distribution in the number of children who had high and low levels of experience. Hirsh (2004) used an online library catalog to investigate the influence of having prior experiences using the computer in children's information seeking. She found that children's experience with a computer did not influence their success in finding information on the online catalog, but the children's prior experience did influence their searching behaviors. Children who had more computer experience used various search techniques, and they were more comfortable in using the full range of the system's search capabilities, while children with less computer experience used a single search technique and did not explore others.

Madden et al. (2006) explored factors that determine children's successful information seeking and found that children's experience in using the Internet is a crucial factor that

influences their successful information seeking on the Internet. Prior experience has certain effects on people's help-seeking behaviors within the digital environment (Wu, 2011). Xie and Cool (2009) investigated novice users' help-seeking situations and found that prior experience in using IR systems affects the help-seeking situation, termed the "Inability to get started" of novice users.

*Cognitive Abilities*

Children are considered as a "special" user group because their cognitive abilities are not as developed as those of adults (Bilal, 2002a). Children's cognitive development has an influence on their interactive search in a digital environment (Cooper, 2005) and their information-seeking behaviors in IR systems (Bilal, 2000).

According to Borgman et al. (1995), children find it easier to recognize information presented to them than to recall it from memory (p. 665). This is because recognition produces less cognitive load than recall. Furthermore, older children can recall more than younger children, as older children know more in a particular domain and are able to recall more concepts. Therefore, Borgman and her colleagues suggested utilizing children's recognition skills in IR systems to increase their effectiveness in information seeking. Bilal (2000) found that children's hyperlink looping during search tasks may have been influenced by their limited recall ability in a search. This finding indicated that some children did not remember the concepts they used in their research statements due to their limited recall ability. Also, children's lack of focus on tasks and limited navigational skills can be considered as main problems of their cognitive ability in relation to information seeking. Gossen and Nürnberger (2013) studied influences on children's information seeking from an information processing perspective. They found that older children

have larger chance of success or need less time to perform complex tasks more successfully than younger children because older children are able to retrieve information processes from long-term memory and perform those processes automatically. In addition, Gossen and Nürnberger emphasized that as children get older, they are able to process information faster and perform searches better with better fine motor skills than younger children.

*Affective States*

Many studies have considered the role of affect in the information-seeking process (Foss et al., 2012). According to Kuhlthau (2004), the feelings expressed by users may help researchers better understand users' information-seeking behaviors.

Bilal (2005) emphasized the importance of children's affect in information seeking. While searching, children's affective states, such as "joy of using the web, frustration, confusion and motivation," were observed in her previous studies (2000, 2001, 2002a). First, in spite of the search difficulties and breakdowns, Bilal found joy, motivation, and self-confidence in using the web and positive emotions influencing children's persistence and patience in searching information. She also found that when children received zero results and did not find relevant information, they were likely to feel frustration. Kuhlthau (2004) emphasized that anxiety in information seeking and feelings of anxiety are attributed to a lack of familiarity with information sources and systems. Furthermore, Wu (2011) believed that feelings of anxiety are an important factor in help seeking in digital environments. She reported that users with high anxiety related to using the computer may not use help features to complete tasks in digital environments.

## 2.7. Human Development Theories

### 2.7.1. Children's Cognitive Development: Information Processing Theory (IPT)

Information processing perspectives are useful for understanding children's development of cognition during the ages of 8 to 10 because the theory characterizes human thinking and "cognitive aspects of human motivation" (Ormond, 1999, p. 177).

*Information Processing Theory*

According to Miller (2010), information processing is not a single theory but a framework characterizing a large number of research programs, with information processing investigators examining the flow of information through the cognitive system. Siegler and Alibali (2005) indicated that the most fundamental assumption of information processing theories is that thinking is information processing. Thus, proponents of Information Processing Theory (IPT) have examined developmental differences in several important aspects of children's thinking and the aspects of children's information processing that influence all types of thinking, including: 1) memory capacity, 2) speed of processing, 3) use of strategies, 4) metacognition, and 5) knowledge base (Miller, 2010; Shaffer & Kipp, 2010). It is believed that young children have poor memories (Miller, 2010).

Siegler and Alibali (2005) noticed that children's basic cognitive organization is viewed within a three-part framework, including sensory memory, working memory, and long-term memory. They emphasized that the capacity of children's sensory memory increases with their age. According to Baddeley (2003), the concept of working memory (WM) proposes that a dedicated system keeps and stores information in the short term. Also, he said that current views of working memory involve a central executive and two storage systems: a "phonological loop"

and a "visuospatial sketchpad." The visuospatial sketchpad specializes in processing and maintaining visual and spatial information, and the phonological loop processes and retains speech sounds, and constitutes children's memory span (Miller, 2010).

First, Baddeley (2000) emphasized the importance of an episodic buffer as a new component of the working memory that is assumed to be a limited-capacity temporary storage system. The buffer is episodic in the sense that it holds episodes whereby information is integrated across space and potentially extended across time (Baddeley, 2000, p. 421). The episodic buffer is important in that it helps form representations that are both visuospatial and auditory, and it constructs a new representation that can then be stored in long-term memory (Miller, 2010). Older children can maintain considerably more information in their working memory than younger ones because of their more rapid rate due to repeated rehearsal (Siegler & Alibali, 2005). As children develop cognitively and construct systems of related concepts in their long-term memory, it is easier for them to rehearse and remember (Miller, 2010).

Second, the faster children can process information, the more information they can deal with at any one time (Miller, 2010, p. 290). Miller emphasized that children can repeat back a string of numbers that increases in length as age increases. Furthermore, Shaffer and Kipp (2010) revealed that biological maturation, such as increased myelination of neurons, is primarily responsible for broad, age-related differences in the speed of information processing. The faster processing leads to improved performance on many tasks (Siegler & Alibali, 2005, p. 242).

Third, a central view to the IPT is that people have a variety of cognitive operations that they apply to information and that both the quantity and quality of these operations change with age (Shaffer & Kipp, 2010). Shaffer and Kipp indicated that much of people's thinking is guided by strategies, and even young children may discover or invent strategies when they encounter

problems in everyday life (p. 304). Although young children can use some strategies effectively, generally younger children use fewer strategies and use them far less effectively than older children (Shaffer & Kipp, 2010). Furthermore, children continue to obtain and fine tune their strategies, and by the preteen years, children can choose a strategy that fits the particular task and perform the strategy spontaneously, quickly, and efficiently, with the result that older children are more likely to select relevant material than younger children (Miller, 2010). Siegler's overlapping waves theory provides a characterization of development, and it depicts children as using multiple approaches for prolonged periods of time (Shrager & Siegler, 1998). The overlapping waves theory indicates that children are viewed as typically knowing and using a variety of strategies for solving a given problem at a given time (Sigler, 2005).

Fourth, knowledge of one's thought process is described as metacognition (Shaffer & Kipp, 2010). Ormrod (1999) indicated that people's knowledge of their own learning and cognitive processes—and their consequent regulation of those processes to improve learning and memory—are collectively known as metacognition. Metacognition can be divided into two types of knowledge (Siegler & Alibali, 2005). One is implicit (unconscious) knowledge and the other is explicit (conscious) knowledge. Implicit knowledge, factual knowledge about memory, is evident in individuals monitoring their own cognitive activities (Siegler & Alibali, 2005). Self-monitoring skills are critical in children's cognitive activities, and older children can more effectively monitor their knowledge and study strategies than younger children (Siegler & Alibali, 2005). Explicit knowledge includes information about tasks, strategies, and characteristics of people; much of this knowledge seems to be collected between ages 5 and 10 (Siegler & Alibali, 2005). About 50% of first graders know that it is easier to remember the gist

of a story than it is to remember the story verbatim, while most fifth graders know this (Siegler & Alibali, 2005).

Finally, knowledge helps recall (Miller, 2010). The more people know about a topic, the better they learn and remember new information about the topic (Siegler & Alibali, 2005). A greater knowledge in a particular domain helps children demonstrate good memory in that domain, and a rich knowledge base may allow children to automatically access items to be recalled (Miller, 2010). Prior knowledge influences children's execution of basic processes and strategies, their metacognitive knowledge, and their acquisition of new strategies (Siegler & Alibali, 2005). Nevertheless, McNeil and Alibali (2005) pointed out that some domains of knowledge, such as mathematics, science, and foreign languages, are so difficult to learn that many people fail to accomplish basic competence after years of schooling. As children learn about a topic, spreading activation helps them remember effectively; therefore, more knowledgeable children can use strategies more often than less knowledgeable ones (Siegler & Alibali, 2005, p.263).

### 2.7.2. Information Processing Theory for Children's Information and Help-Seeking Behaviors

IPT focuses on how people process the information they receive from the environment (Ormrod, 1999). Children ceaselessly strive to reach their goals in spite of limited memory capacities and limited knowledge (Siegler & Alibali, 2005). In order to overcome limited memory capacities, children use strategies such as rehearsal, and they use tools, such as encyclopedias, calculators, the Internet, and older children and adults who will answer their questions, to overcome their limited knowledge (Siegler & Alibali, 2005). According to Case (2007), an information need is a recognition that your knowledge is inadequate to satisfy a goal

that you have, and information seeking is a conscious effort to acquire information in response to a need or gap in your knowledge (p. 5).

Today, with the widespread use of the Internet and digital technology tools, a variety of user groups, including children, have engaged in information seeking in Information Retrieval (IR) systems such as search engines, online library catalogs, and digital libraries more and more freely to satisfy their limited knowledge. However, many studies do not consider age differences in exploring children's information seeking in IR systems. Byrnes and Bernacki (2013) pointed out that few studies have explored possible age differences in information-seeking behaviors. They emphasized the importance of considering age differences in the tendencies to seek, interpret, or use information for studies on children's information-seeking behaviors. Cognitive developmental viewpoints generally depict age and thought (Siegler, 1996), and the information processing perspective is particularly applicable to studies exploring how children find information and seek help in IR systems. The theory is effective for understanding and explaining cognitive growth and the knowledge base of children in the concrete operational stage for their information seeking and help-seeking behaviors because IPT covers "the flow of information through the cognitive system" (Miller, 2010) and "cognitive growth such as age-related and experience-related changes" (Siegler & Alibali, 2005). Also, IPT involves detailed, in-depth analyses of children's performance on a single task or a narrow range of tasks and the development of children's thinking (Siegler & Alibali, 2005).

Memory capacity, speed of processing, use of strategies, metacognition, and knowledge base are aspects of children's information processing that influence their thinking.

*Memory Capacity in Children's Information Seeking and Help Seeking in IR Systems*

Gathercole, Pickering, Ambridge, and Wearing (2004) found age-related differences in the structure of working memory (WM), and Swanson (1999) also revealed age-related differences in WM span. As a child grows, his/her WM span expands. Byrnes and Bernacki (2013) indicated that age-related improvements in performance reflect increases in the ability to process information quickly, store larger chunks of information temporarily, and shift attention. Furthermore, according to Nesset (2005), younger children's information processing requires a great deal of WM capacity due to their limited experience compared to adolescents and adults. As children gain experience, they will experience lower cognitive loads as well as less challenge of the processing capacity of the individual's WM. As children get older, they are likely to retrieve tasks of higher complexity from long-term memory compared to younger children because older children have more experiences than the younger ones (Shaffer & Kipp, 2010).

"Information retrieval processes may cause children's memory to overload" (Gossen & Nürnberger, 2013, p. 743), and kid-friendly IR system design is needed to support children's limited memory capacity. For example, Gossen and Nürnberger (2013) proposed the usage of color, recognizable objects, a built-in history, and result storage functionality for kid-friendly IR interface design. Bilal (2007) suggested usage of iconic representations and symbols that are developmentally appropriate, concrete, and based on children's preferences for the design. According to Beheshti, Bilal, Druin, and Large (2010), when children interacted with IR systems, they experienced more cognitive overload in keyword searching than in browsing.

Gossen and Nürnberger (2013) investigated whether concepts from the information processing perspective influences children's information seeking in digital environments. They found that older children have a larger chance for success or need less time to perform complex

tasks successfully than younger children because older children are able to retrieve information processes from long-term memory and perform the processes automatically. Prior experience in using a computer and the web has been considered as one of the important factors having an influence on information-seeking behaviors (Bilal, 2000; Hirsh, 2004; Hsieh-Yee, 2001; Madden et al., 2006) and help-seeking behaviors (Wu, 2011; Xie & Cool, 2008). If enough experience is gained by conducting more searches in IR systems, the searcher will move from novice to intermediate and perhaps to expert status (Macpherson, 2004).

Xie and Cool (2009) investigated novice users' help-seeking situations and found that prior experience using IR systems affects the help-seeking situation of novice users, which is termed the "Inability to get started—Unfamiliar with digital libraries." In the "Inability to get started" situation, searchers experienced a lack of mental models of digital libraries and how to search within the digital libraries due to their unfamiliarity with IR systems. Moreover, when children engaged in help seeking in IR systems, they experience a reduced cognitive load due to the effectiveness of help systems. Thus, many researchers (Aleven et al., 2003; Bilal, 2007; Cooper, 2005) emphasized the importance of system design supporting children's help-seeking cognition. For instance, Bilal (2007) proposed system designs such as spelling suggestions, recommendations on search refinement, and context-driven help that provided corrective feedback to recover from search breakdowns.

*Speed of Processing in Children's Information Seeking and Help Seeking in IR Systems*

According to Nesset (2005), as children grow and mature, the ability of information processing improves and becomes more effective. Also, she indicated that some processes that have been mastered can be transferred to long-term memory, freeing up space in the WM. As

children gain experience, this helps them to learn new tasks. Therefore, older children are more likely to succeed at performing complex tasks involving many processes because they can perform some of the processes automatically, resulting in an increased processing speed (Nesset, 2005). Gossen and Nürnberger (2013) emphasized that as children get older, they are able to process information faster and perform searches better using their fine motor skills than younger children. Hourcade, Bederson, Druin, and Guimbretière (2004) and Hutchinson et al. (2005) found slower information processing speed causes children to fine tune mouse motion less frequently.

*Use of Strategy in Children's Information Seeking and Help Seeking in IR systems*

Bjorklund, Dukes, and Brown (2008) indicate strategies as "mentally effortful, goal-directed processes that are adopted to enhance memory performance" (p. 145). There is more variability and less consistency in children's strategies and performance than thought (Miller, 2010). Gossen, Hempel, and Nürnberger (2013) revealed that children's cognitive skills influence their information-seeking behaviors, such as their searching strategy and relevant result selection. Children's amount of Internet access influences their information-seeking behaviors in IR systems. For instance, insufficient Internet access leads to a lack of persistence that may cause poor task definition, weak search strategy, or failures of information seeking. On the other hand, positive Internet access experiences contribute to children's sense of success and accomplishment of learning (Spears & Mardis, 2014). Furthermore, Macpherson (2004) found that novice searchers tend to be very slow and careful in their selection of search terms and online databases, and in the formulation of search strategies, and they fail to recognize patterns. Thus, they performed ineffective strategies in information seeking, while expert searchers tend to

recognize pattern easily and recall and mentally test optimal search strategies (Macpherson, 2004).

Marchionini (1989) found that older elementary school children used carefully planned information-seeking strategies, such as locating relevant information in a more direct manner, and exhibiting a better balance between lookup and examine moves in an online database. He mentioned that children who had no previous experience with an online database are likely to have formed more limited information-seeking strategies in the online database than children who had previous experience. Aleven and Koedinger (2000) examined 15-year old students' help seeking strategies within computer-based tutoring systems supporting intelligent and unintelligent help facilities. The intelligent help includes a form of on-demand hints, whereas the unintelligent help involves a glossary. They found that students tended to wait a long time before asking for hints, then focused only on the most specific hints, and repeated their help request until they reached the final hint. They did not read the intermediate hint levels and read only the final hint message.

*Metacognition in Children's Information Seeking and Help Seeking in IR systems*

Metacognition, "thinking responsibly about our thinking" (Bowler & Nesset, 2013, p. 55), is known as individual's understanding of his or her own mental processes (Ormrod, 1999). According to Borgman, Hirsh, Walter, and Gallagher (1995), children find it easier to recognize information presented to them than to recall it from memory (p. 665). This is because recognition needs less cognitive load than recall. Bowler (2009) believed that metacognitive knowledge may help youths to solve complex information problems when it was used in information seeking, and found 13 attributes of youths' metacognitive knowledge related to information-search

processes. The attributes help researchers understand youths' cognitive demands involved in information searching that are multi-faceted, circuitous, and sometimes tangled patterns (Bowler & Nesset, 2013). A lack of overall pattern by youths may be a weakness in the Bowler and Nesset study. To scaffold youths' metacognitive searching behaviors, Bowler and Nesset emphasized the importance of information literacy instruction because they believe that metacognitive knowledge is the most useful asset when people approach a new domain of knowledge in information seeking.

Many researchers (Aleven, McLaren, Roll, & Koedinger, 2004; Babin, Tricot & Mariné, 2009; Nelson-Le Gall, 1985; Puustinen & Rouet, 2009;) have emphasized the importance of children's metacognitive skills to accurately perceive the need for help. In learning, children's ability to engage in selective or self-regulated help seeking depends on their level of metacognitive knowledge (Puustinen & Rouet, 2009). Therefore, they found that third grade children have been reported to have more difficulty in assessing their need for help than fifth graders. On the other hand, Aleven, McLaren, Roll, & Koedinger (2004) explored metacognitive skills in help seeking within a computer-based setting. They believe that metacognitive skill is the ability to solicit help when needed from human or online help systems. In order to help build youths' ability to better seek help, Aleven et al. developed a help tutor, which provides context-sensitive and decontextualized on-demand hints. They found that youths exhibit unproductive help-seeking behaviors and they frequently used hints to find information rather than trying to assess their need for help and understand the tasks. Furthermore, adolescents display more appropriate help-seeking behaviors than children because adolescents are better able to monitor their performance due to their improved metacognitive skills (Aleven et al., 2003).

*Knowledge Base in Children's Information-Seeking and Help-Seeking in IR systems*

Byrnes and Bernacki (2013) emphasized that knowledge is organized along specific distinctions, kinds, or categories, and one basis for organization is content domains such as mathematics, science, or history. Most people have varying levels of expertise in different domains, and cognition is domain-specific (Byrnes & Bernacki, 2013). Borgman, Hirsh, Walter, and Gallagher (1995) revealed that older children can recall more than younger children because older children know more in a particular domain and are able to recall more concepts. Therefore, Borgman and her colleagues suggested utilizing children's recognition skills in IR systems for effective information seeking. In addition, they indicated that the less the children know about the domain, the more likely the children need recognition of assistances to prompt their memory and develop a suitable search strategy. Hirsh (2004) found domain knowledge influences on children's searching behaviors; children who have different domain knowledge levels shows different searching behaviors.

The limited domain knowledge of children resulted in difficulties in formulating keywords (Gossen & Nürnberger, 2013). Nelson-Le Gall (1985) explored children's help-seeking behaviors within the context of education. She believed that too little or too much knowledge in a problem area will lessen the probability of using help seeking as a strategy for solving problems that are encountered. Furthermore, children differ developmentally in their ability to seek help and to use the help available in formal learning situations. Thus, a higher incidence of help seeking at the fifth-grade level than at the lower grades was found. Babin, Tricot, and Mariné (2009) revealed that seeking help and taking advantage of help provided by a system is associated with the domain knowledge of users. They found that experts asked for help in information systems less frequently than novices, such as users with less domain knowledge.

## 2.7. Summary of Literature Review

Relevant prior studies were reviewed in Chapter 2. Children's information-searching and help-seeking behaviors in using IR systems are different from ones of adults, and their behaviors need to be explained with children's cognitive abilities, which are different from ones of adults. However, theories and models focusing on information behaviors are still do not take into account children's cognitive abilities. In addition, there is little research on children's help-seeking behaviors, associated help-seeking situations and factors**,** and, in particular, the effect of domain knowledge on children's help seeking and use of help features. In order to fill the gaps, this study examines children's help-seeking behaviors as one of the information-searching process components that applies IPT, because research using the theory indicates its practicality in explaining children's information-seeking behaviors and help-seeking behaviors with their developmental characteristics. In addition, information processing perspectives help describe how cognitive growth and knowledge base influence help-seeking behaviors of children in the concrete operational stage.

# Chapter 3: Methodology

Both quantitative and qualitative research methodologies were used to understand children's help-seeking behaviors and the effect of domain knowledge on help seeking and the use of help features in using IR systems. Considering the developmental characteristics of children, this dissertation administered surveys and think-aloud protocols, and also conducted observations and interviews to study children's help-seeking behaviors and the interactions of children with IR systems. Each data collection method has its advantages and limitations; therefore, this study has embraced a mixed methodology. Finally, concepts of internal validity, external validity, and reliability in quantitative research that differ from those in qualitative research were considered for this study.

## 3.1. Participants

### 3.1.1. Sampling and Recruitment

For this study, 30 children 8 to 10 years old having no special needs were recruited as the participants in the study. For the quantitative research design, the sample size of 30 is justifiable because it is known that around 30 or more is relatively large (Gravetter & Wallnau, 2011), and the sample size should not be less than 30 if a study has a survey design (Delice, 2010). Participants in this study are in the range of Piaget's concrete operational stage (ages 8 to 10). Children in the concrete operational stage may lack the ability to find the right search queries, large vocabulary, and good writing skills, and they need more support for their information-searching tasks than children in the formal operational stage (ages 11 to 18) (Gossen, 2016).

This dissertation focuses on children in the concrete operational stage and does not examine age differences. Since there are no significant gender differences between boys and girls

in height, weight, strength, endurance, or motor skill abilities before puberty (Bright Futures in Practice: Physical Activity, 2016), this study does not investigate differences in gender. For the diverse sample, demographic information was asked when pre-questionnaires were conducted. Besides children's age, 8 to 10, no additional exclusion criteria were enforced.

Participants were recruited through multiple methods, including printed flyers, online postings, emails, and a snowball sampling method to secure a large enough sample size. To reduce bias, the sample selection avoided recruitment from "the schools that are generally homogenous in terms of the students registered at the school" (Delice, 2010, p. 2013). Printed flyers were posted at local public libraries in a city of the Midwest (see Appendix A: Recruitment Flyer). Online postings were placed on local blogs and websites where parents might visit for information for their children. In addition, email messages describing this study and encouraging participation were distributed through the mailing lists of the university. Referrals through parents of the participants who already took part in this study were implemented to recruit appropriate participants.

In order to compensate participants' completion of the study, each participant was offered a $50 gift card and a certificate of participation. This incentive can be considered as "appreciation payments that are bonuses given after children's participation to thank them for their efforts" (Wendler, Rackoff, Emanuel, & Grady, 2002). 3.1 shows the demographic characteristics of children who participated in this study.

Table 3.1

*Demographic Characteristics of Participants*

| | Category | Number | Percent |
|---|---|---|---|
| **Age** | 8 years old | 8 | 26.7 |
| | 9 years old | 7 | 23.3 |
| | 10 years old | 15 | 50.0 |
| **Grade** | 3rd | 8 | 26.7 |
| | 4th | 7 | 23.3 |
| | 5th | 15 | 50.0 |
| **Gender** | Girl | 15 | 50.0 |
| | Boy | 15 | 50.0 |
| **Race/Ethnicity** | African American | 3 | 10.0 |
| | Asian or Pacific Islander | 11 | 36.7 |
| | White | 13 | 43.3 |
| | Hispanic/Latino | 3 | 10.0 |

Fifty percent of participants were 10 years old and fifth graders. Even though this study did not investigate gender differences in help-seeking behaviors, gender numbers were balanced. In terms of race/ethnicity, 43.3 percent of children who participated in this study identified as non-Hispanic white, and 36.7 percent of participants were Asian. African American (non-Hispanic) and Hispanic/Latino participations each accounted for 10 percent in this study.

### 3.1.2. Types of Developmental Considerations of Children in the Concrete-Operational Stage

The age of the participants in this study were matched with Piaget's concrete operational stage. Children in the concrete operational stage show different cognitive, physical, and affective development from children in other stages. As digital technology develops rapidly and is

affordable, children's early use of the Internet has been inevitable. Therefore, children who are 8 to 10 years old were selected as participants in this study. Even though it is difficult to find studies investigating children's information behaviors that consider their developmental stages by age, it is necessary to involve children's developmental considerations to explain the phenomena of children's interactions with IR systems effectively. The author considered characteristics of the cognitive, physical, and affective developmental stages of children who are 8 to 10 years old for this study.

*Cognitive Development*

Children's cognitive development at ages 8 to 10 can be explained with Piaget's concrete operational stage lasting "between age 7 or 8 and 11 or 12" (Piaget & Inhelder, 1969, p. 96). An operation is an internalized mental action and with the ability to use operations in which children's representations are no longer isolated, rigid, or simply juxtaposed (Miller, 2010). Concrete-operational children have an appreciation of causal principles and are able to ignore misleading appearances and focus on more than one aspect of a situation when seeking answers to a problem (Shaffer & Kipp, 2010). Moreover, they can arrange items mentally along a quantifiable dimension such as height or weight (Shaffer & Kipp, 2010).

Concrete-operational children are able to reason logically about concrete events and classify objects in their world into various sets (Gallahue & Ozmun, 2006). A characteristic of concrete-operational thinking is the concept of reversibility. Reversibility is referred to as the capacity of the child to understand that any change of shape, order, position, or number can be mentally reversed and returned to its original shape, order, position, or number (Gallahue & Ozmun, 2006). Information processing theorists believe that there are developmental differences

in children's thinking. According to Siegler (1996), in descriptions of the development of serial recall strategies, fourth graders (age 9) and older children can retrieve answers from their memory, and 11-year-old children are able to rehearse in a more elaborate way than 8-year-old children. Before age 7, children seem to be biased toward encoding and remembering verbatim traces, while children older than 8 are more inclined to encode and remember fuzzy and gist-like traces (Shaffer & Kipp, 2010). Children 7-10 years old can ignore irrelevant information to perform tasks better than younger ones (Shaffer & Kipp, 2010). When finding hidden objects, 8-year-old children can spontaneously use the strategy of picking up, and 9-10-year-olds use rehearsal and organizational strategies more frequently than 5-6-year-old-children (Siegler & Alibali, 2005). According to Siegler and Alibali (2005), many important strategies such as rehearsal, organization, and selective attention become prominent between ages 5 and 7, and the quality of the strategies, their frequency of use, and the flexibility continue to develop well into later childhood and adolescence. Shaffer and Kipp (2010) indicated that 8-to-12-year-old children begin to distinguish effort from ability, whereas Butler (1999) found that only at age 11-12 years do children gain the differentiated concept of ability.

*Physical Development*

Children's hand-eye coordination and control of the small muscles improve rapidly, and they can make more sophisticated use of their hands (Shaffer & Kipp, 2010). For instance, by age 8 or 9, children can use household tools and have become skilled performers at games that require hand-eye coordination (Shaffer & Kipp, 2010). Borgman, Hirsh, Walter, and Gallagher (1995) reported that children experience difficulty in spelling and typing keywords because children's spelling skills do not begin to improve until the age 11. According to Nielsen (2010),

older children (ages 9-12) scroll the mouse more often than younger children, and 12-point font size is appropriate for children's effective reading and searching on the web ("Children's Websites: Usability issues in designing for kids," 2010). Young children (7-9 year olds) struggled with complex motor and visual interactions between the mouse, keyboard, and screen when searching the web (Druin et al., 2010). Hutchinson et al. (2005) found difficulties in children's mouse dragging and clicking while searching in digital libraries.

*Emotional Development*

According to Shaffer and Kipp (2010), various emotions appear at different times over the first 2 years of a child's life, and children gradually develop a greater capacity to experience complex emotions such as pride, guilt, shame, and concern as they internalize more and more rules, ethical principles, and performance standards. Affect, the feelings and emotions, is a critical factor in learning and cognition (Ormrod, 1999). Ormrod believed that anxiety has been the most widely studied form of affect in the context of human learning, and that anxiety interferes with an individual's attention to perform a task and with effective cognitive processing. Wu (2011) believed that the feeling of anxiety is an important factor in help seeking in digital environments. For instance, users with high anxiety of using a computer may not use help features to complete tasks in digital environments. Furthermore, some children experienced confusion and frustration in using the search engine "Yahooligans" designed for children ages 7 to 12 because the site did not have a good visual appearance nor did it display a kid-friendly system design, while most children expressed positive feelings such as joy and fun. The positive feelings that had an influence on their persistence and patience are considered as motivational factors in using the search engine (Bilal, 2000). Denham (1998) indicated that before expecting

certain levels of understanding of emotion, it would be wise to consider each individual child's age and his or her levels of cognitive ability.

### 3.2. Ethical Consideration

Studying human subjects, particularly children, involves "the legal, moral and ethical aspects" (Vasta, 1979, p. 187). Since participants in this study consist of those under 18 years old, a children's assent form (see Appendix B: Participant Assent Form) and a parental consent form (see Appendix C: Parental Consent Form) were collected before the study commenced. This research received approval from the University of Wisconsin-Milwaukee Institutional Review Board (IRB) (see Appendix D: IRB Application Approval).

To protect participant privacy and respect their rights (Flewitt, 2005), issues of confidentiality should be considered during data collection. In this study report, no participant names were discussed and identified. Instead of their names, participant numbers (e.g., participant No.1, participant No.2, etc.) were assigned and used in this dissertation. Video and audio record data, hand-written and transcribed data, and data about personal information of the participants were preserved in a secure location.

### 3.3. Data Collection

#### 3.3.1. Data Collection Methods Adopted by Prior Research

Analytical review of prior literature about children's interaction with IR systems using questionnaires, interviews, observations, transaction logs, and think-aloud data collection methods are discussed below. Each data collection method has not only its advantages but also

limitations. Mixed data collection methods were administered in this dissertation to overcome each method's drawbacks.

*Questionnaires*

A questionnaire is one of the popular methods of data collection used to explore children's information-seeking behaviors or interaction with IR systems. In studies of children's information-seeking in IR systems, questionnaires have been employed to gather data and to investigate children's difficulty with performing search tasks or finding information. Jochmann-Mannak, Huibers, Lentz, and Sanders (2010) investigated with which type of interface children perform a search task best. In order to evaluate children's difficulties with performing the search task in four interfaces designed for children, the researchers asked children to answer a questionnaire that was comprised of a smiley-scale and an ordinal scale. Thirty-five children participated in the survey, which was filled in at the beginning of the research session.

Furthermore, Flanagin and Metzger (2010) used an online questionnaire to investigate children's information credibility on the Internet. They collected data on information trust, credibility, and quality from 2,747 children. Flanagin and Metzger indicated that survey data of large samples of young people can be accurately generalized to the overall youth population. However, they should have collected additional interview data from a small-scale focus group of children in order to measure the clarity, comprehensiveness, and relevance of the questionnaire targeting the youths. In this study, questionnaires were used to collect data about demographic information and experiences of information searching and help seeking.

*Transaction Log Data*

Many studies (Bilal, 2000, 2001, 2002a; Bilal & Kirby, 2002; Bilal & Bachir, 2007; Borgman, Hirsh, Walter, & Gallagher, 1995; Hirsh, 1997; Jochmann-Mannak, Huibers, Lentz, & Sanders, 2010; Large, Beheshti & Rahman, 2002; Schacter, Chung, & Dorr, 1998) used the experimental approach to investigate children's information-seeking behaviors while searching in IR systems. In the experiments, different types of searching methods, different types of interfaces, or different types of tasks are compared, and the various data are collected using video and recording software during searching performances in the IR systems. Schacter, Chung, and Dorr (1998) and Hirsh (1997) collected search processes, such as whether "browsing" or "keyword searching" methods were used, and search performance through a recorded search log.

Bilal (2000, 2001, 2002) and Bilal and Kirby (2001) measured web traversal that measured children's weighted traversal effectiveness and efficiency scores as well as the quality of the children's search moves and search success. Search success and search time (Bilal & Bachir, 2007), as well as the number of search activities, such as clicks and submitted queries; deviation numbers during navigation; search time, search success; and search strategies such as keyword searching or browsing (Jochmann-Mannak et al., 2010) were collected through the recording of children's task performances. The experimental approach has some advantages to collecting data on children's information seeking in IR systems. For example, children's use of the computer that was captured and understood through system logs helps researchers understand early hypermedia technologies with children, as well as understand children's patterns of interaction with different system tools (Druin, 2002). In addition, the log data from the recordings allow researchers to understand users' ability to construct a search query with a

keyword search (Jochmann-Mannak, Huibers, & Sanders, 2008). Transaction log data for this study were collected to identify participants' behavioral data, including pages viewed and clicks.

*Interview Data*

Interview data were collected in face-to-face interviews or focus group interviews in order to investigate children's interaction with IR systems and to understand youth information seeking behaviors. Hirsh (1999) collected interview data during two interview sessions to investigate children's relevance criteria and information seeking using electronic resources. In the first interview session, data was collected with respect to the types of computer resources children accessed outside of school, and the reasons why children selected particular electronic resources to do the research that the researcher assigned to them. The second interview collected data related to the types of and reasons for children's final selection, as well as an evaluation of the electronic resources used for the research assignment. Foss and her colleagues (2012) relied on data from both parent and child interviews to understand children's behavior patterns when interacting with Google. In the parent interviews, the researchers collected data on the computer rules of parents, their child's prior computer experience level, searching habits, and areas of frustration in the parent interviews. Data about the frequency of computer use and reasons for search were obtained from interviews with children.

Creswell (2009) indicated that interview data provides indirect information filtered through the views of interviewees. Hanna, Risden, and Alexander (1997) pointed out that children are eager to please adults, and when children respond to questions, they may conceal information from interviewers just to make adults happy. However, Druin (2002) emphasized that children are incredibly honest in their assessments. Although it is difficult to generalize

findings based on interview data of small samples of children (Flanagin & Metzger, 2010), interview data is helpful in interpreting data generated from the quantitative method (Bilal & Bachir, 2007, p. 54).

A focus group interview is another method for collecting interview data. Meyers, Fisher, and Marcoux (2007) collected data on tweens' information seeking, information sources, and social life by conducting focus groups of four to six tweens who engaged in a discussion with two adults. They emphasized the strengths of focus groups involving adults when studying tweens' information-seeking behaviors. For instance, the interviews conducted in focus groups with adults help researchers collect a large amount of data quickly and allow youths to interact with peers. Also, group discussion can decrease individual anxiety and lessen the response pressures and cognitive load associated with individual interviews (Meyers, Fisher, & Marcoux, 2007, p. 317). However, the authors also pointed out that the focus group interview approach prevents researchers from gathering data relating to naturally occurring behaviors. Hence, additional methods, such as observation, should be used to gather such data. Interviews were used to collect data regarding participants' encountered problems while searching as well as their perceptions, satisfaction, and suggestions for using help features in IR systems.

*Observational Data*

In order to investigate children's book-selection behaviors in the ICDL, Reuter (2007) gathered data that included 96 log files from each session, videotapes of the children's interactions with the ICDL, and observational field notes. In order for robust observation, recorded video and the researcher's field notes were collected to identify children's distinct behavior patterns as displayed by the children when they were interacting with a search engine

(Foss et al., 2012). There are some advantages to the data collection of observations. According to Creswell (2009), a researcher engaged in observation has a first-hand experience with the participant and can record information as it occurs.

In addition, Hanna, Risden, and Alexander (1997) found that observations help gauge children's behavioral signs of engagement such as smiles and laughs, or leaning forward to try things, as well as signs of disengagement such as frowns, sighs, yawns, or turning away from the computer during searching. They emphasized that the data from the children's behavioral signs are much more reliable than children's responses to questions. On the other hand, when being observed, children may present special problems in establishing rapport (Creswell, 2009). Furthermore, the obtrusive nature of the observational methods might have some effect on the participants' behaviors (Slone, 2000). In other words, if participants know they are being observed, they may behave differently than normal. Participants in this study were observed while searching in Google and Kids.gov, and their searching and help-seeking behaviors and activities were noted by the author.

*Think-Aloud Data*

The think-aloud technique is described in the literature under many names, such as verbal reports, concurrent verbal protocols, retrospective verbal protocols, think-afters (retrospective verbal protocols), and verbal protocols (Van den Haak & De Jong, 2003). Think-aloud is a method in which the subject is asked to talk aloud while solving a problem. It refers to the fact that the subject keeps on talking and speaks out loud whatever thoughts come to mind while performing tasks (Someren, Barnard, & Sandberg, 1994). Branch (2000) collected the number of words youth participants used in each search task activity to determine the amount of data that

was generated during think-alouds. Also, Branch (2003) gathered data about the information-seeking processes of youths by collecting verbal reports (think-aloud) while the participant was completing a search task for information on the Internet. Madden, Ford, Miller, and Levy (2006) also gathered verbal data about children's search strategies and the factors that influence children's search performance.

Moreover, Tai, Woolf, and Arroyo (2011) collected verbal reports of youths while solving math problems in math tutoring software with the purpose of observing participants' minds and understanding students' help-seeking behaviors when using math tutoring software. According to Shenton (2004a), think-aloud protocols are similar to interviews in providing an insight into participants' minds. Branch (2003) emphasized that the think-aloud method enables researchers to understand the thought processes and decision-making steps of children and adolescents. Branch (2000) found that some youths experienced difficulties in doing think-afters such as interviews because they forget some things. To reduce children's cognitive load associated with think-afters, think-alouds is more helpful for gathering data efficiently. Hanna, Risden, & Alexander (1997) reveal that children ages 11 to 14 may be able to think-aloud during a usability session. In order to collect participants' verbalizations of their intentions, thoughts, difficulties, and feelings, think-aloud protocols during their searching were used in this study.

### 3.3.2. Data Collection Instruments

Data was collected by multiple methods, including performance-based domain knowledge quizzes as direct measurements**,** domain knowledge self-assessments as indirect measurements, pre-questionnaires, transaction logs, think-aloud protocols, observations, and post-interviews. Morae usability testing software was used to record participants' search task

activities. Figures 3.1 and 3.2 show examples of sessions, showing both the screen and the participant in a picture-in-picture mode, recorded by Morae.

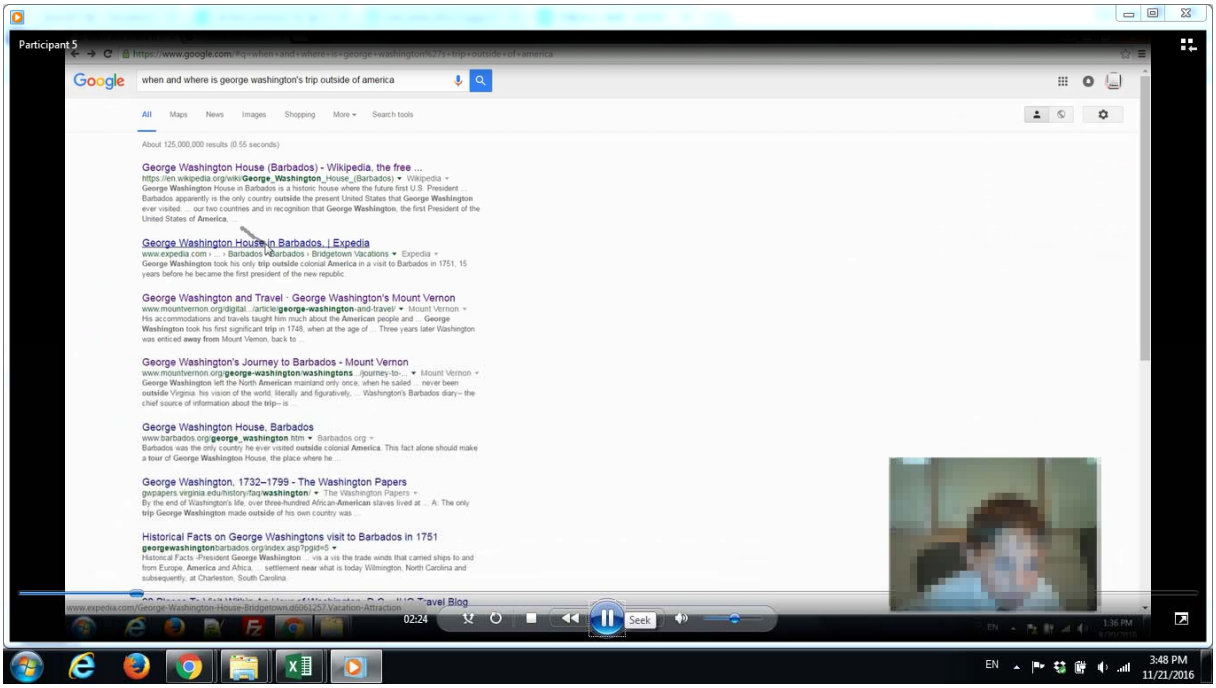


*Figure 3.1.* Usability Testing of Participants in Using Google

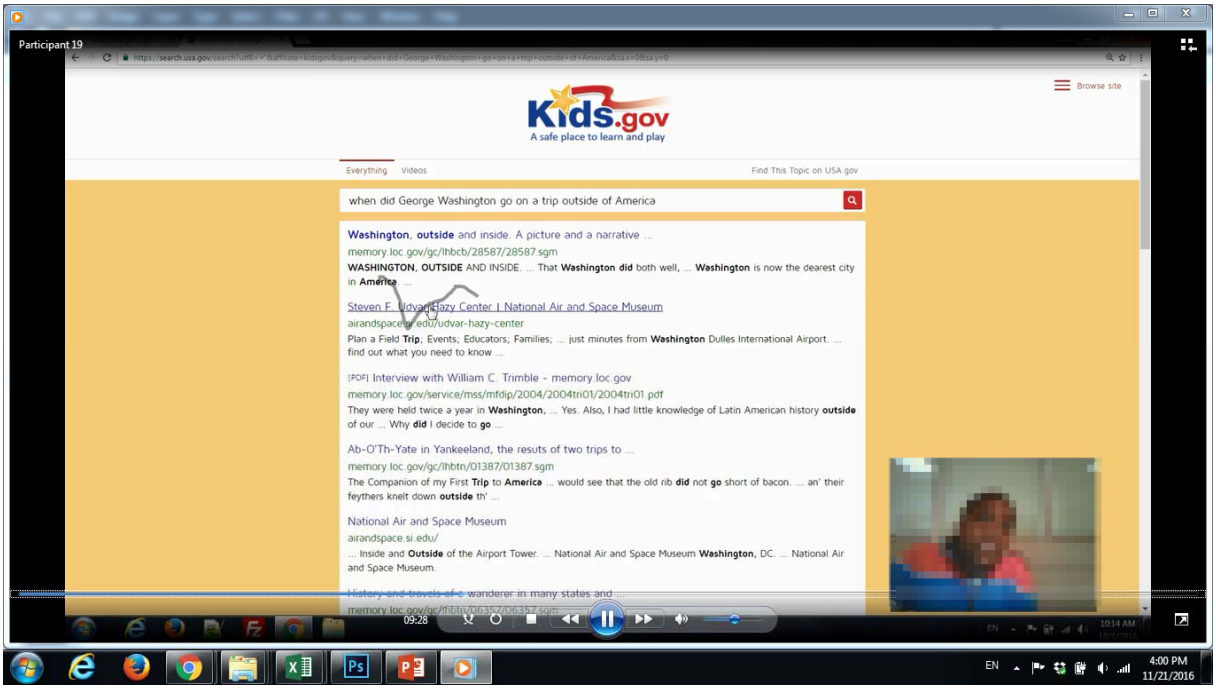


*Figure 3.2.* Usability Testing of Participants in Using Kids.gov

### 3.3.3. Data Collection Procedures

All the experiment sessions were held in a usability lab at the university located in a city in the Midwest. The entire procedure of each session is presented below:

First, parental consent forms and participants' assent forms were gathered to ensure parents' permissions and children's willingness to participate.

Second, a questionnaire design offers a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of the population (Creswell, 2009). Participants were asked to fill out a pre-questionnaire focusing on demographic information and experiences of information searching and help seeking (see Appendix E: Pre-Questionnaire).

Third, a performance-based domain knowledge quiz, consisting of 12 questions about George Washington, with four answer choices for each answer to measure participants' domain knowledge of George Washington, was asked. Cohen and Spenciner (1998) stated that the purpose of performance-based assessment affects the issue of reliability. To ensure reliability, the purpose of this test was explained clearly to participants before the test started.

Fourth, a self-assessment consisting of six questions, with seven Likert-type scale responses to measure participants' familiarity with the topic of George Washington, was given to participants. For consistency, the self-assessment questions were created based on performance-based knowledge quiz questions of George Washington. Since young children are likely to overestimate their performance due to lack of their cognitive skills (Ross, 2006), participants were asked to conduct the performance-based knowledge quiz as well as the self-assessment for valid measurements of participants' domain knowledge.

Fifth, participants were asked to conduct two search tasks using Google and a web portal**,** Kids.gov sites. Users' search activities were logged and audio and video data while searching

two tasks on George Washington's outside of trip and farewell address letter were recorded using Morae usability testing software (https://www.techsmith.com/morae.html). The two search tasks on Google and Kids.gov did not run longer than 45 minutes in total, as suggested in previous studies (Hanna, Ridsen, & Alexander, 1997; Druin et al., 2010) due to children's attention span. The time for each task assigned in Google and Kids.gov was 5 to 10 minutes, which is a typical time provided to a child participant for a search task (Rutter, Ford, & Clough, 2015; Gossen, 2016). Table 3.3 shows each search task.

Instructions stating how to conduct search tasks in Google and Kids.gov sites were provided to the children before search tasks were performed (see Appendix F: Instruction for Search Tasks).

Also, this study collected users' verbalization of their intentions, thoughts, difficulties, and feelings through think-aloud protocols while they conducted their search activities. The think-aloud method helps researchers obtain data about the behavioral, cognitive, and affective processes of the information-seeking process (Branch, 2000) as well as to gather data about children's thought processes and decision-making steps (Branch, 2003, p. 50).

Additionally, participants were observed when they conducted search tasks using Google and Kids.gov. According to Creswell (2009), qualitative observations are those in which researchers take field notes on the behaviors and activities of individuals at the research site in an unstructured or semi-structured way.

Finally, children answered post-interview questions including their encountered problems while searching as well as their perceptions, satisfaction, and suggestions about the help features (see Appendix G: Post-Interview).

To help children's understanding of a pre-questionnaire and the post-interview questions, the questions were read to them. Also, participants were asked to rate the pictorial five-point Likert-style scale (discussed below).

Jochmann-Mannak et al. (2010) and Creel (2007) used Likert scale assessments using "smiley-faces" pictures for the data collection on children's information seeking in IR systems. The pictorial Likert scales have some advantages for data collection from children. For instance, the Likert-style survey using pictures has become a favorite of teachers and administrators in the assessment of young children (Reynolds-Keefer, Johnson, Dickenson, & McFadden, 2009). Also, Druin (2002) emphasized the development of age-appropriate and easily comprehensible survey and survey language. Hence, the pictorial Likert-style survey is considered an age-appropriate and effective instrument for collecting data from children. Figure 3.3 shows the pictorial Likert five-point scale used for data collection in this study. Figure 3.4 presents the data collection procedures of the study.

1 Very Difficult (☹☹☹) 2 Difficult (☹☹) 3 Neutral (😐) 4 Easy (☺☺) 5 Very easy (☺☺☺)

1- Very dissatisfied (☹☹☹)

2- Dissatisfied (☹☹)

3- Unsure (😐)

4- Satisfied (☺☺)

5- Very satisfied (☺☺☺)

*Figure 3.3.* Pictorial Likert Scale

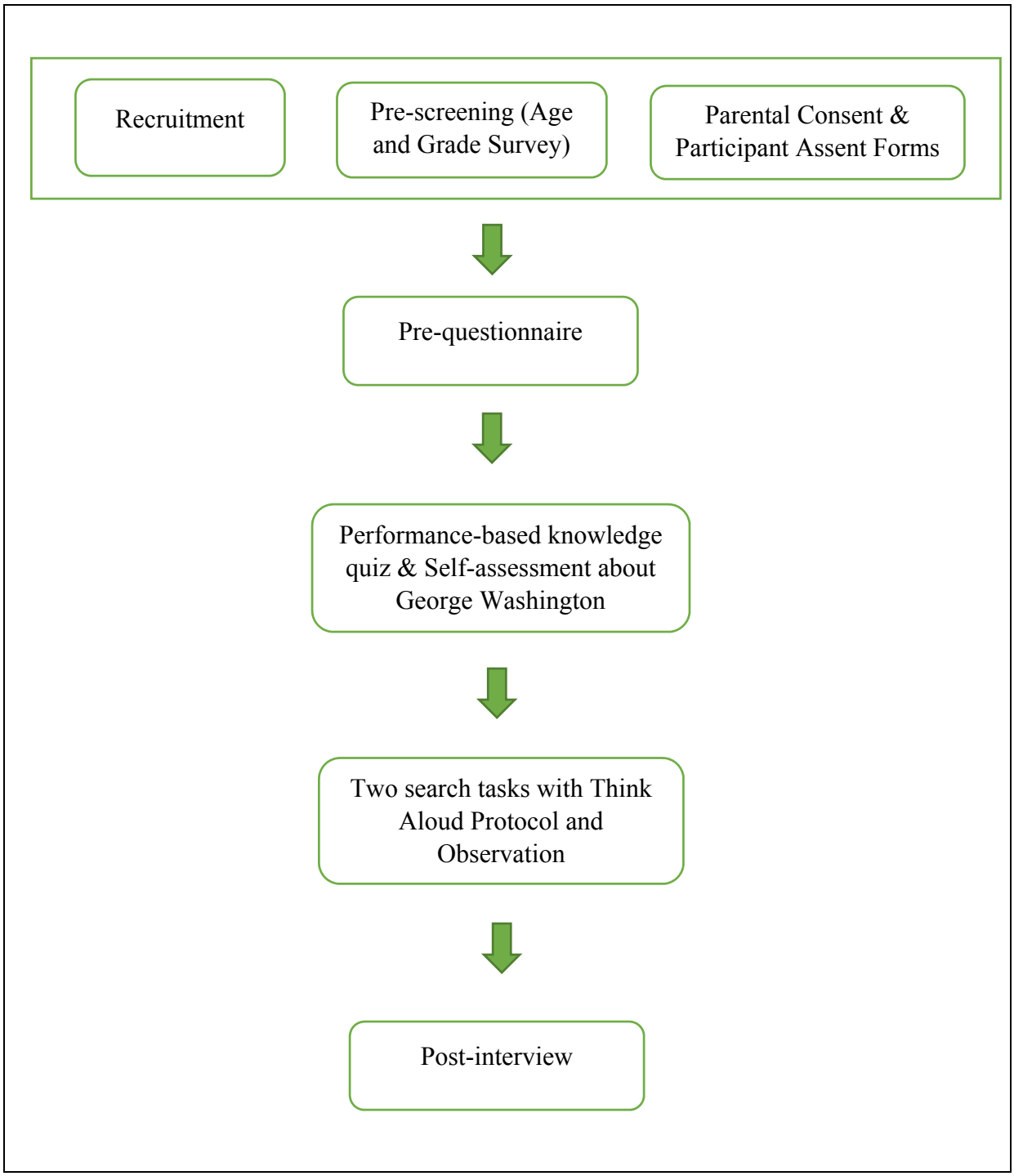


*Figure 3.4.* Data Collection Procedures

### 3.3.4. Selected IR Systems

For this research, Google and Kids.gov as IR systems were selected. Google was selected because it is one of world's most popular search engines for adults as well as children. Kids.gov was also chosen since it is considered as "the official kids' portal for the U.S. government" (Kids.gov About, 2017). Also, a variety of help features supported by Google and Kids.gov were considered as one of the selection criteria. Table 3.2 shows available and easily noticeable types of help features in Google and Kids.gov. Additionally, the following figures are screen shots of Google and Kids.gov homepages, as well as types of search support features available in Google and Kids.gov.

Table 3.2

*Types of Help Features in Google and Kids.gov*

| | Google (https://www.google.com) | Kids. gov (https://kids.usa.gov) |
|---|---|---|
| Help Features | Autocomplete | Autocomplete |
| | Spell-check | Spell-check |
| | Showing results for | Showing results for |
| | Searches related to | Searches related to |
| | Search tools | Site Index |
| | Result Snippets (Preview) | Result Snippets (Preview) |
| | People also search for | Recommended by Kids.gov |
| | Featured Snippet (Preview box) | N/A |
| | Help Page | N/A |

*Google*

According to the Alexa top sites rank (http://www.alexa.com/topsites), Google is ranked first place globally as well as by kids and teens in the U.S (Last Updated March 24, 2017). There are several reasons why Google was selected to be investigated for this study. First, Google returns relevant results quickly because Google crawls and indexes many web pages (retrieved from https://www.google.com/insidesearch/howsearchworks/crawling-indexing.html). Second, Google provides multiple search methods including keyword search, voice search, and search by images. Third, Google provides a variety of search help features such as "autocomplete", "spelling auto-correction", "search tools", "related searches", help page, and so on. Figures from 3.5 to 3.13 show examples of Google help features. Finally, Google uses page rank to determine credible search results and authoritative sources.

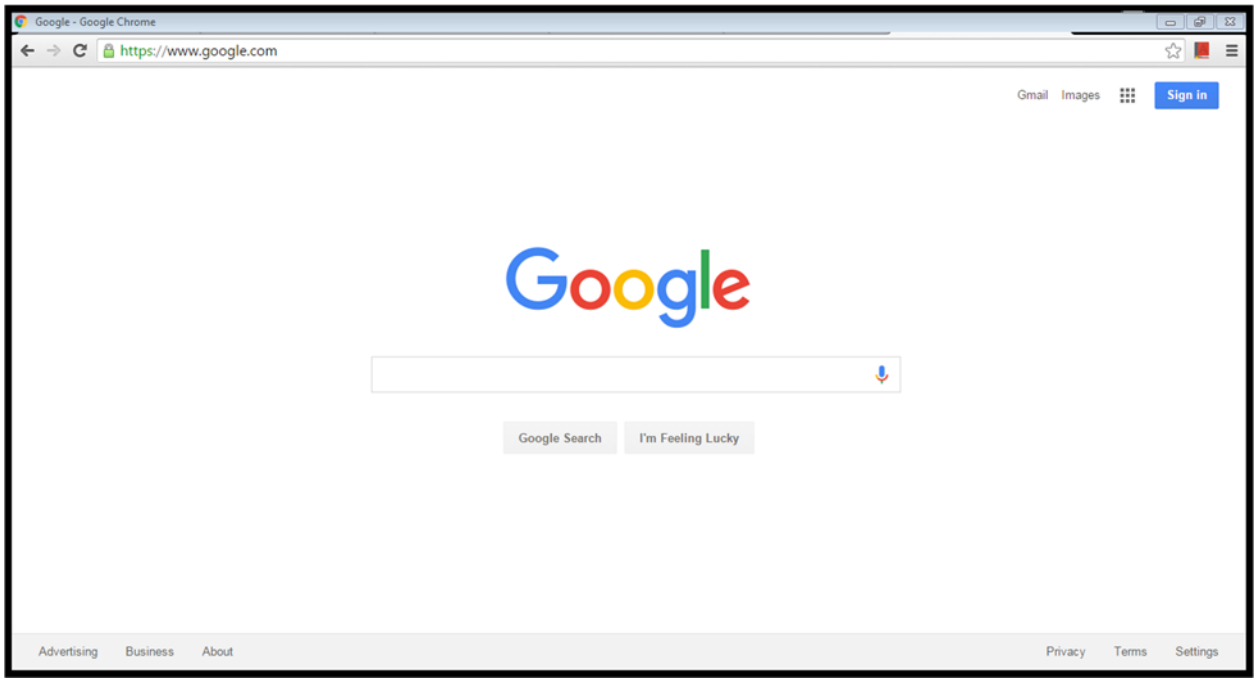


*Figure 3.5.* Google Homepage

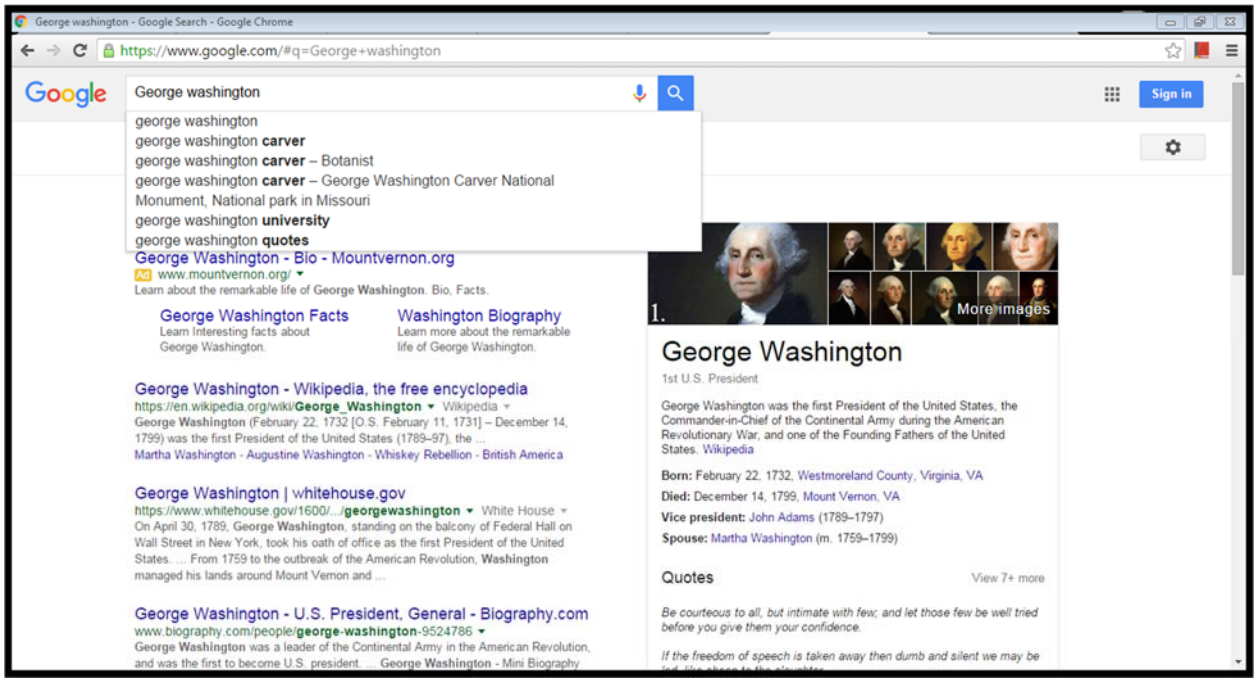


*Figure 3.6.* Google "Autocomplete"

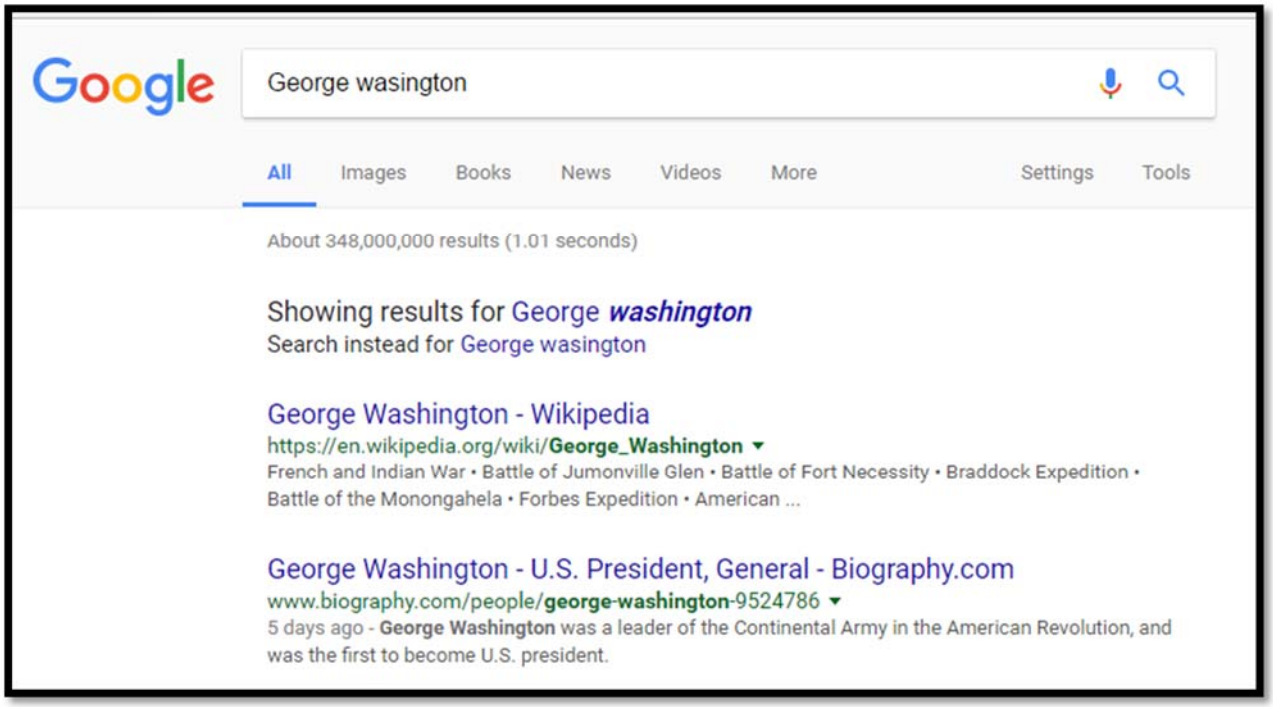


*Figure 3.7.* Google "Showing Result for" Feature

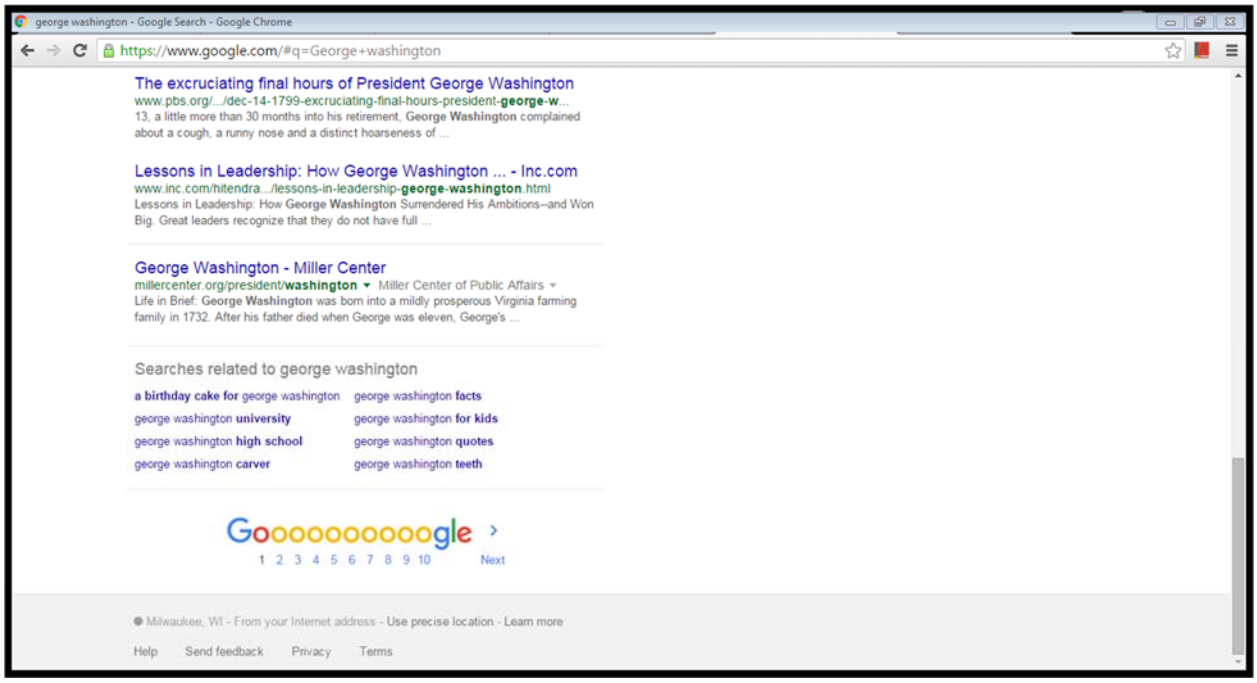


*Figure 3.8.* Google "Related Searches" Feature

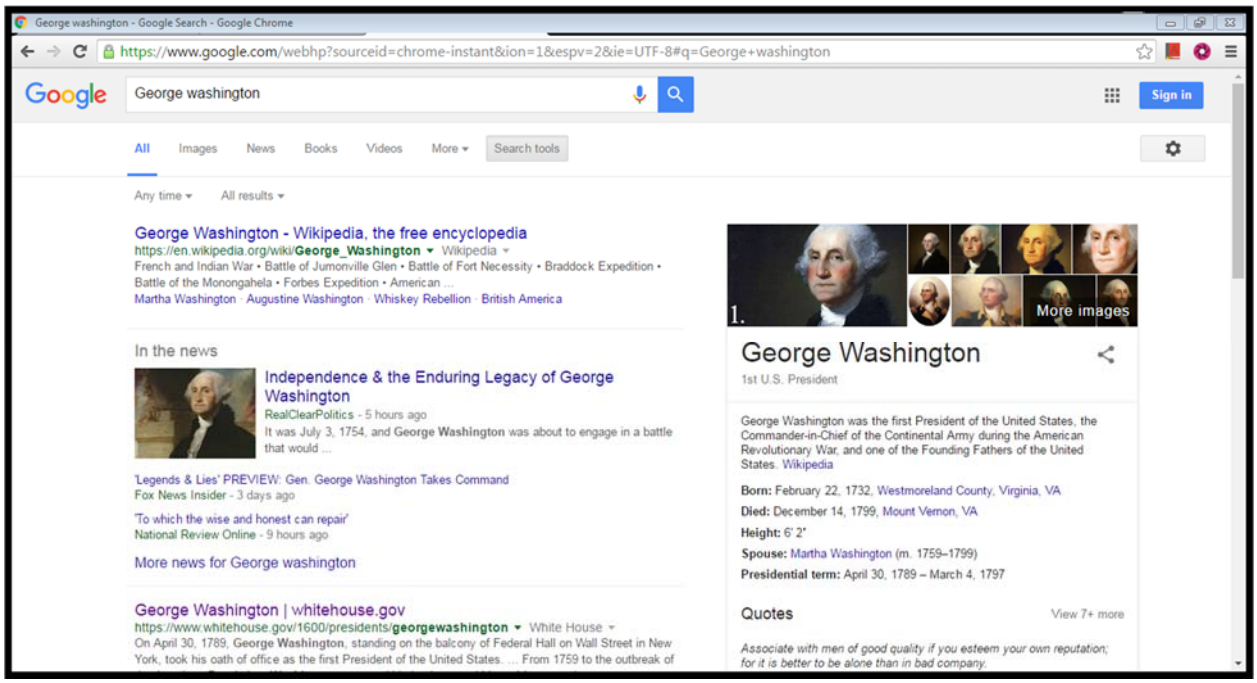


*Figure 3.9.* Google "Search Tools" Feature

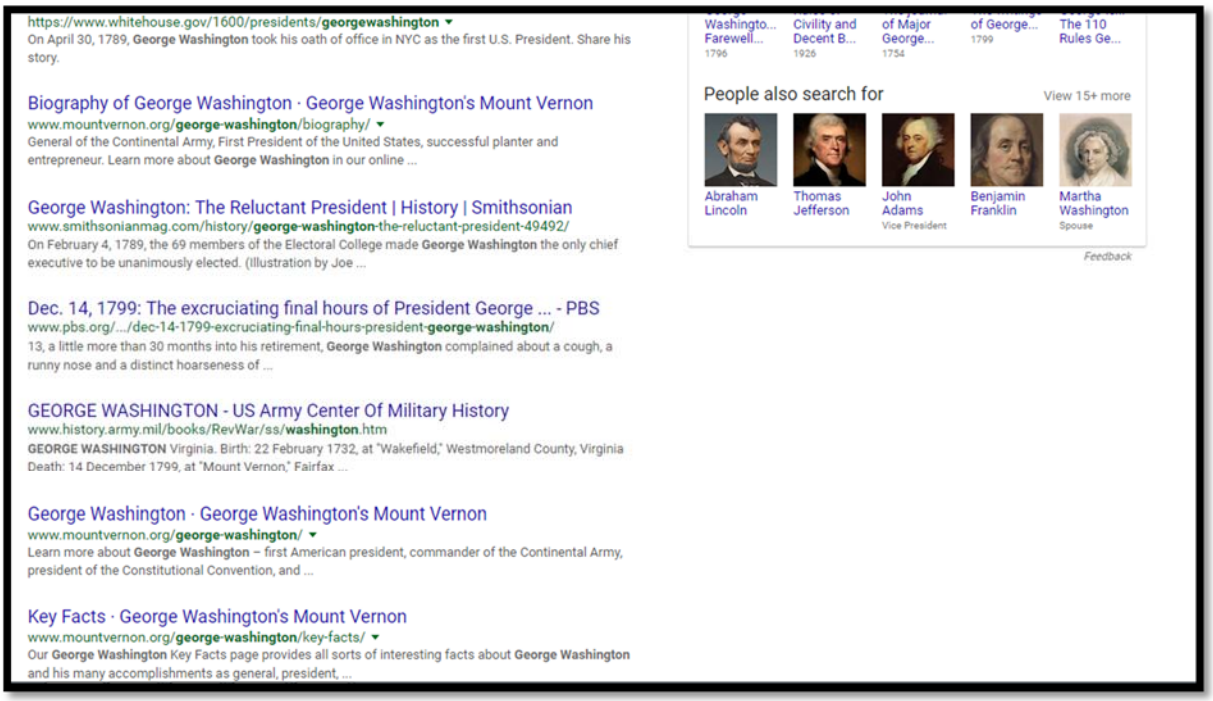


*Figure 3.10.* Google "People also Search for" Feature

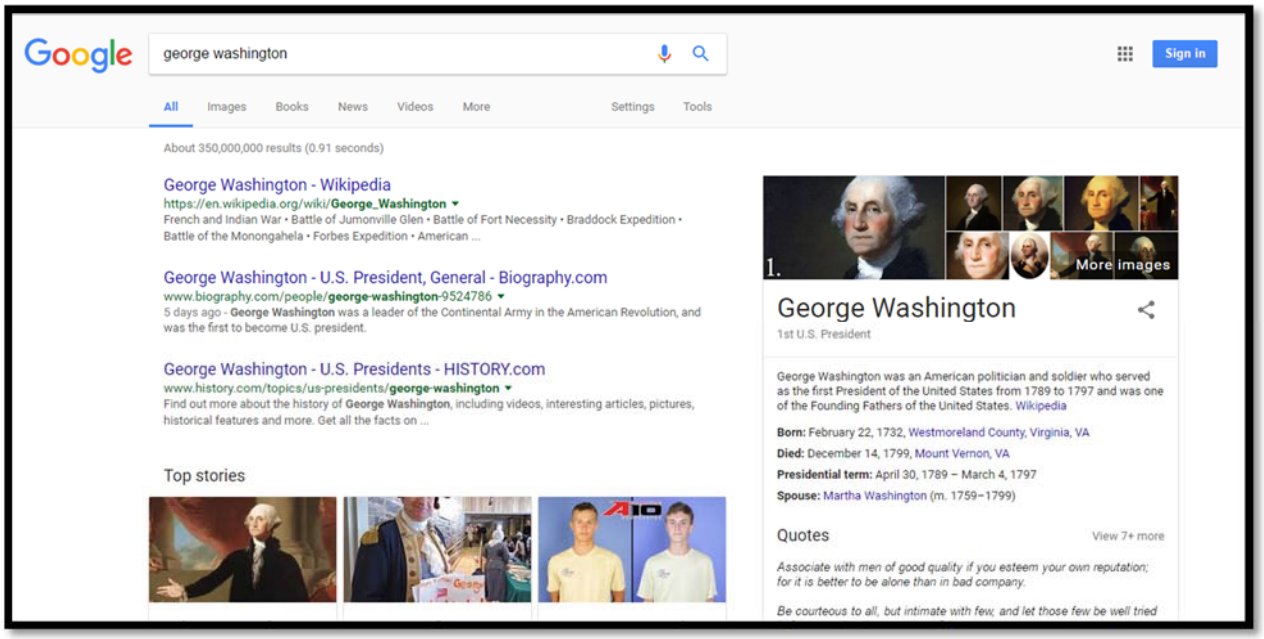


*Figure 3.11.* Google "Result Snippets"

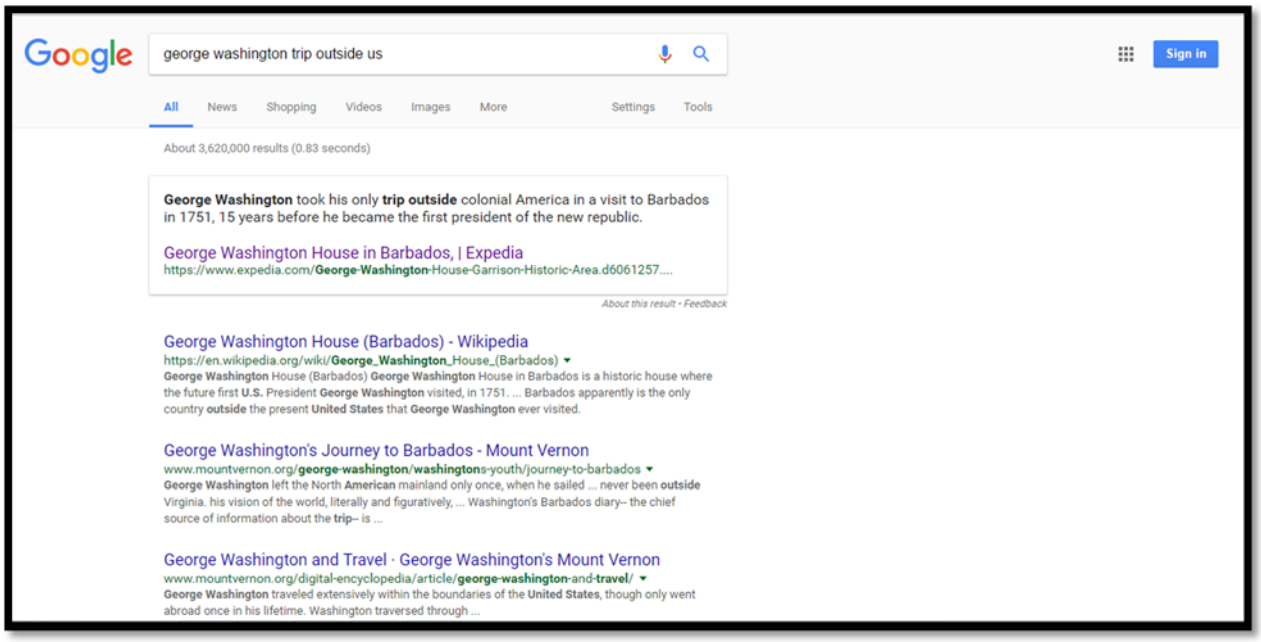


*Figure 3.12.* Google "Featured Snippet"

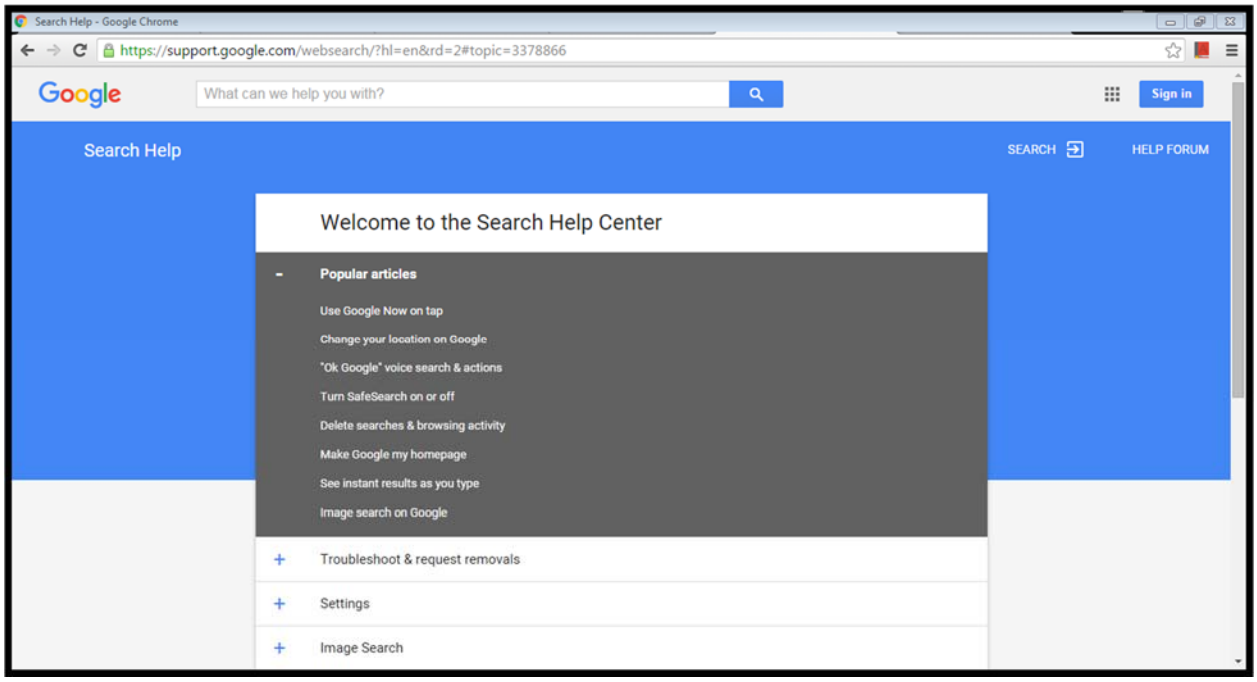


*Figure 3.13.* Google Help Page

*Kids.Gov*

Kids.gov was chosen as a great website for elementary aged kids by the Association for Library Service to Children (ALSC). Kids.gov provides safe online resources for four audience groups: Kids (grades K-5), Teens (Grades 6-8), Teachers, and Parents. This portal site offers links to not only many government sites but to some private sites designed for kids that contain information about the United States government (Bisland, 2009).

The first reason why this site was used for investigation is that Kids.gov covers various resources, including federal and state as well as commercial, nonprofit, and educational sites and resources. Second, government resources indexed by Kids.gov are "excellent sources for children to get an up-close, personal look at a variety of topics in a multitude of areas" (Harper, 2011, p.194). Third, Kids.gov provides a variety of formats for audiovisual collection materials. Finally, this portal supports "a collection of government-monitored and- approved children's websites" (Bremer, 2005) and a kid-friendly interface with various help features. Figures from 3.14 to 3.20 present examples of Kids.gov help features.

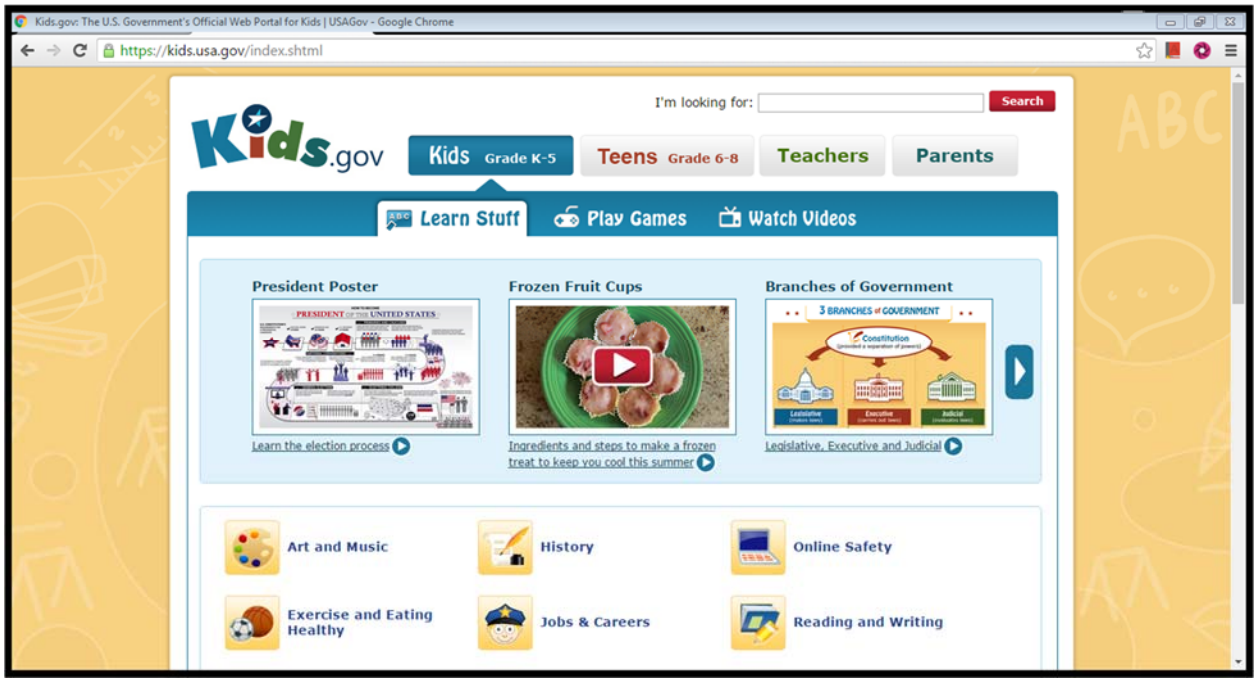


*Figure 3.14.* Kids.gov Homepage


*Figure 3.15.* Kids.gov "Autocomplete"

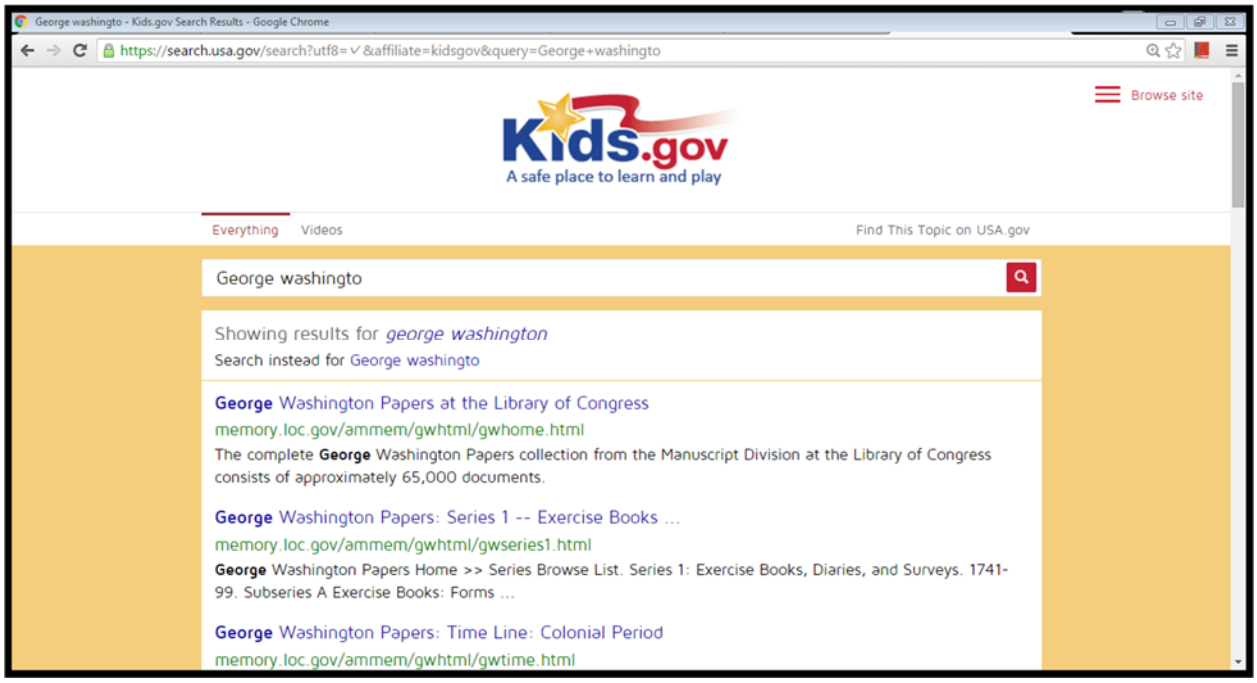


*Figure 3.16.* Kids.gov "Showing Results for" Feature

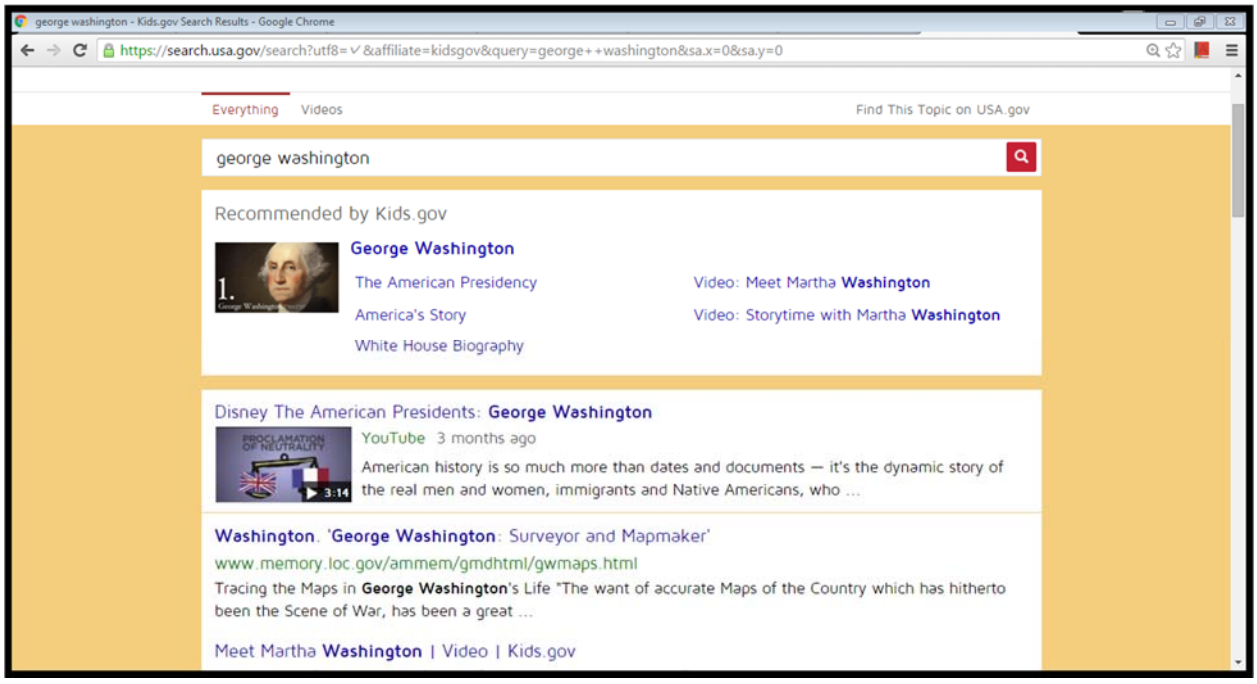


*Figure 3.17.* "Recommended by Kids.gov" Feature

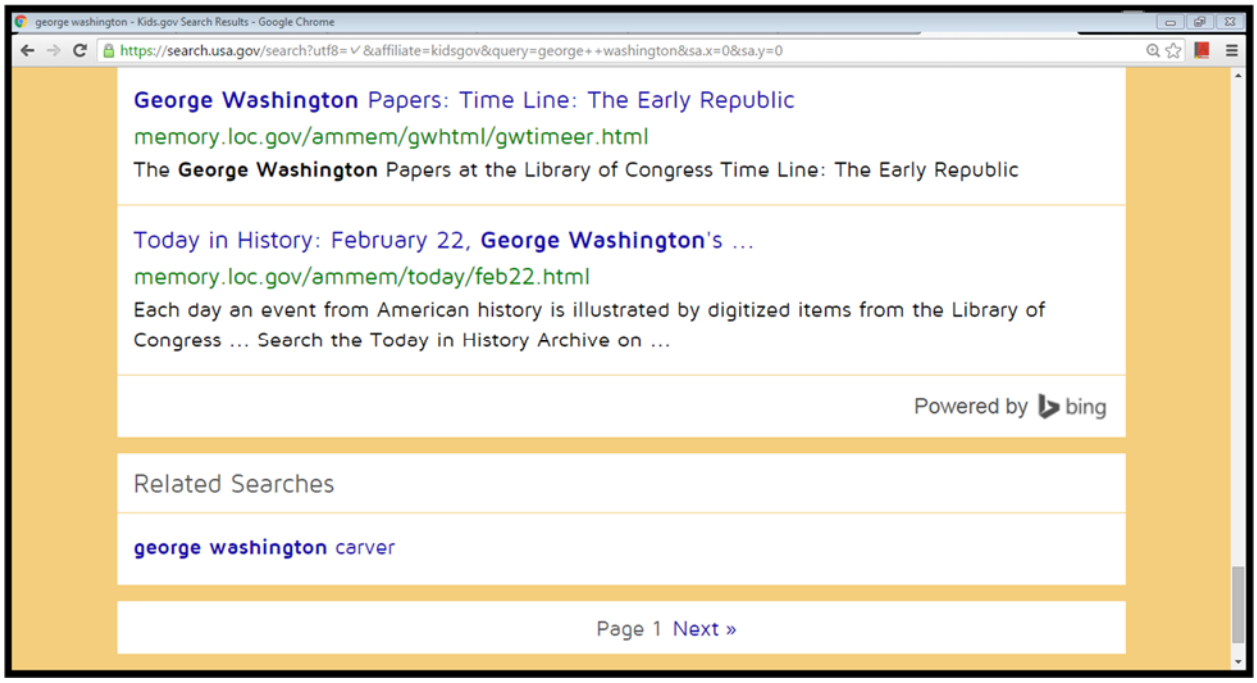


*Figure 3.18.* Kids.gov "Related Searches" Feature

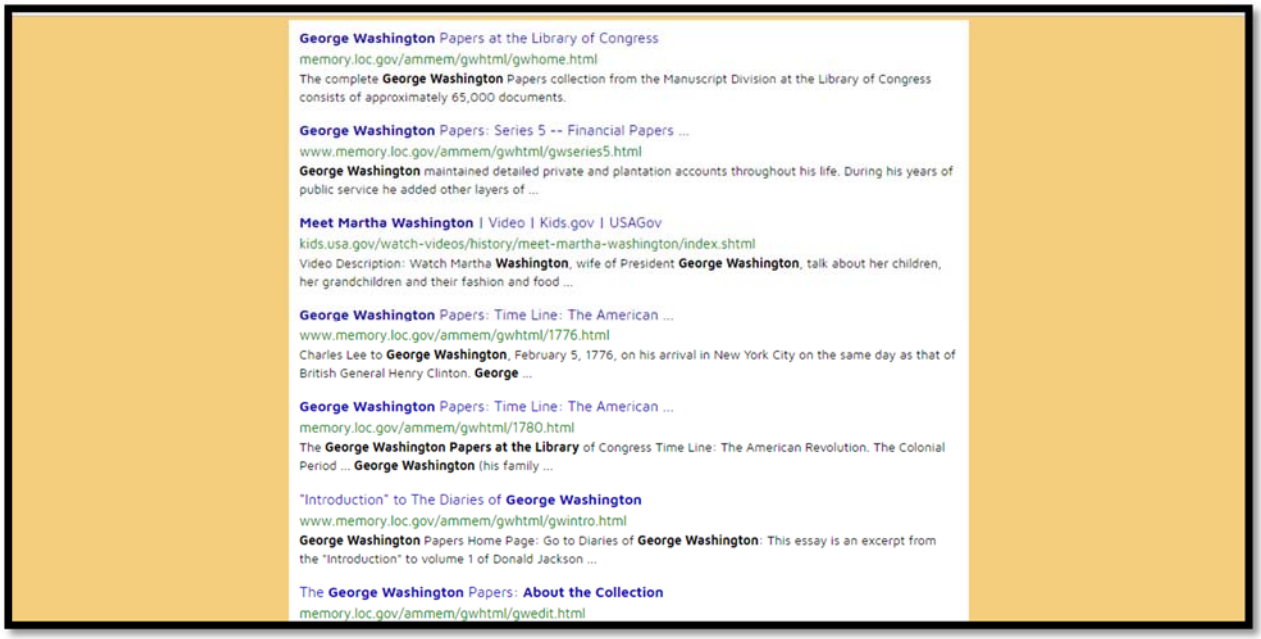


*Figure 3.19.* Kids.gov "Result Snippets"

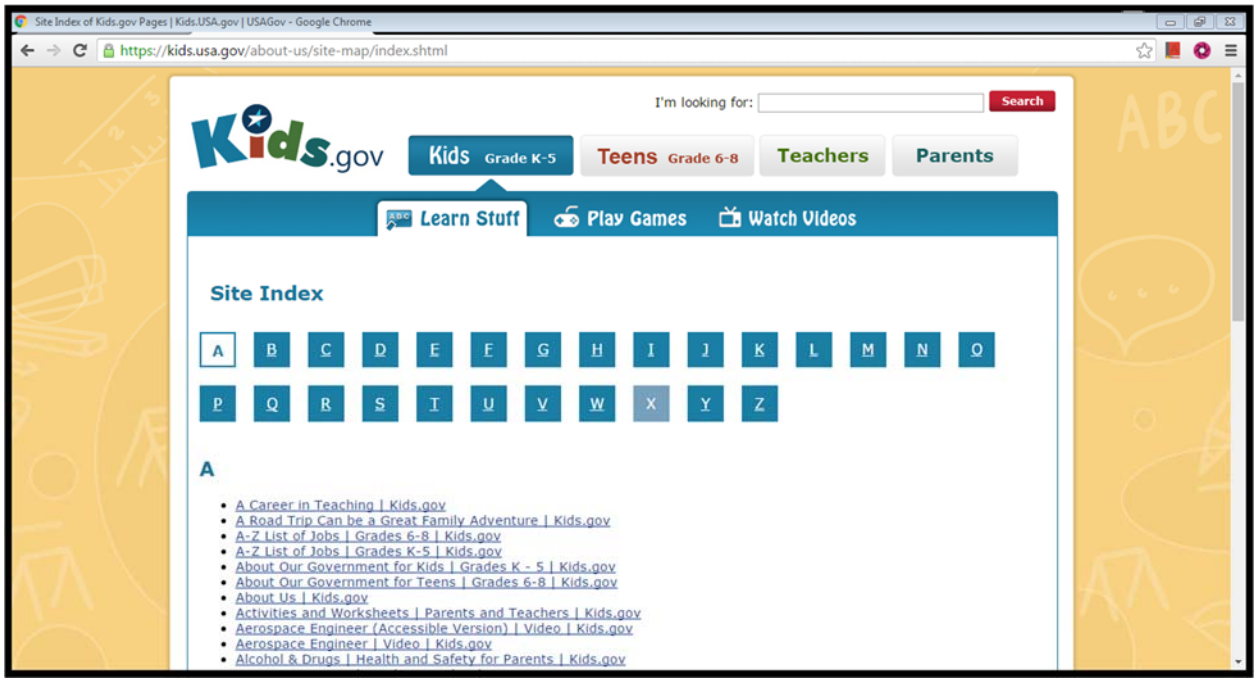


*Figure 3.20.* Kids.gov "Site Index"

### 3.3.5. Search Tasks

In this study, two search tasks were designed to investigate children's search interactions with Google and Kids.gov. The task subject was social studies and the topic was George Washington. Participants were asked to perform two search tasks in both Google and Kids.gov by using a stable browser, Google Chrome. In order to explore the participant's help-seeking situation and use of help features during query formulation and evaluation of search results, "assigned fact-based search task" (Bilal, 2000) and "imposed complex search task" (Foss & Druin, 2014) were adopted. In this study, the term "imposed" is considered to have the same meaning as "assigned," hence "imposed complex search task" was changed into "assigned complex search task" for consistency. Complex search tasks allow researchers to investigate children's upper threshold of search skill (Foss & Druin, 2014). The intended purpose of the complex tasks is to observe diverse help-seeking situations and use of search support features

during the searching process due to the complexity. Table 3.3 presents each search task and types of tasks designed for this research.

Table 3.3

*Two Search Tasks*

| Task ID | Type of Task | Task |
|---|---|---|
| Task 1 | Assigned fact-based search task | 1. Find relevant information about George Washington's trip outside of America a) When and where was George Washington's trip outside of America, b) With whom did George Washington go on a trip outside of America? |
| Task 2 | Assigned complex search task | 2. George Washington's Farewell Address was a letter written by George Washington. What did George Washington urge the American people to do in his Farewell Address? Please list more than two. |

### 3.4. Data Analysis

Overall, data in this dissertation included a survey, think-aloud notes, search screen recordings and transaction logs, a knowledge quiz and a self-assessment, interview notes, and observation notes. The collected data were analyzed both quantitatively and qualitatively. Research questions, data collection, and data analysis methods are presented in Table 3.4.

Table 3.4

*Research Questions and Data Collection and Analysis*

| **Research Questions and Hypotheses** | **Data Collection** | **Data Analysis** |
|---|---|---|
| RQ1.What are the types of help-seeking situations experienced by children (8-10 years old)<br>a) when they formulate search queries in a search engine and a kid-friendly web portal?<br>b) when they evaluate search results in a search engine and a kid-friendly web portal? | 1) Think-aloud protocol<br>2) Screen recoding<br>3) Observation<br>4) Post-Interview | 1) Open-coding<br>2) Taxonomy of help-seeking situations when participants formulated search queries in a search engine and a kid-friendly web portal<br>3) Taxonomy of help-seeking situations when participants evaluated search results in a search engine and a kid-friendly web portal |
| RQ2. What types of help features do children (8-10 years old) use and desire<br>a) when they formulate search queries in a search engine and a kid-friendly web portal?<br>b) when they evaluate search results in a search engine and a kid-friendly web portal? | 1) Pre-Questionnaire<br>2) Think-aloud protocol<br>3) Observation<br>4) Post-Interview<br>5) Screen recording<br>6) Transaction logs | 1) Descriptive Statistics<br>2) Open-coding<br>3) Taxonomy of used help features<br>4) Taxonomy of desired help features |

| | | |
|---|---|---|
| RQ3. How does children's (8-10 years old) domain knowledge affect their help seeking and use of help features<br>a) when they formulate search queries in a search engine and a kid-friendly web portal?<br>b) when they evaluate search results in a search engine and a kid-friendly web portal?<br>H1-H4 (See Page 6) | 1) Performance-based knowledge quiz<br>2) Self-assessment<br>3) Screen recording<br>4) Transaction logs | 1) Linear Regression |

### 3.4.1. Qualitative Data Analysis

The open coding method was used to analyze the qualitative data; open coding is "the process of breaking down, examining, comparing, conceptualizing and categorizing data" (Strauss & Corbin, 1990, p. 61). Adopted from the article of Xie et al. (2015) and adjusted for this study, a coding scheme (Figure 3.21) was used to identify help-seeking situations, as well as used and desired help features by the participants. Two different coders coded the same body of content, and any disagreements were resolved by discussion in order to ensure the reliability of the coding. Holsti's (1969) formula was used to verify inter-coder reliability.

| | |
|---|---|
| Help-Seeking Situation | |
| Task | |
| Existing help features used | |
| Desired help features | |
| Outcome of the situation | |
| Starting Time | |
| Ending Time | |
| Subject Number | |
| Quote/Description:<br>1) Pre-state<br>2) Help-seeking situation quote<br>Help-seeking situation in bold ***italics***<br>Existing help used: **bold red**<br>Desired help features: **bold blue**<br>Outcome: **bold purple**<br>3) Post-action | |

*Figure 3.21.* Coding Scheme

In order to answer RQ 1, the open coding method outlined by Strauss and Corbin (1990) was used to identify help-seeking situations experienced by children from notes on think-aloud, observation, and post-interview. As a qualitative analysis, a taxonomy of help-seeking situations when children formulate search queries and evaluate search results in using IR systems was generated. For the detailed information on how the help-seeking situations were analyzed, see Appendix H: Code definitions.

For RQ 2, the types of help features children used and suggested when they formulated search terms and evaluated search results were analyzed from data of the questionnaire, think-aloud, observation, and post-interview. Particularly, the post interview of this study was created to collect data on participants' suggestions for help features in using Google and Kids.gov. Also, the coding scheme included help-seeking situations; the used and suggested help features obtained by the participants were used to ensure the reliability of the coding.

Two independent coders coded transcripts and analyzed help-seeking situations and types of help features children used and desired from 30 participants. The inter-coder reliability of help-seeking situations identified between the two coders was 0.916 according to Holsti's reliability formula (Reliability = 2*M* /(*N* 1 + *N* 2)). In addition, the types of help features children used and desired were identified by the two coders until agreements were reached. Table 3.5 indicates examples of help-seeking situations children encountered. Also, Table 3.6 shows some examples of the types of help features used and desired from by the 30 children. More specific help-seeking situations and types of help features are provided with definitions and examples in the results section for RQ 1 and RQ 2.

Table 3.5

*List of Help Seeking Situations: Types, Definitions, and Examples*

| **Help Seeking Situations** | **Types** | **Definitions** | **Examples** |
|---|---|---|---|
| Cognitive Help-Seeking Situations at Query Formulation Stage | Limited visibility of help features | Difficulty locating existing help features | P4: "I didn't even see there is the autocomplete or even their help features." |
| | Spelling errors | Misspelled keywords | P3: [typing "what did George Washington's urge the American people to do in his farewell adress", clicks corrected phrase of "what did George Washington urge the |

| | | | |
|---|---|---|---|
| | | | American people to do in his farewell address", clicks link] It says here something. |
| | Difficulty in formulating queries | Difficulty on how to start and formulate keywords due to lack of domain knowledge | P17: Participant: "I don't know what to search up." Interviewer: "So you mean making the keywords is difficult?" Participant: "Yeah." |
| Physical Help-Seeking Situations at Query Formulation Stage | Size of the search box | Difficulty locating search box due to small size | P7: Participant: "Where do I press it?" Interviewer: "Keyword search is here." Participant: "Oh!" |
| Emotional Help-Seeking Situations at Query Formulation Stage | Anxiety while formulating queries | Anxious feeling due to difficulty formulating keywords | Participant 29 took more than 2 minutes to type in her first query with 11 words, but still with two typos. She ended up using "Showing results for" help feature on Google. (See page 103 for the justification) |
| Cognitive Help-Seeking Situations at Result Evaluation Stage | Mismatched reading level | Difficulty reading adult-oriented text level | P24: "I sometimes have trouble reading cursive. Original documents they all have cursive thing so I can read some cursive, I guess, but this is illegible." |
| | Comfortability from system knowledge | Difficulty in evaluating search results due to lack of system knowledge | P4: "The thing is, I'm more familiar with using Google, and I guess it's much easier." |
| | Negative effect from lack of domain knowledge | Difficulty in evaluating search results due to lack of domain knowledge | P7: "I don't know what the words mean and I don't know, like, what to press, and none of this stuff really say about where he went. All it says is about, like, like yes, stuff that he did and stuff so I don't know." |
| Physical Help-Seeking Situations at Result | Too many irrelevant results | Problems having too many irrelevant items in | P13: Interviewer: "You mean they provide not relevant information." |

| | | | |
|---|---|---|---|
| Evaluation Stage | | a result list | Participant: "Irrelevant information, yeah." |
| | Too small fonts | Difficulty reading search results due to small size of fonts | P20: “I can’t see it because the letters are so small.” |
| | Navigational confusion | Difficulty reading search results due to unnecessary navigational items and customization options | P13: “Well, like, for example, I saw this before, but the way it’s laid out is kind of weird. And then, yeah … and, like, for example, the actual article is off to the side with where the article would have been and there’s a bunch of navigation stuff. And then there is a bunch of, you know, customizations for viewing this, so it’s kind of strange.” |
| Emotional Help-Seeking Situations at Result Evaluation Stage | Anxiety by system error messages | Anxious feeling due to system error messages | P16: Participant: “[clicks link] Oh,” Interviewer: “Can you read? Do you think this is readable or not?” Participant: “That’s readable, but …” Interviewer: “Yeah, looks like system error.” (See page 108 for the justification) |
| | Frustration with poor system performance | Frustrated feeling with poor system performance | P18: Interviewer: "Why do you think it (kids.gov) is very difficult?" Participant: "It doesn't have much related stuff to see." (See page 109 for the justification) |
| | Confusion by similar pronouns | Confused feeling by similar pronouns | P4: “And I think another thing would be to make – to make, like, when it does Washington outside… Mr. George Alfred… like, names of other things should be a different color, because I got started trying to click those and I’m just like, ‘Oh, |

| | | | |
|---|---|---|---|
| | | | it's not the right one." (See page 109 for the justification) |

Table 3-6.

*List of Used and Desired Help Features: Types, Definitions and Examples*

| Types | Help Features | Definitions | Examples |
|---|---|---|---|
| Used Help Feature at Query Formulation Stage | Autocomplete | Search predictions, which are possible search terms users can use that are related to the terms they are typing | P15: "Yeah, the autocomplete. Also, I use it sometimes, like how I did. So I clicked "when did George Washington die" and then just deleted the "die" part so I didn't have to type in Washington because that takes…" |
| Used Help Feature at Query Formulation Stage | Spell-check | A red line in the search box as user types | P 10: "W-A? [corrects spelling, then continues typing] … outside… [types "usa"]" |
| Used Help Feature at Query Formulation Stage | Showing results for | A feature helps users correct their misspelled words | P 28: "Yeah, the little thing that when I spell something wrong, it spells it for me." |
| Desired Help Feature at Query Formulation Stage | Synonym search | Providing Synonym suggestions | P3: "One thing they can do is search for synonyms that are, so it would give a more accurate and much wider variety of searches." |
| Desired Help Feature at Query Formulation Stage | Images or icons for search | Providing Images or button icons for keyword search | P7: Participant: "Yeah, I would put, like, if they want to look for books they want to find and they can't find it, then I'll put ... I'll put something, something in there that ... I'll put ..." Interviewer: "Any image or button like that? [clicks back to main kids.gov page]" |
| Desired Help Feature at Query Formulation Stage | Browsing option | Providing keyword categories and sub-categories | P5: Participant: "Satisfied, I guess. I mean, I like this part." Interviewer: "The |

| | | | |
|---|---|---|---|
| | | | browsing option." Participant: "Yeah, the type part because ..." |
| Used Help Feature at Result Evaluation Stage in Google | Result Snippets (Preview) | Represents both the content of a page and references appearing on the web | P23: "I check it here – the preview." |
| Used Help Feature at Result Evaluation Stage in Google | Featured Snippet (Preview Box) | A summary of the answer with a link to the page and the page title and URL at the top of the search results page | P2: Participant: What I found was this little page ... Interviewer: Yes, it is a preview box. |
| Used Help Feature at Result Evaluation Stage in Google | People also search for | A feature allows users expand their search by providing additional search results in a box | P9: "I think the most helpful thing was the "George Washington – U.S. President, General – Biography…" |
| Used Help Feature at Result Evaluation Stage in Google | Searches related to | A feature provides terms that are most frequently searched with the term users entered in the same search session | P10: "I can't find… I can't find what I'm looking for. [clicks related search suggestion "places George Washington has been"]" |
| Used Help Feature at Result Evaluation Stage in Kids.gov | Result Snippets (Preview) | Provides page titles, URL and descriptions of the result | P21: "Maybe more information in the preview." |
| Used Help Feature at Result Evaluation Stage in Kids.gov | Recommended by Kids.gov | A feature enables users expand their search by offering additionally related search results in a box | P15: "Like recommended and stuff, yeah. I'm – I would put myself as satisfied." |
| Used Help Feature at Result Evaluation Stage in Kids.gov | Site Index | A list of web pages accessible to users | P6: "Where were that…[clicks site index, then "G," then "T," back to main page] Still can't find anything about George Washington leaving America." |
| Desired Help Feature at Result Evaluation Stage | More kid-friendly design | Design with vibrant colors and demonstration in result display | P2: "I think they should make it, like, more how kids would like to read it and not that, like, the websites I got on – the ones that had those words that the paper was, like, really white and the words were |

| | | | |
|---|---|---|---|
| | | | all on the sides – those seemed really boring for kids and I think they should make it more how kids want to make it like." |
| Desired Help Feature at Result Evaluation Stage | Effective screen space use | No waste space for page results | P27: “They should put some on the other side so the computer looks like it has more space and you don’t have to flip and flip and flip through.” |
| Desired Help Feature at Result Evaluation Stage | Different formats of information | Providing a variety of formats in result display | P24: "If you type in Google, it has news, video and map. I would add that to kids.gov because it has everything in videos." |
| Desired Help Feature at Result Evaluation Stage | Separate “Help” page | Providing separate "HELP" page | P26: "Make it less confusing. Maybe like a helper page like how to search best things." |
| Desired Help Feature at Result Evaluation Stage | Brighter color for previously visited sites | Providing brighter color for previously visited sites | P14: Participant: "Maybe you might want to use, like, a brighter color when you… because you know how it turns purple when you already do that? The purple’s pretty close to the blue and I get mixed up." Interviewer: "Okay." Participant: "I would have it maybe a different color like red or gray or whatever." |
| Desired Help Feature at Result Evaluation Stage | Pagination on result pages | Providing total pagination on result pages | P24: “I would actually make it kind of show how many pages there are in total. Like it says page one, but I would say how many pages it actually has.” |
| Desired Help Feature at Result Evaluation Stage | A bigger preview | Providing bigger sizes of preview | P14: Participant: “The preview … if you could have the preview … maybe if you could go like that … and you’d see a little more of the preview …” Interviewer: “Bigger one?” |

| | | | |
|---|---|---|---|
| | | | Participant: "yeah, like a bigger one you could just put your mouse and if you, like, clicked on someplace, you could just see a bigger one. Then click it again, you could …" |

### 3.4.2. Quantitative Data Analysis

For RQ 2, descriptive statistics were used to analyze the frequency of help features children used during search sessions for their search tasks.

To answer RQ 3, inferential statistics were administered. First, each participant's knowledge level was assessed during the performance-based knowledge quiz and self-assessment for the answers to RQ3. Levels of children's domain knowledge were identified to conduct a linear regression analysis that describes the effects of levels of children's domain knowledge on their help seeking and use of help features when they create search queries and assess search results. Linear regression helps predict the effect of domain knowledge on children's help seeking and use of help features as well as describing the relationship between children's domain knowledge and their help seeking and use of help features.

Frequency of occurrences of help-seeking situations and frequency of help-feature use of participants were counted through data from screen recordings and transaction logs. The findings resulting from the linear regression analysis in this study help verify prior findings**,** which discussed that domain knowledge is one of crucial factors affecting help-seeking behaviors (Wood, 2001; Bartholomé, Stahl, Pieschl, & Bromme, 2006; Xie & Cool, 2009; Wu, 2011) and information behaviors (Marchionini, 1995; Hirsh, 1997; Hsieh-Yee, 2001; Bilal, 2001; Wildemuth, 2004; Hembrooke, Granka, Gay, & Liddy, 2005; Dinet, Bastien, & Kitajima 2010; Gossen & Nürnberger, 2013).

### 3.5. Validity and Reliability

The concepts of "validity" and "reliability" in quantitative research and qualitative research methods are controversial, and the uses of the terms "validity" and "reliability" are different in quantitative research and qualitative research.

According to Winter (2000), the ability to generalize findings to wider groups and circumstances is one of the most common tests of validity for quantitative research. Maxwell (1992) indicated that "proponents of quantitative and experimental approaches have frequently criticized the absence of standard ways of assuring validity, such as quantitative measurement, explicit controls for various validity threats and the formal testing of prior hypotheses" (p. 279) in the qualitative method. Winter emphasized that quantitative research tries to deal with both internal and external generalization referring to these as "internal validity" and "external validity." Winter has explained both internal validity and external validity. First, internal validity has a connection with whether the findings of the research are related to and are caused by the phenomena under investigation. Within quantitative research, techniques for measuring influences and causality must be established for the test to be valid. There are many factors that pose a threat to validity, such as the maturation of the individual in a longitudinal study, the previous experiences of the individuals, or lost data (Winter, 2000).

Furthermore, the measure of external validity is the extent to which the findings can be generalized and applied to other populations. Threats to external validity are similar to those for internal validity, except for the test itself, which is more likely to pose a threat as an alternative explanation for similar results (Winter, 2000). A measurement procedure is considered reliable to the extent that it produces stable and consistent measurements (Gravetter & Wallnau, 2008, p. 476). Regarding this study, using various techniques for measuring reduces threats to internal

validity. Inferential statistical analysis, including linear regression, helps to ensure reliability by measuring data through tests with an adequate sample size.

In order to ensure trustworthiness in qualitative research, many researchers (Creswell, 2009, 2012; Roberts, Priest, & Traynor, 2006; Shenton, 2004b) provide strategies for internal validity, external validity, and reliability. The strategies for validity include triangulation, member checking, prolonged stays in the field, the use of peer debriefing or peer review, the use of an external auditor, clarifying researcher bias, and searching for negative cases (Creswell, 2009; 2012; Roberts, Priest, & Traynor, 2006; Shenton, 2004b). According to Roberts, Priest, and Traynor (2006), reliability can be thought of as the trustworthiness of the procedures and data generated in qualitative research; to ensure reliability, researchers need to confirm findings by revisiting data under different circumstances. To enhance the reliability of qualitative research, Roberts, Priest, and Traynor proposed strategies including inter-coder reliability, qualitative content analysis, using data analysis software such as NVivo, ensuring technical accuracy in recording and transcribing, and the use of standardized transcription notation. Creswell (2009, 2012) also suggested inter-coder agreement or cross-checking as a strategy for enhancing reliability. Qualitative data analysis used in this study confirms validity by employing various strategies including inter-coder reliability, use of data analysis software and ensuring technical accuracy. Also, the mixed method design in this study reduces validity threats and enhances "validity and reliability of the data and their interpretation" (Zohrabi, 2013, p. 254).

### 3.6. Summary of Methodology

This dissertation recruited 30 children who are 8 to 10 years old in a Midwestern city. Data was collected through pre-questionnaires, transaction logs, think-aloud protocols, observations, and

interviews. Participants were asked to conduct two imposed search tasks in Google and Kids.gov. In order to answer three different research questions, qualitative and quantitative data analysis techniques were applied. For research question 1, open coding method and taxonomy were used to identify help-seeking situations when participants formulate search queries and evaluate search results. For research question 2, open coding and taxonomy methods were employed to find types of help features children use and desire when they formulate search terms and evaluate search results, and the frequency of help features use were quantified. Linear regression analysis was applied to examine the effects of children's domain knowledge levels on their help seeking and use of help features while formulating search queries and evaluating search results for research question 3.

# Chapter 4: Results

After analyzing the collected data, this chapter discusses this study's findings and answers three research questions and their sub-questions and hypotheses.

## 4.1. Research Question 1 (a): What are the types of help-seeking situations experienced by children (8-10 years old) when they formulate search queries in a search engine and a kid-friendly web portal?

### 4.1.1. Cognitive Help-Seeking Situations at Query Formulation Stage

Due to the limited cognitive ability of their ages, participants who were 8 to 10 years old had various help-seeking situations when they formulated their queries for the tasks. Cognitive help-seeking situations at the query formulation stage include limited visibility of help features, spelling errors, and difficulty in formulating search queries.

#### Limited visibility of help features

Limited visibility of help features is the help-seeking situation where participants could not locate the existing help features easily. Participants did not know there were help features available, particularly in Kids.gov. This help-seeking situation accounted for 35% of the cognitive help-seeking situations at the query formulation stage. They simply assumed that the site had no such help features. More careful design is needed for a better interface in terms of available help features. Participant 4 did not realize there is the "autocomplete" or any help features when she formulated her search queries. Participant 4 said:

"I didn't even see there is the autocomplete or even their help features."

Participant 24 was also not able to see the "autocomplete" feature when she formulated keywords in Kids.gov due to the lack of visibility of the feature and stated:

> “It doesn't really have a good autocomplete and this still isn't popping out, but if you go to Google like this and just click — georg — I didn't even finish typing George and options just keep coming out, but Kids.gov you can't — even if you finish typing in the whole thing it doesn't even give very many autocompletes.”

**Spelling errors**

Spelling errors were common at the participants’ query formulation stage. Participants had numerous spelling errors while they entered their queries. Thirty-five percent of cognitive help-seeking situations at the query formulation stage were spelling errors. Participant 3 made spelling errors when she formulated search keywords and clicked “showing results for” feature, which is an auto correction:

> [typing “what did George Washington’s urge the American people to do in his farewell adress”, clicks corrected phrase of “what did George Washington urge the American people to do in his farewell address”, clicks link] It says here something.

Participant 4 also made spelling errors at the keyword formulation stage and used the “Showing results for” feature. Her example shows:

> [typing "farewell adress"] I don't know if my spelling is right. [clicks suggested "farewell address" search]

**Difficulty in formulating queries**

Difficulty in formulating queries is a cognitive help-seeking situation at the query formulation stage where participants had difficulty with how to start keywords. Some participants literally typed the exact task given into the search box, while others entered a few words, only to generate too many irrelevant search results. This help-seeking situation accounted for 30% of the

cognitive help-seeking situations at query formulation stage. The next examples illustrate the participants' difficulty in formulating queries while searching. Participant 2 entered only a few words, and it caused too many irrelevant search results. For example, Participant 2 typed "George Washington and Travel" for Task 1, which is too broad to have a good result. Participant 17 had difficulty in formulating search queries to generate search results:

> Participant: "I don't know what to search up." Interviewer: "So you mean making the keywords is difficult?" Participant: "Yeah."

Participant 26 shared his searching experience with the interviewer, and more specific keywords made his searching successful:

> Interviewer: "Before moving to #2, can you share anything, any difficulties or problems or any helpful things?" Participant: "Well, to be a little more specific to get the right answer." Participant: "Yeah." Interviewer: "It was helpful? More specific keywords, was it helpful to find the right answer?" Participant: "Yes."

Participant 8 typed the whole question or only a few words in the search box, and it caused irrelevant search results. Moreover, lack of domain knowledge or lack of proper vocabulary level led to query formulation difficulties as well. Participant 3 had a problem understanding the meaning of the topic of task 2 and commented:

> Wait, does it mean farewell address meaning that . . . where he was, where he died? Or something like that?

### 4.1.2. Physical Help-Seeking Situations at Query Formulation Stage

Physical help-seeking situations do not result from either the cognitive or emotional aspects of the participants but from the system or its interface. Physical help-seeking situations are more frequent in evaluating search results than in formulating queries. There was one physical help-seeking situation at the query formulation stage in this study.

**Size of the search box**

At Kids.gov, the search box is rather small. Participants had difficulty in locating it for their keyword search. This help-seeking situation accounted for 100% of the physical help-seeking situations at query formulation stage.

The example of participant 7 indicated that a small size of search box caused participants' difficulty in locating the keyword search box. According to participant 7:

> Participant: "Where do I press it?" Interviewer: "Keyword search is here." Participant: "Oh!"

### 4.1.3. Emotional Help-Seeking Situations at Query Formulation Stage

Emotional help-seeking situations have nothing to do with participants' cognitive or intellectual development, but are related to their feelings, such as anxiety or frustration. Emotional help-seeking situations involved anxiety while formulating queries.

**Anxiety while formulating queries**

Participants felt anxious when they create search terms. One hundred percent of emotional help-seeking situations at the query formulation stage involved anxiety while formulating search queries. Participants rarely said anything while they typed their search queries. Their anxiety led to typos and retyping. The examples of participants 29 and 30 showed behaviors such as

hesitation in creating keywords and chewing on hair due to difficulties in formulating appropriate keywords. Anxiety can cause people to give a few extra moments of hesitation (Calm clinic, n.d.). In addition, chewing or twirling hair is one of children's anxiety symptoms, according to Anxiety and Depression Association of America (ADAA).

> Participant 29 took more than 2 minutes to type in her first query with 11 words, but still made two typos. She ended up using the "Showing results for" feature on Google.
>
> Participant 30 could not type more than three words even after 90 seconds, chewing on her hair during this time.

Overall, among the help-seeking situations at the query formulation stage, 87% were cognitive, 4% were physical, and 9% were emotional.

## 4.2. Research Question 1 (b): What are the types of help-seeking situations were experienced by children (8-10 years old) when they evaluated search results in a search engine and a kid-friendly web portal?

### 4.2.1. Cognitive Help-Seeking Situations at Result Evaluation Stage

Participants who were 8 to 10 years old had various help-seeking situations when they evaluated search results due to their limited cognitive ability. These included mismatched reading level, comfortability with system knowledge, and negative effect from lack of domain knowledge.

#### Mismatched reading level

Participants expressed their difficulty reading too many words, too-long passages, or handwritten (cursive) texts. This is considered a mismatched audience, in this case, adult-oriented text level

presented to kids. This help-seeking situation accounted for 62.5% of the cognitive help- seeking situations at the result evaluation stage.

Participant 4 had a problem in reading too many words and passages from the result page. A result had 21 pages. Participant 4 remarked:

> Fancy words I can't read. Oh my gosh! That's apparently how people wrote back then." . . . "I don't know if there was a better way to get to the answer, but this is a 21-page document with a lot of words. If I was to read, you know, cover-to-cover, I'd take me the whole time." . . . "I'm not going to read this entire thing and I can't read it because it's in script.

Participant 24 was not able to read cursive texts on a result and mentioned:

> "I sometimes have trouble reading cursive. Original documents they all have cursive thing so I can read some cursive, I guess, but this is illegible."

**Comfortability with system knowledge**

Participants felt more comfortable with the systems that they have used frequently before. Twenty-five percent of cognitive help-seeking situations at the result evaluation stage were from the lack of system knowledge. Participant 4 felt more at ease when she reviewed search results in Google because she had used Google before. According to Participant 4:

> "The thing is, I'm more familiar with using Google, and I guess it's much easier."

However, as the example of participant 3 reveals, lack of system experience led to participants' difficulty in evaluating results.

> "Uh, well, since I haven't used it a lot before, put probably difficult."

**Negative effect from lack of domain knowledge**

If participants do not have enough domain knowledge about the given task, even relevant search results provide little value. The lack of domain knowledge hinders effective review of search results. This help-seeking situation accounted for 12.5% of the cognitive help-seeking situations at the result evaluation stage. Participant 4 had difficulty in understanding the retrieved result due to lack of domain knowledge:

> "What's Barbados? I don't know these."

Participant 7 reviewed several search results; however, he was not able to understand the retrieved items because of his limited domain knowledge. Participant 7 commented:

> "I don't know what the words mean and I don't know, like, what to press, and none of this stuff really say about where he went. All it says is about, like, like yes, stuff that he did and stuff so I don't know."

### 4.2.2. Physical Help-Seeking Situations at Result Evaluation Stage

Physical help-seeking situations are from aspects of the system or its interface. Physical help-seeking situations are more frequent in evaluating search results and involve too many irrelevant results, too-small fonts, and navigational confusion.

**Too many irrelevant results**

Participants had too many irrelevant items in a result list when they evaluated search results. Seventy-three percent of physical help-seeking situations at the result evaluation stage were related to the issue of too many irrelevant results. Participant 13 reviewed several search results

but had difficulty finding correct information because the system provides too many irrelevant results:

> Participant: "It's like . . . I can't . . . it's not giving me, like I typed in what did George Washington urge in the farewell address, and down here I have a folk history of slavery, the life and history of John Floyd, governor of Virginia . . . " Interviewer: "You mean they provide not relevant information." Participant: "Irrelevant information, yeah. Whereas when I was using Google back there, it worked better."

Participant 24 complained of the irrelevant links of Kids.gov's result pages:

> "One thing about Kids.gov is that they have really irrelevant links because I just searched 'George Washington's trip' and it gave me George Washington mapmaker things."

**Too-small fonts**

Participants had difficulty reading search results because the font size was too small for them. This help-seeking situation accounted for 18% of the physical help-seeking situations at the result evaluation stage. The examples of participants 20 and 24 indicate that bigger font size for search results is needed for children to read results effectively. Participant 20 remarked:

> "I can't see it because the letters are so small."

Participant 24 said:

> "I would make these fonts a little bigger because for someone who doesn't have that good of vision . . . "

**Navigational confusion**

A participant pointed out that unnecessary navigational items and customization options led to confusion, which made effective review of search results difficult on Google. This help-seeking situation accounted for 9% of the physical help-seeking situations at the result evaluation stage. Participant 13 experienced difficulty in reviewing search results effectively because Google has many navigational items and options in a result page and mentioned:

> "Well, like, for example, I saw this before, but the way it's laid out is kind of weird. And then, yeah . . . and, like, for example, the actual article is off to the side with where the article would have been and there's a bunch of navigation stuff. And then there is a bunch of, you know, customizations for viewing this, so it's kind of strange."

### 4.2.3. Emotional Help-Seeking Situations at Result Evaluation Stage

Emotional help-seeking situations are related to children's negative feelings such as anxiety, confusion, and frustration. Emotional help-seeking situations include anxiety about system error messages, frustration with poor system performance, and confusion about similar pronouns.

**Anxiety by system error messages**

Kids.gov generated dead-end system error messages, which caused the participants anxiety. This help-seeking situation accounted for 40% of the emotional help-seeking situations at the result evaluation stage. Participants 16 and 30 encountered difficulty reading and reviewing results due to repeated system errors. Participant 16 exhibited expressionless behaviors, which is one of children's anxiety symptoms (ADAA, 2015):

> Participant: “[clicks link] Oh,” Interviewer: “Can you read? Do you think this is readable or not?” Participant: “That’s readable, but . . . ” Interviewer: “Yeah, looks like system error.”

In addition, participant 30 showed expressionless behaviors caused by system error messages:

> Participant: “[silent]” Interviewer: “You can click if you think it’s the right answer. Is it easy to read? Again, system error.” Participant: “[silent]”

**Frustration with poor system performance**

Participants expressed their frustration with poor system performance, in other words, not much relevant information in the search results. According to Nesset (2014), poor system performance while searching led to children’s frustration. Children’s frustrated expressions caused by poor system performance in this study were found, and this accounted for 40% of emotional help-seeking situations at the result evaluation stage. For example, participant 4 felt frustrated because Kids.gov provides a lot of irrelevant results:

> “I think the problem with this site [Kids.gov] is that they don't have a lot of results and that forces a lot of [irrelevant] information to be put in the results.”

Participant 18 also experienced frustration with Kids.gov’s poor system performance:

> Interviewer: "Why do you think it [Kids.gov] is very difficult?" Participant: "It doesn't have much related stuff to see."

**Confusion with similar pronouns**

Participants were confused with similar pronouns such as the same first names or last names.

Participants in this study were confused due to spellings of a similarly pronounced name while reviewing their search results. This help-seeking situation accounted for 20% of the emotional help-seeking situations at the result evaluation stage.

The example of participant 4 shows that similar pronouns made children confused when reviewing search results:

> "And I think another thing would be to make —to make, like, when it does Washington outside . . . Mr. George Alfred . . . like, names of other things should be a different color, because I got started trying to click those and I'm just like, 'Oh, it's not the right one."

Overall, the help-seeking situations at the result evaluation stage consisted of 50% cognitive, 34% physical, and 16% emotional help-seeking situations.

## 4.3. Research Question 2 (a): What types of help features do children (8-10 years old) use and desire when they formulate search queries in a search engines and a kid-friendly web portal?

### 4.3.1. Types of help features children use when they formulate search queries

This study identified different types of help features children used when they formulate search queries in Google and Kids.gov.

Google has help features including "autocomplete," "spell-check," and "showing results for" for query formulation; these features are noticeable by setting when users create their keywords. According to Google, "autocomplete" is search predictions, which are possible search terms users can use that are related to the terms they are typing. If there is a misspelling, "spell-check" shows a red line in the search box as user types. The feature of "showing results for" helps users correct their misspelled words. Kids.gov also has "autocomplete," "spell-check," and

"showing results for" features for users' keyword formulation. Although Kids.gov supports an "autocomplete" feature, their "autocomplete" is not noticeable compared to Google. For example, Kids.gov "autocomplete" does not provide the terms other users search for, including trending stories. Also, Kids.gov does not have a service such as "Web & app" activity like Google does, which helps provide relevant searches users have done in the past. Figure 4.1 illustrates the frequency of help features children used when they create search queries in Google and Kids.gov.

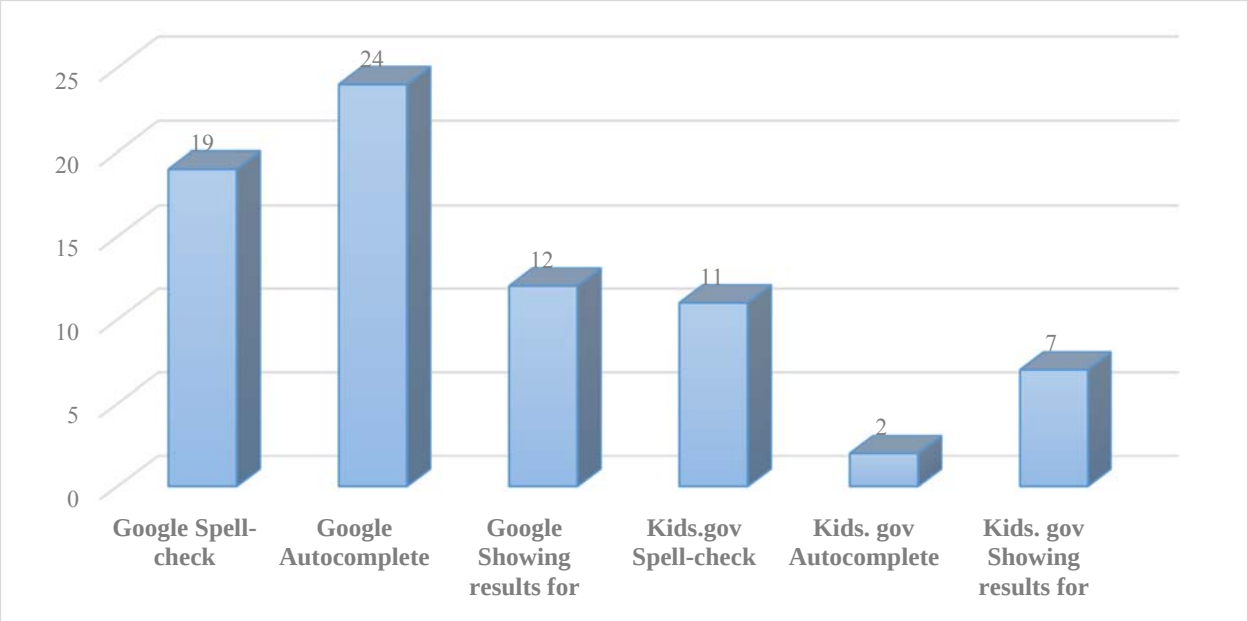


*Figure 4.1.* Frequency of Help Features Children Used When they Formulated Search Queries in Google and Kids.gov

Out of 30 participants, 24 participants used Google "autocomplete" when they formulated keywords, while only two participants used Kids.gov "autocomplete". Nineteen participants used "spell-check", and 12 participants used "showing results for" in Google searches. Eleven children employed "spell-check", and seven used the "showing results for" feature when they formulated search queries in Kids.gov. Table 4.1 shows types of help features and definitions used when participants formulated keywords in Google and Kids.gov.

Table 4.1

*Types of Help Features and Definitions for Query Formulations in Google and Kids.gov*

| Help Features | Definitions |
|---|---|
| Autocomplete | Search predictions, which are possible search terms users can use that are related to the terms they are typing |
| Spell-check | A red line in the search box as user types |
| Showing results for | A feature helps users correct their misspelled words |

Here are quotes from participants when they used those help features for formulating of keywords on Google and Kids.gov:

**Autocomplete**

Participant 9 expressed frequent use of "autocomplete" for keyword formulation, mentioning:

> "Their [Google's] help features . . . .. really the only one I use is autocomplete."

Participant 15 used the "autocomplete" feature when formulating keywords without typing all words and said:

> "Yeah, the autocomplete. Also, I use it sometimes, like how I did. So I clicked "when did George Washington die" and then just deleted the "die" part so I didn't have to type in Washington because that takes . . . "

**Spell-check**

Participants 10 and 12 utilized "spell-check" and realized their spelling errors. This example of Participant 10 reveals the use of "spell-check":

> "W-A? [corrects spelling, then continues typing] . . . outside . . . [types "usa"]"

Participant 12 used "spell-check" and realized the spelling error as well:

[typing “what did George Washingtonurge”] Oops, I forgot to do the space. [corrects typing error, continues typing “. . .  the American”]

**Showing results for**

The examples of participants 24 and 28 reveal that the “showing results for” feature enables children to correct their spell errors as well as help their query formulations. Participant 24 remarked:

"Google has a lot of tools to help me, for example ‘what did you mean?’ and that. So there’s a lot of tools you can use in this Google search engine".

Participant 28 also commented about the “showing results for” feature:

"Yeah, the little thing that when I spell something wrong, it spells it for me."

### 4.3.2. Types of help features children desire when they formulate search queries

Participants in this study suggested help features they want to use when they formulate keywords. Children’s desired help features for query formulations include synonym search, images or icons for search and browsing feature.

**Synonym search:**

Participant 3 recommended a synonym search feature for children to help their formulation of search queries with expanded vocabulary:

“One thing they can do is search for synonyms that are, so it would give a more accurate and much wider variety of searches.”

**Images or icons for search:**

Participant 7 suggested adding word suggestions with images or button icons for keyword search rather than typing search queries in the search box:

> Participant: "Yeah, I would put, like, if they want to look for books they want to find and they can't find it, then I'll put . . . I'll put something, something in there that . . . I'll put . . . " Interviewer: "Any image or button like that? [clicks back to main kids.gov page]" Participant: "Yes, like that. I'll put that stuff on there so that they can, they don't have to type it down, they can just see it right there."

**Browsing option:**

Some participants prefer browsing to keyword searching. Participant 5 liked browsing in Kids.gov more than the keyword search in Google:

> Interviewer: "OK. Please rate the satisfaction level in using Kids.gov's help features." Participant: "Satisfied, I guess. I mean, I like this part." Interviewer: "The browsing option." Participant: "Yeah, the type part because . . . " Interviewer: "Not the keyword search." Participant: "Yeah, not the keyword search."

Browsing options help children reduce cognitive overload without formulating keywords. Participant 24 recommended having a browsing feature for children to find information easily:

> “I actually think the browsing links are much better and helpful than the keyword search because the keyword search is just not relevant and then "Government" had specific things under that topic so I could find them easily.”

## 4.4. Research Question 2 (b): What help features do children (8-10 years old) use and desire when they evaluate search results in a search engine and a kid-friendly web portal?

### 4.4.1. Types of help features children use when they evaluate search results

This study found different types of help features children used when they evaluate search results in Google and Kids.gov.

Google offers multiple help features including “result snippets (preview),” “featured snippet,” “search tools,” “people also search for,” and “searches related to” for result evaluations. In this study, children who participated in this study used “result snippets,” “featured snippet,” “people also search for,” and “searches related to” features in Google. “Result snippets (preview)” represents both the content of a page and references to it that appear on the web, according to Google. Also, the “featured snippet” shows a summary of the answer with a link to the page and the page title and URL at the top of the search results page. Google’s “people also search for” feature allows users expand their search by providing additional search results in a box. The “searches related to” feature in Google provides terms that are most frequently searched with the term users entered in the same search session. It is placed at the bottom of the result page. Figure 4.2 indicates the frequency of help features participants used when they evaluated search results in Google. Also, Table 4.2 presents types of help features and definitions when participants evaluated results in Google.

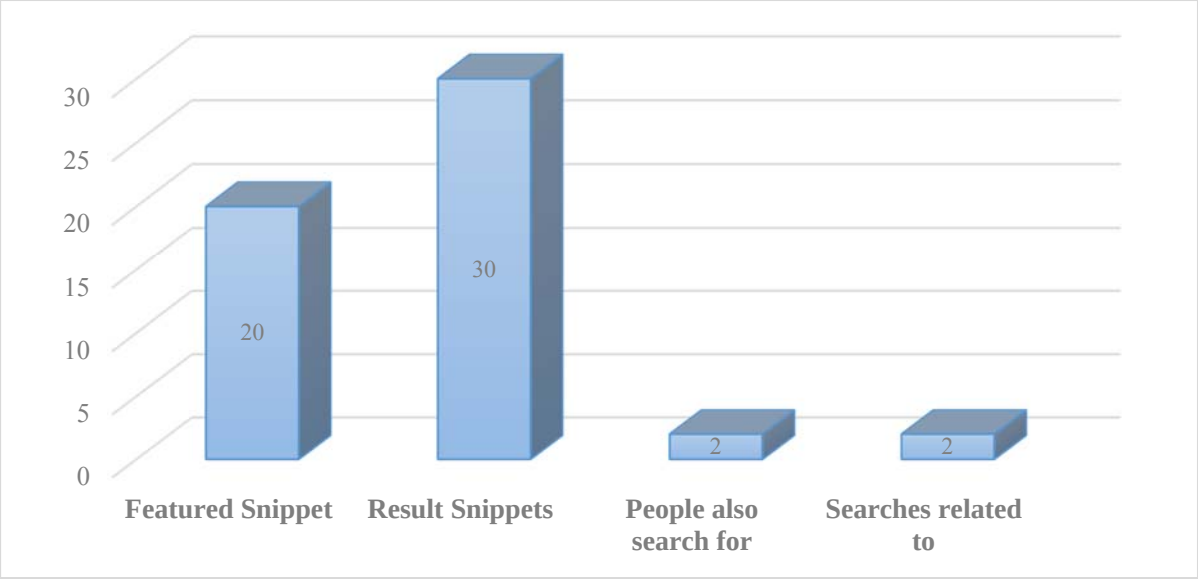


*Figure 4.2.* Frequency of Help Features Children Used When They Evaluated Results in Google

Table 4.2

*Types of Help Features and Definitions for Result Evaluations in Google*

| Help features (Google) | Definitions |
|---|---|
| Result Snippets (Preview) | Represents both the content of a page and references appearing on the web |
| Featured Snippet (Preview Box) | A summary of the answer with a link to the page and the page title and URL at the top of the search results page |
| People also search for | A feature allows users expand their search by providing additional search results in a box |
| Searches related to | A feature provides terms that are most frequently searched with the term users entered in the same search session. |

Here are quotes from participants when they used help features for evaluating of search results on Google.

**Result Snippets (Preview)**

All participants used Preview when they evaluated search results in Google. For example, Participant 23 expressed use of Preview in Google:

"I check it here – the Preview."

**Featured Snippet (Preview Box)**

Google provides “featured snippet” for users, and 20 participants used this feature to find correct information. Participant 2 explained use of the “featured snippet” in Google:

Participant: What I found was this little page . . . Interviewer: Yes, it is a Preview box.

**People also search for**

Only two participants used the “people also search for” feature in Google. Participant 9 stated “people also search for” feature helped find information easily:

"I think the most helpful thing was the “George Washington — U.S. President, General — Biography . . . ”

**Searches related to**

Two participants used "searches related to" feature when they evaluate results in Google. The example of participant 10 indicates participant's use of the searches related to feature in Google:

> "I can't find . . . I can't find what I'm looking for. [clicks related search suggestion "places George Washington has been"]"

All participants in this study used "result snippets (previews)" with the page titles when they checked retrieved results. Twenty participants made use of the "featured snippet" while accessing results. Out of 30 participants, two used the "people also search for" and "searches related to" features when they evaluated results in Google.

Kids.gov has limited help features for result evaluation compared to Google. It provides "result snippets (preview)," "recommended by Kids.gov," "searches related to," and "site Index." Children who participated in this study used "result snippets", "recommended by Kids.gov", and "site Index". "Result snippets" of Kids.gov also provides page titles, URL, and descriptions like the ones of Google. The "recommended by Kids.gov" feature is similar feature with Google's "people also search for," which enables users expand their search by offering additionally related search results in a box. "Site Index" is a list of web pages accessible to users. Kids.gov has a "site Index" having web pages accessible in alphabetical order. Figure 4.3 presents the frequency of help features participants used when they evaluate search results in Kids.gov.

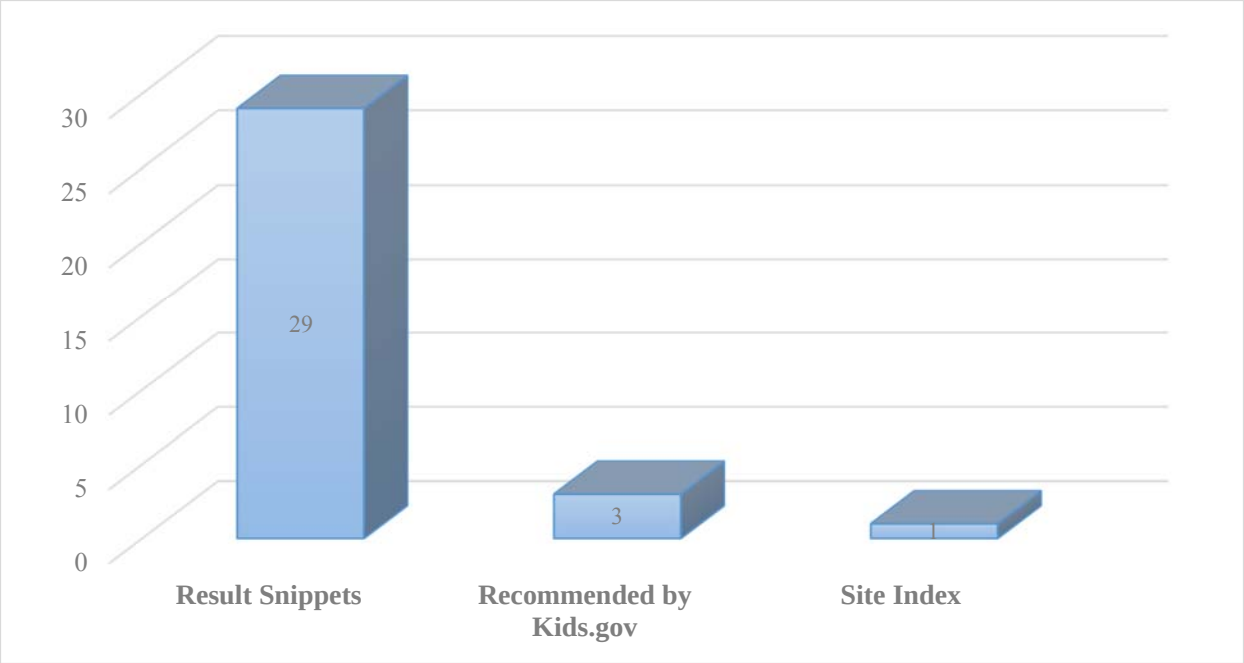


*Figure 4.3.* Frequency of Help Features Children Used When They Evaluated Results in Kids.gov

The frequency data shows that 29 participants in this study used "result snippets" when they evaluated results in Kids.gov. One of 30 participants did not make use of the "result snippet" because his results were not retrieved with his keyword formulation in the Kids.gov site. Three children who took part in this study used the "recommended by Kids.gov" feature for their result assessments. One participant checked the "Site Index" feature while checking retrieved results in Kids. gov. Table 4.3 indicates types of help features and definitions when participants evaluate search results in Kids.gov.

Table 4.3
*Types of Help Features and Definitions for Result Evaluations in Kids.gov*

| **Help features (Kids.gov)** | **Definitions** |
|---|---|
| Result Snippets (Preview) | Provides page titles, URL and descriptions of the result |
| Recommended by Kids.gov | A feature enables users expand their search by offering additionally related search results in a box |
| Site Index | A list of web pages accessible to users |

Below are quotes from participants when they used help features for evaluating of search results on Kids.gov.

**Result Snippets (Preview)**

Almost all participants used “result snippets” when they evaluated search results in Kids.gov. For example, participant 21 mentioned the use of Preview in Kids.gov but suggested more detailed information for Preview in Kids.gov:

"Maybe more information in the Preview."

**Recommended by Kids.gov**

Three participants used the “recommended by Kids.gov” feature in Kids.gov. Participant 15 said the use of “recommended by Kids.gov” feature for evaluating results and was satisfied with the feature:

"Like recommended and stuff, yeah. I’m — I would put myself as satisfied."

**Site Index**

One participant used the “Site Index” feature in Kids.gov. Participant 6 used the “Site index” but failed to find correct information. The example shows:

"Where were that . . . [clicks site index, then “G,” then “T,” back to main page] Still can’t find anything about George Washington leaving America."

### 4.4.2. Types of help features children desire when they evaluate search results

Participants in this study suggested help features they want to use when they evaluate search results. Children’s desired help features for result evaluation include kid-friendly design in search result display, effective screen space for result pages, a variety of formats of

information, separate Help page, brighter colors for visited links, pagination on result pages, and bigger preview.

**More kid-friendly design:**

Participants often desired more kid-friendly design in search result display. Participant 2 suggested a more kid-friendly design with vibrant colors and demonstration in result display:

> "I think they should make it, like, more how kids would like to read it and not that, like, the websites I got on — the ones that had those words that the paper was, like, really white and the words were all on the sides — those seemed really boring for kids and I think they should make it more how kids want to make it like."

**More effective use of space:**

Participants desired more effective screen space use. Participants 4 and 27 recommended no waste of screen space for result pages and more contents to fill up the entire space. Participant 4 said:

> "They could make it fill up the entire space of the screen and not waste — first of all, be kinder to my eyes — and not wasting space, you know?"

Moreover, participant 27 mentioned:

> "They should put some on the other side so the computer looks like it has more space and you don't have to flip and flip and flip through."

**Different formats of information:**

Participants wanted a variety of formats of information. The examples of participants 24 and 25 shows that various formats such as video, map, news, and blogs, are needed for children to find results effectively. Participant 24 suggested:

"If you type in Google, it has news, video and map. I would add that to kids.gov because it has everything in videos."

Participant 25 recommended:

"Maybe include a blog for people who know stuff."

**Separate "Help" page:**

A participant suggested a separate "Help" page. Participant 26 proposed a separate "Help" page to get any help from the site:

"Make it less confusing. Maybe like a helper page like how to search best things."

**Brighter color for previously visited sites:**

The default purple color for previously visited sites is not distinctively noticeable. Brighter color may help. Participant 14 suggested changing color for visited site links. Google's default preview color is blue, and the default visited site color is purple, but this made children confused due to the similar color. Participant 14 wanted to have brighter colors such as red for visited sites:

Participant: "Maybe you might want to use, like, a brighter color when you . . . because you know how it turns purple when you already do that? The purple's pretty close to the blue and I get mixed up." Interviewer: "Okay." Participant: "I would have it maybe a different color like red or gray or whatever."

**Pagination on result pages:**

Participant 24 expressed the need for pagination on result pages to understand how many pages there are in total:

"I would actually make it kind of show how many pages there are in total. Like it says page one, but I would say how many pages it actually has."

**A bigger preview:**

Some participants had difficulty in reviewing previews effectively due to the small size of fonts and size of the preview. Participant 14 wanted to have a bigger preview on result pages:

> Participant: "The preview . . . if you could have the preview . . . maybe if you could go like that . . . and you'd see a little more of the preview . . . " Interviewer: "Bigger one?" Participant: "yeah, like a bigger one you could just put your mouse and if you, like, clicked on someplace, you could just see a bigger one. Then click it again, you could . . . "

## 4.5. Research Question 3 (a): How does children's (8-10 years old) domain knowledge affect their help seeking and use of help features when they formulate search queries in a search engine and a kid-friendly web portal?

This final result answers the third research questions, which examine the significant predictor of the dependent variable and the relationships between children's domain knowledge and their help seeking and use of help features in Google and Kids.gov.

### 4.5.1. Effects of Domain Knowledge on Help Seeking When Children Formulate Search Queries

Linear regression was calculated to test the hypotheses H1A and H1B: Levels of children's domain knowledge affect the frequency of occurrence of help seeking situations when they formulate search queries in Google and Kids.gov

Table 4.4
*Regression of Level of Domain Knowledge Self-Assessment on Help Seeking of Keyword Formulations in Google*

| Predictor | B | Std.Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 3.345 | 0.683 | | 4.896 | 0.000 |
| Level of DK self-assessment | -0.514 | 0.229 | -0.390 | -2.242 | 0.033 |

Dependent variable: Help seeking situations of keyword formulations in Google

The effect of children' domain knowledge on their help-seeking situations when they formulate keywords was investigated based on regression analysis. As shown in Table 4.4, the result indicates that level of children's domain knowledge self-assessment affects occurrences of their help-seeking situations when they formulate search queries in Google at the alpha level of 0.05. The beta value is -0.390. In other words, the more domain knowledge a child thinks she or he has, the less frequently the child has help-seeking situations when they formulate a query on Google, and this is statistically significant ($F(1,28)=5.027$, $P=0.033$ with an $R^2$ of 0.152).

Table 4.5
*Regression of Level of Domain Knowledge Self-Assessment on Help Seeking of Keyword Formulations in Kids.gov*

| Predictor | B | Std.Error | β | T | Sig. |
|---|---|---|---|---|---|
| (Constant) | 2.245 | 0.647 | | 3.468 | 0.002 |
| Level of DK self-assessment | 0.202 | 0.217 | 0.173 | 0.931 | 0.360 |

Dependent variable: Help seeking situations of keyword formulation in Kids.gov

As shown in Table 4.5, there was no predictor that has a significant effect on occurrences of children's help-seeking situations when they create keywords in Kids.gov ($F(1,28) = 0.867$, $P=0.360$) with an $R^2$ of 0.030). It is thought that the less kid-friendly interface of Kids.gov failed to generate a meaningful relationship between two variables.

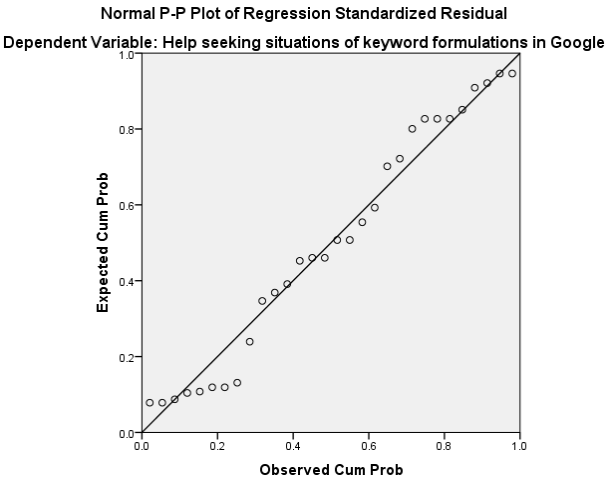


*Figure 4.4.* Normal P-Plot for Level of Domain Knowledge Self-Assessment on Help Seeking of Keyword Formulations in Google

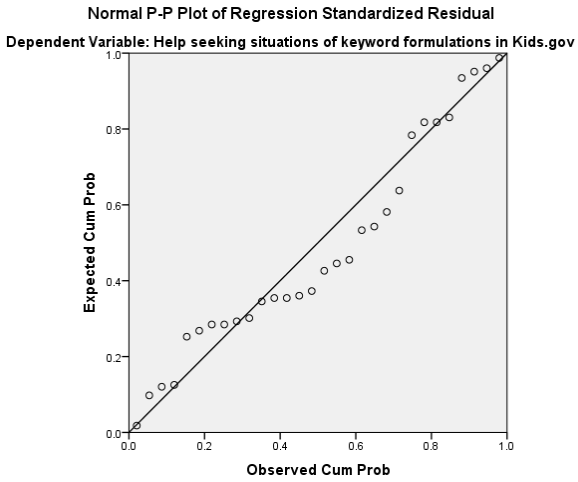


*Figure 4.5.* Normal P-Plot for Level of Domain Knowledge Self-Assessment on Help Seeking of Keyword Formulations in Kids.gov

Figures 4.4 and 4.5 show the normal probability plot, which is a graphical technique for checking the normality of a data set. The plotted points should follow the straight line to predict the normal distribution. Figure 4.4 indicates the plotted points form a nearly linear pattern, while the points of figure 4.5 show a little departure from the straight line.

Table 4.6
*Regression of Level of Domain Knowledge Quiz on Help Seeking of Keyword Formulations in Google*

| Predictor | B | Std. Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 3.913 | 0.688 | | 5.688 | 0.000 |
| Level of DK quiz | -0.036 | 0.015 | -0.424 | -2.479 | 0.019 |

Dependent variable: Help seeking situations of keyword formulation in Google

Table 4.6 presents how the level of the children's domain knowledge quiz affects the occurrence of their help-seeking situations when they formulate keywords in Google at the alpha level of 0.05. A significant regression equation was found ($F(1,28)=6.145$, $P=0.019$), with an $R^2$ of 0.180.

With a minus value of beta (-0.424), this means that on Google, the more domain knowledge a child has, the less frequently the child has help-seeking situations.

Table 4.7
*Regression of Level of Domain Knowledge Quiz on Help Seeking of Keyword Formulations in Kids.gov*

| Predictor | B | Std. Error | β | T | Sig. |
|---|---|---|---|---|---|
| (Constant) | 3.395 | 0.511 | | 6.642 | 0.000 |
| Level of DK quiz | -0.016 | 0.012 | -0.244 | -1.331 | 0.194 |

Dependent variable: Help seeking situations of keyword formulation in Kids.gov

Table 4.7 shows that the level of the children' domain knowledge quiz does not affect their help-seeking situations when they create search queries in Kids.gov because the predictor variable is not significant (F (1,28)=1.771, P=0.194), with an $R^2$ of 0.059. As in the case of self-assessed domain knowledge, the lack of a kid-friendly interface on the site is thought to fail to generate a meaningful relationship between the two variables. However, it still shows a strong tendency that a higher domain knowledge may lead to fewer frequent help-seeking situations.

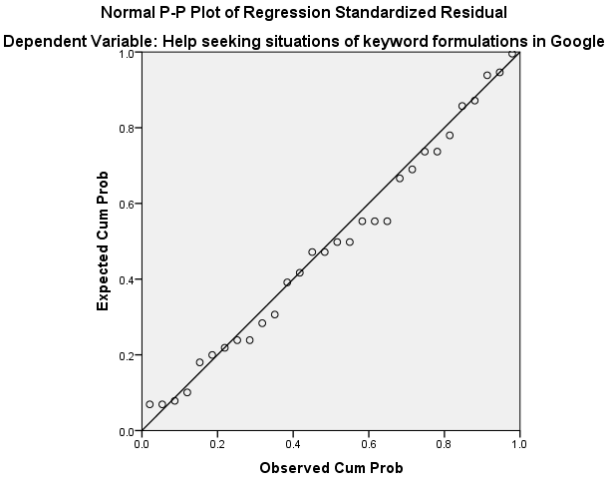


*Figure 4.6.* Normal P-Plot for Level of Domain Knowledge Quiz on Help Seeking of Keyword Formulations in Google

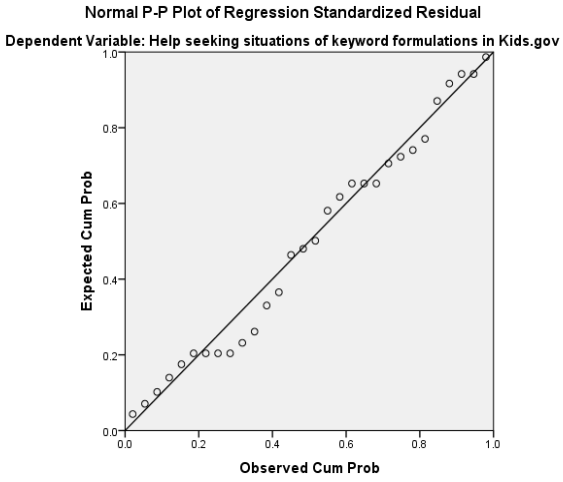


*Figure 4.7.* Normal P-Plot for Level of Domain Knowledge Quiz on Help Seeking of Keyword Formulations in Kids.gov

The linear pattern of Figure 4.6 reveals the normal distribution; however, in Figure 4.7, the plot presents slight departures from the straight line.

### 4.5.2. Effects of Domain Knowledge on Use of Help Features When Children Formulate Search Queries

Linear regression was calculated to test the hypotheses H2A and H2B: Levels of children's domain knowledge affect the frequency of the Help feature use when they formulate search queries in Google and Kids.gov.

Table 4.8
*Regression of Level of Domain Knowledge Self-Assessment on Use of Help Features for Keyword Formulations in Google*

| Predictor | B | Std. Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 2.518 | 0.844 | | 2.983 | 0.006 |
| Level of DK self-assessment | 0.103 | 0.283 | 0.068 | 0.363 | 0.719 |

Dependent variable: Help-feature use of keyword formulation in Google

Table 4.8 indicates that there was no predictor that has a statically significant impact on the frequency of children's use of Help features when they formulate search queries in Google. A significant regression equation was not found ($F(1,28)=0.132$, $P=0.719$), with an $R^2$ of 0.005.

Table 4.9
*Regression of Level of Domain Knowledge Self-Assessment on Use of Help Features for Keyword Formulations in Kids.gov*

| Predictor | B | Std. Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 0.609 | 0.489 | | 1.246 | 0.223 |
| Level of DK self-assessment | 0.130 | 0.164 | 0.149 | 0.795 | 0.433 |

Dependent variable: Help-feature use of keyword formulation in Kids.gov

Table 4.9 shows that children's level of domain knowledge self-assessment does not affect their use of Help features when they create keywords in Kids.gov. No significant regression equation was found ($F(1,28)=0.632$, $P=0.433$), with an $R^2$ of 0.022.

On both Google and Kids.gov, participants' self-assessed domain knowledge failed to show any statistically significant effects on their use of Help features when they formulated search queries.

Table 4.10
*Regression of Level of Domain Knowledge Quiz on Use of Help Features for Keyword Formulations in Google*

| Predictor | B | Std. Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 2.470 | 0.675 | | 3.660 | 0.001 |
| Level of DK quiz | 0.009 | 0.016 | 0.105 | 0.560 | 0.580 |

Dependent variable: Help feature use of keyword formulation in Google

Table 4.10 offers the linear regression result with children's level of the domain knowledge quiz. The children's level of the domain knowledge quiz does not predict their use of help features when they formulate keywords in Google. No significant regression equation was found ($F(1,28)=0.314$, $P=0.580$), with an $R^2$ of 0.011.

Table 4.11
*Regression of Level of Domain Knowledge Quiz on Use of Help Features for Keyword Formulations in Kids.gov*

| Predictor | B | Std. Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 0.765 | 0.394 | | 1.942 | 0.062 |
| Level of DK quiz | 0.005 | 0.009 | 0.110 | 0.586 | 0.562 |

Dependent variable: Help feature use of keyword formulation in Kids.gov

The result reveals that there was no predictor that has a statically significant effect on frequency of children's use of Help features when they formulate search queries Kids. gov (Table 4-11). The results above suggest that children's domain knowledge would not affect their use of Help features while creating keywords ($F(1,28)=0.344$, $P=0.562$), with an $R^2$ of 0.012.

On both Google and Kids.gov, the participants' domain knowledge failed to show any statistically significant effects of the performance-based domain knowledge quiz result on their use of Help features when they formulated search queries.

## 4.6. Research Question 3 (b): How does children's (8-10 years old) domain knowledge affect their help seeking and use of help features when they evaluate search results in a search engine and a kid-friendly web portal?

### 4.6.1. Effects of Domain Knowledge on Help Seeking When Children Evaluate Search Results

Linear regression was calculated to test the hypotheses H3A and H3B: Levels of children's domain knowledge affect the frequency of occurrence of help-seeking situations when they evaluate search results in Google and Kids.gov.

Table 4.12
*Regression of Level of Domain Knowledge Self-Assessment on Help Seeking of Result Evaluations in Google*

| Predictor | B | Std.Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 3.946 | 0.948 | | 4.164 | 0.000 |
| Level of DK self-assessment | -0.187 | 0.318 | -0.110 | -0.587 | 0.562 |

Dependent variable: Help seeking situations of result evaluation in Google

Table 4.12 reveals that the level of children's domain knowledge self-assessment does not influence their help-seeking situations when they evaluate search results in Google because the predictor variable is not significant ($F(1,28)=0.345$, $P=0.562$), with an $R^2$ of 0.012.

Table 4.13
*Regression of Level of Domain Knowledge Self-Assessment on Help Seeking of Result Evaluations in Kids.gov*

| Predictor | B | Std. Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 6.886 | 1.114 | | 6.181 | 0.000 |
| Level of DK self-assessment | 0.224 | 0.374 | 0.112 | 0.598 | 0.554 |

Dependent variable: Help seeking situations of result evaluation in Kids.gov

The results show that the effect of level of children's domain knowledge self-assessment on their help-seeking situations when they assess results in Kids.gov was not statistically significant (Table 4.13). No significant regression equation was found ($F(1,28)=0.358$, $P=0.554$), with an $R^2$ of 0.013.

On both Google and Kids.gov, participants' self-assessed domain knowledge failed to show any statistically significant effects on the frequency of help-seeking situations when they evaluated search results.

Table 4.14
*Regression of Level of Domain Knowledge Quiz on Help Seeking of Result Evaluations in Google*

| Predictor | B | Std. Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 3.931 | 0.757 | | 5.193 | 0.000 |
| Level of DK quiz | -0.013 | 0.018 | -0.141 | -0.752 | 0.458 |

Dependent variable: Help seeking situations of result evaluation in Google

Table 4.14 indicates that there was no predictor that has a statically significant impact on occurrence of children's help-seeking situations when they assess search results in Google ($F(1,28)=0.566$, $P=0.458$), with an $R^2$ of 0.020.

Table 4.15
*Regression of Level of Domain Knowledge Quiz on Help Seeking of Result Evaluations in Kids.gov*

| Predictor | B | Std. Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 7.223 | 0.897 | | 8.051 | 0.000 |
| Level of DK quiz | 0.007 | 0.021 | 0.067 | 0.353 | 0.726 |

Dependent variable: Help seeking situations of result evaluation in Kids.gov

As shown in Tables 4.4 to 4.15, there was no predictor that has a significant effect on the occurrence of children's help-seeking situations when they evaluate search results in Kids.gov. No significant regression equation was found ($F(1,28)=0.125$, $P=0.726$), with an $R^2$ of 0.004.

On both Google and Kids.gov, participants' domain knowledge failed to show any statistically significant effects of the performance-based domain knowledge quiz on the frequency of help-seeking situations when they evaluated search results. The results above imply that children's domain knowledge would not influence their help-seeking situations while assessing search results.

### 4.6.2. Effects of Domain Knowledge on Use of Help Features When Children Evaluate Search Results

Linear regression was calculated to test the hypotheses H4A and H4B: Levels of children's domain knowledge affect the frequency of help feature use when they evaluate search results in Google and Kids.gov.

Table 4.16
*Regression of Level of Domain Knowledge Self-Assessment on Use of Help Features for Result Evaluations in Google*

| Predictor | B | Std. Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 3.520 | 0.644 | | 5.464 | 0.000 |
| Level of DK self-assessment | 0.260 | 0.216 | 0.222 | 1.202 | 0.239 |

Dependent variable: Help feature use of result evaluation in Google

Table 4.16 shows that the effect of level of children's domain knowledge self-assessment on their use of help features while evaluating results in Google was not statistically significant, ($F(1,28)=1.446$, $P=0.239$), with an $R^2$ of 0.049.

Table 4.17
*Regression of Level of Domain Knowledge Self-Assessment on Use of Help Features for Result Evaluations in Kids.gov*

| Predictor | B | Std. Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 3.883 | 1.106 | | 3.511 | 0.002 |
| Level of DK self-assessment | 0.954 | 0.462 | 0.364 | 2.067 | 0.048 |

Dependent variable: Help feature use of result evaluation in Kids.gov

Table 4.17 reveals that the level of children's domain knowledge self-assessment affects frequency of their use of help features when they evaluate search results in Kids.gov at the alpha level of 0.05. A significant regression equation was found ($F(1,28)=4.274$, $P=0.048$), with an $R^2$ of 0.132. It is thought that higher motivations from higher self-assessed domain knowledge may be positively associated with their use of help features on Kids.gov, which has less kid-friendly interface.

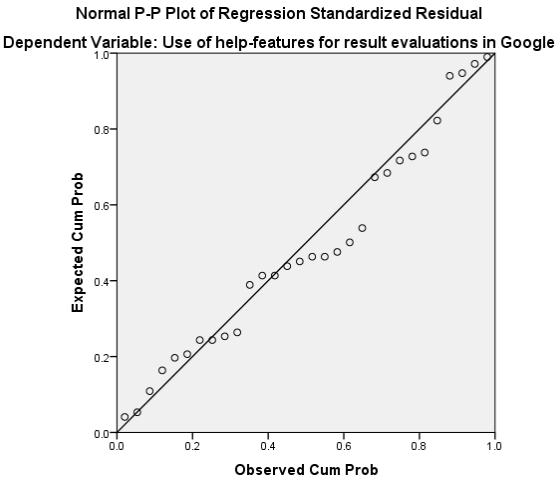


*Figure 4.8.* Normal P-Plot for Level of Domain Knowledge Self-Assessment on Use of Help Features for Result Evaluations in Google

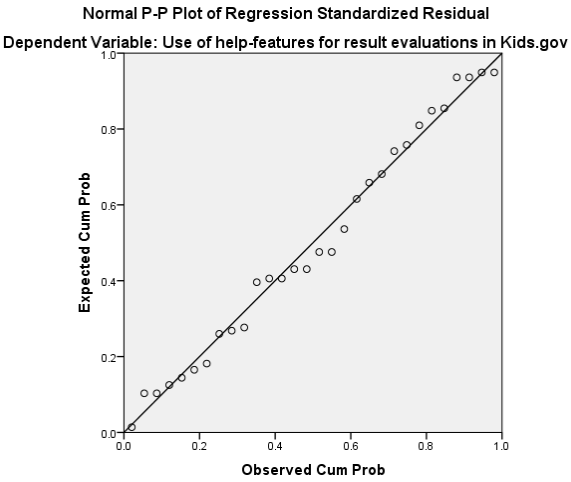


*Figure 4.9.* Normal P-Plot for Level of Domain Knowledge Self-Assessment on Use of Help Features for Result Evaluations in Kids.gov

Figures 4.8 and 4.9 show the normal probability plots. In Figure 4.8, departures indicate that the normality assumption is not met, but those are not serious departures. The points of Figure 4.9 form a linear pattern, suggesting that the normal distribution is met.

Table 4.18
*Regression of Level of Domain Knowledge Quiz on Use of Help Features for Result Evaluations in Google*

| Predictor | B | Std. Error | β | t | Sig. |
|---|---|---|---|---|---|
| (Constant) | 4.167 | 0.530 | | 7.869 | 0.000 |
| Level of DK quiz | 0.002 | 0.012 | 0.027 | 0.142 | 0.888 |

Dependent variable: Help-feature use of result evaluation in Google

As shown in Table 4.18, the level of the children' domain knowledge quiz does not affect their use of help features when they assess search results in Google. No significant regression equation was found ($F(1,28)=0.020$, $P=0.888$), with an $R^2$ of 0.001.

Table 4.19
*Regression of Level of Domain Knowledge Quiz on Use of Help Features for Result Evaluations in Kids.gov*

| Predictor | B | Std. Error | β | T | Sig. |
|---|---|---|---|---|---|
| (Constant) | 0.682 | 0.867 | | 0.787 | 0.438 |
| Level of DK quiz | 0.045 | 0.018 | 0.434 | 2.550 | 0.017 |

Dependent variable: Help feature use of result evaluation in Kids.gov

Table 4.19 indicates that the level of the children's domain knowledge quiz influences the frequency of their use of help features when they evaluate results in Kids.gov at the alpha level of 0.05. A significant regression equation was found (F (1,28)=6.504, P=0.017), with an $R^2$ of 0.189.

As described in the previous section for self-assessed domain knowledge, the performance-based domain knowledge quiz result may be positively associated with participants' use of help features on the less kid-friendly Kids.gov.

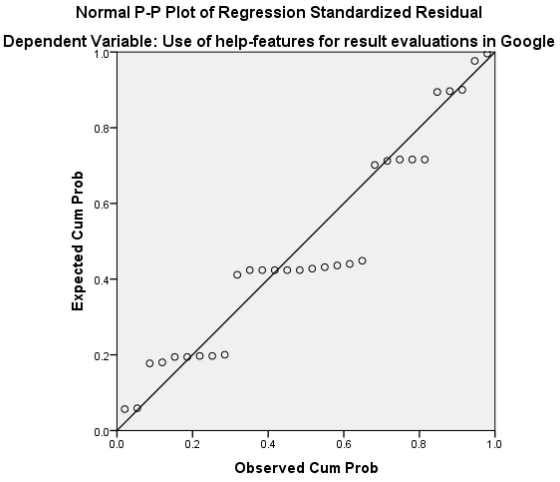


*Figure 4.10.* Normal P-Plot for Level of Domain Knowledge Quiz on Use of Help Features for Result Evaluations in Google

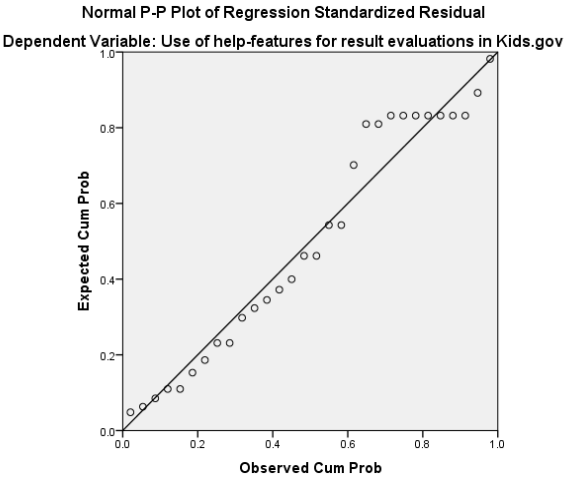


*Figure 4.11.*Normal P-Plot for Level of Domain Knowledge Quiz on Use of Help Features for Result Evaluations in Kids.gov

The plotted points of Figure 4.10 show departures from the straight line, while points on this plot of Figure 4.11 display fairly straight and linear pattern, which indicates that the normal distribution is met for this data set.

### 4.6. Summary of Results

This chapter answered three research questions and their sub-questions and hypotheses. First, the types of cognitive, physical, and emotional help-seeking situations children (8-10 years old) experience when they formulate keywords and evaluate search results in Google and Kids.gov were identified based on open coding. Second, types of help features children (8-10 years old) used and desired when they formulate search queries and evaluated search results in Google and Kids.gov were analyzed based on open coding. In addition, frequency of help features children used during search sessions for search tasks were counted. Finally, levels of children's domain knowledge were measured to conduct a linear regression analysis. The effects of domain knowledge on help seeking and use of help features of children (8-10 years old) when they create search queries and assess search results were identified in this chapter.

Data analysis showed that domain knowledge, either self-assessed or performance-based, did not much affect the participants' help-seeking situations or use of help features on Google and Kids.gov. However, on Google, both self-assessed and performance-based domain knowledge significantly affected help-seeking situations when children formulated search queries. On Kids.gov, both self-assessed and performance-based domain knowledge significantly affected the use of help features when they evaluated search results. Although the R-squared values are relatively low in spite of significant p-values, the plotted points showed a linear relationship by displaying fairly straight and linear patterns.

# Chapter 5: Discussion

This study examined elementary school-aged users' help-seeking behaviors and use of help features and the relationships between their domain knowledge and help seeking in IR systems. This chapter discusses theoretical implications; practical implications including design implications for IR systems; methodological implications; and limitations of the study based on the findings of this research.

## 5.1. Theoretical Implications

This study provides theoretical implications by applying human development theories, including Information Processing Theory (IPT) and Piaget's cognitive development theory.

This study applied IPT focusing on children's information processing, which influences all types of thinking. The findings of this study will be helpful for researchers, information professionals, educators, and IR system designers who strive to find ways to provide effective search tools for diverse user groups, including children, who have different cognitive processes from adults.

IPT addresses the complex organization of human thought and how children use their cognitive skills in a given situation. The information processing perspectives emphasize domain knowledge of specific human behaviors involved in the process of change on a particular task (Miller, 2010). Also, the perspectives are effective for explaining the cognitive growth and knowledge base of children in the concrete operational stage, as the information processing perspectives cover the flow of information through the cognitive growth of humans. The studies on information processing perspectives help to understand children's cognitive characteristics at a particular age. Aspects of children's information processing that influence all types of thinking

include: 1) memory capacity, 2) speed of processing, 3) use of strategies, 4) metacognition, and 5) knowledge base (Miller, 2010; Shaffer & Kipp, 2010).

This dissertation investigated children's knowledge base in using IR systems, which is one of the thinking types that influence children's information processing. According to Siegler and Alibali (2005), the more people know about a topic, the better they learn and remember new information about the topic. Greater knowledge in a particular domain helps children demonstrate good memory in that domain (Miller, 2010). In this study, children who encountered cognitive help-seeking situations at the query formulation stage did not create their keywords effectively due to difficulty in understanding the assigned task about George Washington. In addition, participants who encountered cognitive help-seeking situations at the result evaluation stage had immature reading skills in the result pages and limited evaluation of search results due to their limited domain knowledge.

The IPT's domain knowledge base aspect is useful for understanding these findings of this dissertation However, this study did not find the differences in age groups (8, 9, and 10 years old) in relation to domain knowledge on help-seeking behaviors. This could be due to the fact that children who are 8 to 10 years old were grouped into the concrete operation stage. This study enhanced the IPT by investigating the effect of elementary school-aged children's knowledge base on their help-seeking behaviors and use of help features in using IR systems.

Domain Knowledge has been identified as a significant factor that affects information-seeking behaviors (Bilal, 2001; Hirsh, 1997; 2004; Hsieh-Yee, 2001; Marchionini, 1995) and help-seeking behaviors on IR systems (Babin, Tricot, & Mariné , 2009; Gossen & Nürnberger, 2013 ; Wood & Wood, 1999; Xie & Cool, 2009). This dissertation provides theoretical implications by confirming the findings of previous research regarding the effect of domain

knowledge on help-seeking behaviors within digital contexts. In this study, children who had more domain knowledge encountered fewer help-seeking situations at the query formulation stage than the ones who had less domain knowledge. This finding is consistent with the previous finding of Gossen and Nürnberger, who found that children's limited domain knowledge affected their difficulties in formulating keywords.

This research also confirmed the findings of Wood and Wood's previous study, which showed that children with less domain knowledge sought help more frequently than their peers with more domain knowledge when using computer-based tutoring systems. This dissertation's result showed that children's domain knowledge levels are associated with their use of help features when they evaluate search results, which was highlighted in the study of Babin, Tricot, and Mariné, that seeking help in information systems is associated with the users' domain knowledge. In addition, by considering cognitive, physical, and emotional help-seeking, this study confirmed the findings of Kuhlthau (1991), Bilal (2000), and Cooper (2005), which emphasized the interrelationships between information seeking and cognitive, emotional, and physical dimensions.

With the widespread use of the Internet and digital technology tools, children have engaged in information seeking in IR systems by themselves more and more freely to satisfy their information needs. Byrnes and Bernacki (2013) mentioned that few studies have explored possible age differences in information-seeking behaviors. Xie and Cool (2006) found that users recognized the importance of help features and emphasized the effectiveness of help features in interaction with IR systems. Children in the concrete operational stage (ages 8 to 10) lack large vocabularies and good writing skills as well as the ability to find the right search queries. They

also need more supports for their information-searching tasks than children in the formal operational stage (ages 11 to 18) (Gossen, 2016).

This study contributes to the existing knowledge base on children's information behaviors by identifying specific help features such as "autocomplete", "spell-check", "showing results for", "previews", "searches related to" features children used, and help features children desired when they formulated keywords and evaluate search results. These findings supported previous research (Bilal, 2003, 2007; Druin et al., 2009; Druin et al., 2010; Hirsh, 1997; Jochmann-Mannak, Huibers, Lentz, & Sanders, 2010; Madden, Ford, Miller, & Levy, 2006) on children's information-seeking behaviors that revealed issues that children experienced with existing or lack of help features. These findings identified specific types of help-seeking situations children encountered and help features they used and wanted to have when they searched in IR systems.

This study is significant in that it used reliable assessment techniques to measure children's domain knowledge. As Hirsh (2004) pointed out, measuring domain knowledge by school academic performance has limitations. To overcome them, this study used direct assessments (e.g., performance-based domain knowledge quiz) and indirect assessments (e.g., domain knowledge self-assessment) to measure the children's domain knowledge effectively. A performance-based quiz and self-assessment are considered reliable assessment techniques that produce consistent results (Cohen & Spenciner, 1998). The two different types of domain knowledge assessment techniques in this study helped to measure children's domain knowledge levels effectively. Since this study utilized established theories and methodologies, it can be easily validated in future studies with a similar set of hypotheses and a similar group of

participants. For those mixed results in the quantitative analysis in Chapter 4, use of a larger sample will help to verify them.

This dissertation identified types of children's help-seeking situations and use of help features when they formulate search queries and evaluate results in IR systems, as illustrated in a model (Figure 5.1). This model describes the effect of children's domain knowledge on their help seeking and use of help features as well. Children's domain knowledge is associated with their cognitive, physical, and emotional help-seeking situations. In particular, in this model the significant effects of their domain knowledge on cognitive, physical, and emotional help-seeking situations at the query formulation stage are shown. In addition, children's domain knowledge affects their use of help features when they evaluate search results. Significant relationships between children's domain knowledge and their help-seeking situations and use of help features are indicated with arrows.

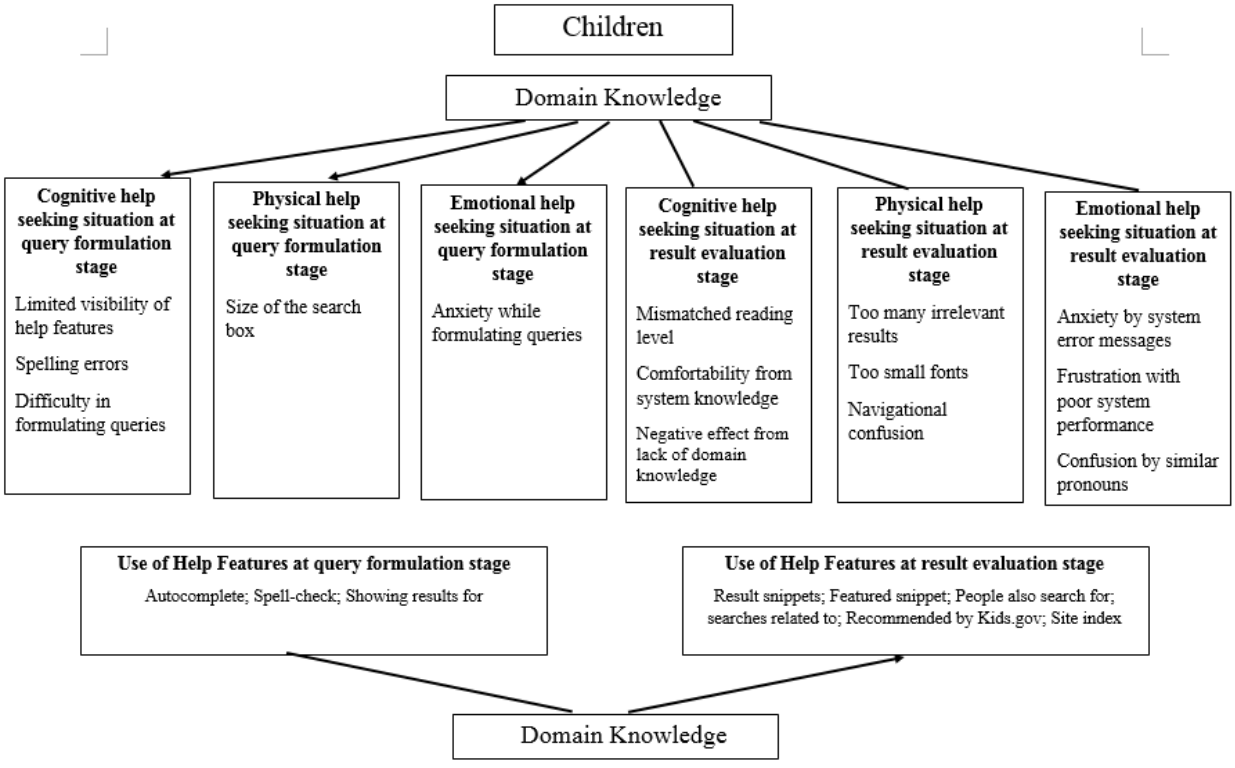

*Figure 5.1.* Model of Children's Help Seeking Situations, Use of Help Features at the Query Formulation and Result Evaluation Stages, and the effect of Domain Knowledge

## 5.2. Practical Implications

This dissertation examined elementary school-aged children's help-seeking behaviors and use of help features when they formulate search queries and evaluate search results in using IR systems. This study provides significant design implications for younger and older children's universal access of IR systems and for them to reduce their cognitive, physical, and emotional help-seeking situations when they formulate search queries and evaluate results.

### 5.2.1. Design Implications for Reducing Children's Cognitive, Physical, and Emotional Help-Seeking Situations When They Formulate Search Queries

Children's difficulty in formulating keywords including problems of typing and spelling is considered one of the main challenges when they search in IR systems. The design implications for reducing children's cognitive, physical, and emotional help-seeking situations when they formulate search queries are discussed below.

#### Design Implications for Reducing Children's Cognitive Help-seeking Situations at the Query Formulation Stage

This dissertation provides design implications for children to reduce cognitive overload when they formulate keywords. The findings of this study showed that participants in this study did not know there were help features available when they formulated keywords in Google and Kids.gov. Help features such as "autocomplete", "showing results for", and help page need to be more clearly visible for children who make mistakes in the spelling. In particular, autocomplete options should show more diverse search terms that users may enter. Children's spelling errors

are common when they formulate search queries. However, Kids.gov "spell-check" is case-sensitive, which causes confusion for children who make frequent spelling errors. IR systems' "spell-check" should not be case-sensitive.

This study found that the lack of children's domain knowledge leads to difficulty in their query formulations. In order to reduce this help-seeking situation, providing browsing options for search terms by categorizing topics will be helpful for kids. Beheshti, Bilal, Druin, and Large (2010) address this in their findings that when children interacted with IR systems, they experienced more cognitive overload in keyword searching than in browsing.

### Design Implications for Reducing Children's Physical Help-seeking Situations at the Query Formulation Stage

As most children are immature in their physical abilities, IR system developers should consider children's visual and motor skills when they design an IR system's interface. This study's results indicated that several participants experienced difficulty locating the search box in Kids.gov for their keyword search. IR systems should offer noticeable and large-sized search boxes to help children find information effectively. Also, most children who participated in this study were familiar with the search box in Google; therefore a long and large search box with "Search or Type" notice should be provided.

### Design Implications for Reducing Children's Emotional Help-seeking Situations at the Query Formulation Stage

The findings of this study indicate that participants felt anxious when they formulated search queries by showing hesitation and chewing on hairs because they felt it was difficult to

start or create keywords to find answers. Offering keyword selection features will be helpful for children to reduce this problem and to create positive feelings while searching.

This dissertation explored which help features children desire to improve their search. The findings of this study suggested additional considerations for IR system design for children who have limited-information processing ability. For example, children in this study wanted to have a synonym search feature. There are words that have the same meaning, such as "chef" and "cook." Providing a synonym search is important for children for processing information faster while searching. Participants in this study suggested adding images or button icons for search and browsing options, which will help even younger children (6-7 years old) search efficiently and accurately. Ravelle et al. (2002) addressed this in their findings that young children are capable of efficient and accurate searching with the support of a visual query interface. Adding large images and buttons in the interface is also helpful for the motor skills of children who are 7 to 11 years old, as Gossen (2016) recommended.

### 5.2.2. Design Implications for Reducing Children's Cognitive, Physical, and Emotional Help-Seeking Situations When They Evaluate Search Results

Children's effective evaluation of search results is difficult due to their limited cognitive, physical, and emotional abilities. Design implications for reducing children's cognitive, physical, and emotional help-seeking situations when they evaluate search results are discussed below.

#### Design Implications for Reducing Children's Cognitive Help-seeking Situations at the Result Evaluation Stage

Participants in this study expressed difficulty in reading too many words, passages that were too long, or cursive texts when they evaluated retrieved results. Those situations caused

cognitive overload while evaluating search results. Adult-oriented text levels should be avoided to help children engage in effective result evaluations. This dissertation found that the lack of children's domain knowledge hindered effective evaluation of search results. Both Google and Kids.gov provide "searches related to" features to help children find search results effectively. However, this feature is placed at the bottom of the result page. These two websites should provide the "searches related to" feature at the top of the page or at the right-hand corner of the page to reduce children's difficulty in evaluating the results and to improve their use of the feature, because children scrolled the retrieved results less often than adults (Bilal & Kirby, 2002).

**Design Implications for Reducing Children's Physical Help-seeking Situations at the Result Evaluation Stage**

A universal interface design of IR systems for diverse users, including children, is important to boost users' satisfaction with using IR systems. The results of this study showed that too many irrelevant items in a result list made it difficult for participants to evaluate search results. Even though 100 percent precision and recall are impossible, IR systems should return relevant items for the search results.

Children who participated in this study had difficulty reading search results due to the small size of the fonts. Font size for the "result snippets (preview)" should be bigger for children to reduce this help-seeking situation.

Finally, unnecessary navigational items and customization options hindered children's effective review of search results in this research. For example, Google showed different styles of the search result page. Some retrieved results in Google have many navigational items such as

"books" and "quotes," etc.; however, others do not. Therefore, for children to assess search results effectively, the result list should be simple and customized consistently.

### Design Implications for Reducing Children's Emotional Help-seeking Situations at the Result Evaluation Stage

Poor system performance caused negative feelings such as frustration, confusion, and anxiety for children in this study. Relevant items in the result list should be provided to reduce children's negative feelings while searching. This study found that Kids.gov generated dead-end system errors as well as irrelevant items. These contributed children's frustrated and expressionless feelings when they reviewed the results. IR systems should reduce their system errors in the result pages for children to review search results effectively and to create positive feelings while searching.

To improve effective result evaluations, participants wanted to have a more kid-friendly design and layout of search results and vibrant colors in search result display. Visualization and presentation of results for children (7-11 years old) affect their judgment of the documents' relevance (Gossen, 2016).

Furthermore, participants in this study suggested help features they want to have when they evaluate search results, suggestions that will be helpful for children to evaluate search results effectively. First, the children who participated in this study suggested that brighter colors for previously visited sites in Google should be used instead of the default purple color, which is not distinctive. A brighter color such as red for previously visited sites, is needed for children to distinguish between unvisited and visited links. The children in this study wanted bigger font sizes for the preview and pagination on result pages with the total number of result pages. A bigger font size for the preview and pagination on result pages with the total number of result

pages in IR systems will help children, particularly young children who have lower information processing speed, not have to use fine-tuned mouse motion skills.

In addition, participants desired more effective screen space use by filling up the entire space of the screen rather than wasting screen space with unused areas. According to Nielsen (2011), higher information density in the space means less need to move around and a higher likelihood that you see what you want. Filling up the entire space of the screen with information in results pages is necessary for the effective evaluation of the search results of children. Also, the children wanted to have a variety of formats of information such as videos, images, audios, and documents, etc. IR system should provide children options for searching for specific formats, as Xie and Cool (2009) recommended. Finally, children would like to have a separate "Help" page, which is important in helping them to learn how to get the best search results, thereby enabling them to get help easily about how to deal with no results and how to deal with overwhelming results, as Xie and Cool (2009) addressed in their study.

Finally, this dissertation provides general implications for how to design interfaces of IR systems for children who have different developmental abilities, in particular for children in the concrete operational stage with different knowledge and skill levels. The children in this study showed different writing skills, with grammar and spelling errors. Therefore, IR systems should reflect children's different writing skills when they design keyword help features by adding diverse query suggestions. IR systems should offer search tools such as domain-specific search considering children's domain knowledge levels, because same-age children do not show the same level of domain knowledge. The children in this study, particularly even younger children, searched and understood search results better than older ones because children today are highly experienced in using search engines. Therefore, IR systems should add more information for the

preview for children to review search results effectively. The younger children in this study indicated lack of skill in identifying commercial sites in the result list. Also, younger children tended to click links that appear first on the list. Thus, IR systems should avoid placing sponsored links first or higher up on the page when they design interfaces for children.

It is clear that different age groups need different interface designs based on their physical and cognitive development stages, and that among the same age group, depending on domain knowledge and skill sets, individuals may need different help features. Therefore, it would be worthwhile in future studies to investigate possibilities to automatically detect children's cognitive and physical developmental stages, their domain knowledge, and their skill sets and to provide adjusted interfaces and sets of help features.

### 5.3. Methodological Implications

This study provides implications for recruiting children and conducting think-aloud protocols and mixed methods for investigating elementary school-aged children.

To recruit children for the study, scheduling with parents was necessary. Giving flexible scheduling to parents was helpful for conducting this study with children who are 9 to 10 years old; Parents preferred weekends to weekdays. Also, before scheduling, the author sent parent consent forms with specific information about what the children would be doing for the study via email and offered adequate time to review the forms without pressure. Investigating children is difficult, but parents' permissions facilitated successful children's participation in this study. Furthermore, having flexible weekend schedules were helpful for encouraging children's participation in the research.

During all the sessions in this study, participants were constantly reminded that they were strongly encouraged to talk aloud while they completed their tasks. However, in some cases, participants were busy trying and retrying without saying much. Often when they had help-seeking situations, they did not seek immediate help from the interviewer. The opposite situation also happened. A few participants talked too much, with a high levels of excitement that included telling about their previous experiences with web searching and use of the Internet, and not focusing on the tasks themselves. It is controversial whether children perform think-aloud well. However, think-aloud is one of the effective ways to collect children's verbalizations without the problem of children's limited cognitive load associated with post-interviews, as noted by Branch (2000). In order to do think-aloud protocols effectively, while conducting research, researchers should gently remind children to "talk more" or "talk less."

This study used mixed methodologies, which were helpful for analyzing the data collected from the children. Qualitative data collection methods included think-aloud protocols, observations, and post-interview sessions. Qualitative data collection helped capture the children's thoughts, perceptions, difficulties, and suggestions. Additionally, a pre-questionnaire, a domain knowledge quiz, and self-assessment and search tasks were used to collect quantitative data in this study. Quantitative data allowed measurement of participants' domain knowledge and frequencies of used help features and help-seeking situations as well as demographic information in an effective manner. The children were informed what they were doing for this study at the beginning of each session. The mixed method approach used in this study provided enhanced the validity and reliability of the data collected from the children and the data analysis by compensating for each method's weaknesses.

## 5.4. Limitations

There are several limitations in the data collection and data analysis. First, the current sample size may not be large enough to generalize from the findings of this study. Also, children ages 8 to 10 are not the only users of Google and Kids.gov. Thus, a larger sample size and a wider range of age groups should be investigated to better understand and generalize the results of children's help-seeking behaviors and the effects of domain knowledge on help seeking and use in IR systems.

Second, most children who participated in this study replied that Google is their most frequently used search site, and most children had more system knowledge of Google than Kids.gov. Lack of familiarity with Kids.gov might have failed to generate more meaningful data in this study, although participants were given time to explore the Kids.gov site before each session began.

Third, this study did not investigate the differences in gender because there are no significant gender differences between boys and girls in physical abilities before puberty (Bright Futures in Practice: Physical Activity, 2016). However, mental and cognitive differences between boys and girls may exist. The gender differences in cognitive and affective aspects should be examined to better understand children's help-seeking behaviors and use of help features in using IR systems.

Fourth, since children who are 8 to 10 years old are considered in the range of Piaget's concrete operational stage, this study did not explore age differences among them. However, the stage is typical and does not explain how children of specific ages function and behave uniquely. Therefore, differences among children who are 8 to 10 years old should be investigated to understand different age groups' help-seeking behaviors in IR systems.

Finally, this study examined children's help-seeking behaviors and used help features in only two search engines, Google and Kids.gov. In order to identify children's diverse help-seeking behaviors and the various help features children use, digital libraries or educational web sites that children visit frequently should be investigated.

# Chapter 6: Conclusion

This study investigated children's help-seeking behaviors and use of help features when they formulate search queries and evaluate search results in IR systems. In addition, this dissertation explored the effects of children's domain knowledge on their help seeking and use of help features in Google and in Kids.gov. This research answered three research questions based on the analysis of collected data from the 30 participants.

The cognitive, physical, and emotional types of help-seeking situations the children experienced in using Google and Kids.gov were analyzed to answer research question 1. At the query formulation stage, children's cognitive help-seeking situations includes that children did not recognize available help features and that spelling errors were common. Moreover, children's difficulty in formulating search queries and lack of domain knowledge's effect on their keyword formulations were associated with their cognitive help-seeking situations. Physical help-seeking situations included children's difficulty locating the search box due to its small size. Children's high anxiety led to typos and retyping, which was categorized in the emotional help-seeking situation.

When children evaluated search results, their types of cognitive help-seeking situations involved difficulty in reading adult-oriented text level including too many words, too-long passages or cursive texts. Additionally, lack of system experience and domain knowledge hindered the children's effective evaluation of search results. Children's physical help-seeking situations at the evaluation of search results stage included too many irrelevant items in a result list, small size of the fonts for preview, and navigational confusion on the result page. Finally, children's emotional help-seeking situations when they evaluated results were associated with

frustration, confusion, and anxiety due to their lack of domain knowledge and poor system performance.

The second research question was about which help features children use and desire when they formulate search queries and evaluate search results. Participants, who were 8 to 10 years old, used "spell-check", "autocomplete", and the "showing results for" features in Google and Kids.gov when they formulated their search queries. However, children used more help features for query formulations in Google than Kids.gov. When evaluating search results, in Google, participants in this study used "result snippets (preview)," "featured snippet (preview box)," "people also search for," and "searches related to features." In Kids.gov, they used "result snippets (preview)," "recommended by Kids.gov," and "site index." When they evaluated search results, participants used "result snippets (preview)" heavily in both Google and Kids.gov.

Participants (8-10 years old) suggested desired help features when they formulated keywords and evaluated search results. They wanted to have a synonym search feature, adding images or icon buttons, and browsing options as an alternative way to keyword search. Participants in this study suggested a more kid-friendly design in search result display by adding vibrant colors and more effective screen space use for the result pages. They wanted to have a variety of formats of information and a separate "Help" page for effective result evaluations. Children who took part in this study asked for a bigger preview for checking results; pagination on result pages, with the total number of pages and distinctively noticeable; and brighter colors for the links of previously visited sites when they evaluated search results.

To answer research question 3, the effects of the children's domain knowledge on their help seeking and use of help features in using Google and Kids.gov were analyzed. In order to

measure the children's domain knowledge level effectively, a performance-based knowledge quiz (as a direct measurement) was conducted and a self-assessment survey (as an indirect one).

Regression results show that the level of children's self-assessed domain knowledge affected occurrences of their help-seeking situations when they formulated search queries in Google, whereas there was no effect of level of their self-assessed domain knowledge on occurrences of their help-seeking situations when they formulated search queries in Kids.gov. Similarly, the scores of the children's domain knowledge quiz showed a statistically significant effect on occurrences of their help-seeking situations when they formulated keywords in Google. However, the children's domain knowledge did not statistically affect their use of help features when they formulated search queries in Google and Kids.gov.

In the stage of result evaluations, the level of the children's self-assessed domain knowledge influenced their use of help features in Kids.gov, while there was no effect of the level of their self-assessed domain knowledge on use of help features in Google. Furthermore, the scores of the children's domain knowledge quiz affected their use of help features when they evaluated search results in Kids.gov. On the other hand, there were no effects of the children's domain knowledge on occurrences of their help-seeking situations when they evaluated search results in Google and Kids.gov.

In conclusion, this study contributes to the literature on children's information behaviors in IR systems by investigating elementary school-aged children's help-seeking behaviors and use of help features. The findings of this study generated a holistic view including cognitive, physical, and emotional abilities about help-seeking behaviors of children in the concrete operational stage. This study measured children's domain knowledge levels and examined their effects on children's help seeking and use of help features in using IR systems.

This dissertation generated several system design implications for children's use of search engines as well as theoretical implications. This study also has contributions and limitations. Further research is needed with different age and gender groups to better understand children's help-seeking behaviors and their use of help features when they search for information. Many children are already more familiar with using Google rather than other IR systems; therefore, investigating children's help-seeking behaviors in other IR systems, such as digital libraries or educational websites, is necessary as well. Finally, this study examined the effect of children's domain knowledge on their help-seeking in using IR systems. To explore children's help-seeking behaviors more dynamically, it is necessary to consider the effects of various factors related to children's thinking process such as memory, speed of processing, strategies, metacognition, and knowledge of IR systems. In addition, for further research, conducting different types of usability testing is necessary to design interfaces that reduce children's help-seeking situations related to their domain knowledge and to discover possibilities for automatically detecting children's cognitive and physical developmental stages, their domain knowledge, and their different skill sets.

## References


Agarwal, N. K. (2014). Use of touch devices by toddlers or preschoolers: Observations and findings from a single-case study. In D. Bilal & J. Beheshti (Eds.), *New directions in children's and adolescents' information behaviors research* (pp. 3-37). West Yorkshire, UK: Emerald Group Publishing.

Aleven, V., & Koedinger, K. R. (2000). Proceedings from ITS '00: Limitations of student control: Do students know when they need help?. Montreal, Canada.

Aleven, V., Stahl, E., Schworm, S., Fischer, F., & Wallace, R. (2003). Help seeking and help design in interactive learning environments. *Review of Educational Research, 73*(3), 277-320.

Aleven, V., McLaren, B., Roll, I., & Koedinger, K. (2004). Proceedings from ITS '04: *Toward tutoring help seeking.* Alagoas, Brazil.

Alexa. (2016). Retrieved from http://www.alexa.com/topsites

Anxiety and Depression Association of America (ADAA). (2015, September). Childhood Anxiety Disorders. Retrieved from https://www.adaa.org/living-with-anxiety/children/childhood-anxiety-disorders

Association of Library Service to Children (ALSC) http://www.ala.org/alsc/

Babin, L. M., Tricot, A., & Mariné, C. (2009). Seeking and providing assistance while learning to use information systems. *Computers & Education, 53*(4), 1029-1039.

Backhausen, D. T. (2012, August). Adaptive IR for exploratory search support. In *Proceedings of the 35th international ACM SIGIR conference on Research and development in information retrieval* (pp. 992-992). ACM.

Baddeley, A. (2000). The episodic buffer: A new component of working memory?. *Trends in Cognitive Sciences, 4*(11), 417-423.

Baddeley, A. (2003). Working memory: Looking back and looking forward. *Nature Reviews Neuroscience, 4*(10), 829-839.

Bartholomé, T., Stahl, E., Pieschl, S., & Bromme, R. (2006). What matters in help-seeking? A study of help effectiveness and learner-related factors. *Computers in Human Behaviors, 22*(1), 113-129.

Bates, M. J. (1989). The design of browsing and berrypicking techniques for the online search interface. *Online Information Review, 13(5),* 407-424.

Bates, M. J. (2010). Information Behaviors. In M. J. Bates & M. N. Maack (Eds.), *Encyclopedia of library and information sciences* (pp. 2381–2391). New York, NY: CRC Press.

Beheshti, J., Bilal, D., Druin, A., & Large, A. (2010). Proceedings from ASIS&T '10: *Testing children's information retrieval systems: Challenges in a new era*. Pittsburgh, PA.

Belkin, N. J. (2005). Anomalous state of knowledge. In K. E. Fisher, S. Erdelez & L. McKechnie (Eds.), *Thoeries of information behaviors* (pp. 44-48). Medford, NJ: Information Today Inc.

Belkin, N. J., Oddy, R. N., & Brooks, H. M. (1982a). ASK for information retrieval: Part I. Background and theory. *Journal of Documentation, 38*(2), 61-71.

Belkin, N. J., Oddy, R. N., & Brooks, H. M. (1982b). ASK for information retrieval: Part II. Results of a design study. *Journal of Documentation, 38*(3), 145-164.

Bjorklund, D. F., Dukes, D., & Brown, R.D. (2008). The development of memory strategies. In M. Courage & N. Cowan (Eds.), *The development of memory in infancy and childhood* (pp. 145-176). Philadelphia, PA: Psychology Press.

Bilal, D. (2000). Children's use of the Yahooligans! Web search engine: I. Cognitive, physical, and affective behaviors on fact-based search tasks. *Journal of the American Society for Information Science, 51*(7), 646-665.

Bilal, D. (2001). Children's use of the Yahooligans! Web search engine: II. Cognitive and physical behaviors on research tasks. *Journal of the American Society for Information Science and Technology, 52*(2), 118-136.

Bilal, D. (2002a). Children's use of the Yahooligans! Web search engine. III. Cognitive and physical behaviors on fully self-generated search tasks. *Journal of the American Society for Information Science and Technology, 53*(13), 1170-1183.

Bilal, D. (2002b). Perspectives on children's navigation of the World Wide Web: does the type of search task make a difference?. *Online Information Review*, *26*(2), 108-117.

Bilal, D. (2003). Proceedings from ASIS&T '03: *Draw and tell: Children as designers of Web interfaces*. Long Beach, CA.

Bilal, D. (2004). Research on children's information seeking on the Web. In M. K. Chelton & C. Cool (Eds.), *Youth information-seeking behaviors: theories, models, and issues (Vol. 1)* (pp. 271-291). Lanham, MD: The Scarecrow Press.

Bilal, D., & Kirby, J. (2002). Differences and similarities in information seeking: Children and adults as Web users. *Information Processing & Management, 38*(5), 649-670.

Bilal, D. (2007). Grounding children's information seeking and system design in child development theories. In D. Nahl & D. Bilal (Eds.), *Information and Emotion: The emergent affective Paradigm in information behaviors research and theory* (pp. 39-50). Medford, NJ: Information Today Inc.

Bilal, D., & Bachir, I. (2007). Children's interaction with cross-cultural and multilingual digital libraries. II. Information seeking, success, and affective experience. *Information Processing & Management, 43*(1), 65-80.

Bilal, D., & Gwizdka, J. (2016). Children's eye-fixations on google search results. *Proceedings of the Association for Information Science and Technology*, *53*(1), 1-6.

Bilal, D., & Sarangthem, S. (2008). Proceedings from IASL ’08: *Task-based models of children's information-seeking behaviors in digital libraries*. Berkeley, CA.

Bilal, D., Sarangthem, S., & Bachir, I. (2008). Proceedings from IIiX ’08: *Toward a model of children's information seeking behaviors in using digital libraries*. London, UK.

Bisland, B. M. (2009). Government Websites for Children: How Useful Are They for Content Instruction?. Paper presented at the American Educational Research Association Annual Convention (San Diego, CA., Apr 13-17, 2009)

Borgman, C. L., Hirsh, S. G., Walter, V. A., & Gallagher, A. L. (1995). Children's searching behaviors on browsing and keyword online catalogs: the Science Library Catalog project. *Journal of the American Society for Information Science, 46*(9), 663-684.

Bowler, L. (2009). Proceedings from ASIS&T ’09: *Adolescent metacognitive knowledge during the information search process.* Vancouver, Canada.

Bowler, L., & Nesset, V. (2013). Information literacy. In J. Beheshti & A. Large (Eds.), *The information behaviors of a new generation: Children and teens in the 21st century* (pp. 45-63). Lanham, MD: The Scarecrow Press.

Branch, J. L. (2000). Investigating the information-seeking processes of adolescents: The value of using think alouds and think afters. *Library & Information Science Research, 22*(4), 371-392.

Branch, J. L. (2003). Instructional intervention is the key: Supporting adolescent information seeking. *School Libraries Worldwide, 9*(2), 47-61.

Bremer, J. (2005). The internet and children: advantages and disadvantages. *Child and Adolescent Psychiatric Clinics of North America, 14*(3), 405-428.

Bright Futures in Practice: Physical Activity. (2016). Georgetown University. Retrieved from https://www.brightfutures.org/physicalactivity/mc/1.html

Burdick, T. A. (1996). Success and Diversity in Information Seeking: Gender and the Information Search Styles Model. *School Library Media Quarterly, 25*(1), 19-26.

Butler, R. (1999). Information seeking and achievement motivation in middle childhood and adolescence: The role of conceptions of ability. *Developmental Psychology, 35*(1), 146.

Byrnes, J. P., & Bernacki, M. L. (2013). Cognitive development and information behaviors. In J. Behehti & A. Large (Eds.), *The information behaviors of a new generation: Children and teens in the 21st century* (pp. 23-43). Lanham, MD: The Scarecrow Press.

Case, D. O. (2007). *Looking for information: A survey of research on information seeking, needs, and behaviors*. West Yorkshire, UK: Emerald Group Publishing.

Calm Clinic. (n.d.). Why anxiety leads to extreme clumsiness. Retrieved from http://www.calmclinic.com/anxiety/symptoms/extreme-clumsiness

Chowdhury, G. (2010). *Introduction to modern information retrieval*. Facet publishing.

Cohen, L. G., & Spenciner, L. J. (1998). *Assessment of Children and Youth*. Glenview, IL: Addison Wesley Longman, Inc.

Cole, C. (2013). Concepts, propositions, models and theories in information behaviors research. In J. Beheshti & A. Large (Eds.), *The information behaviors of a new generation: Children and teens in the 21st century* (pp. 1-22). Lanham, MD: The Scarecrow Press.

Cooper, L. Z. (2005). Developmentally appropriate digital environments for young children. *Library Trends, 54*(2), 286-302.

Creel, S. (2007). *Are online catalogs for children giving them what they need? Children's cognitive development and information seeking and their impact on design*. (Doctoral dissertation). Retrieved from University of North Texas.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. London, UK: Sage Publications, Inc.

Creswell, J. W. (2012). *Qualitative inquiry and research design: Choosing among five approaches*. London, UK: Sage Publications, Inc.

Delice, A. (2010). The Sampling Issues in Quantitative Research.*Educational Sciences: Theory and Practice*, *10*(4), 2001-2018.

Denham, S. A. (1998). *Emotional development in young children.* New York: NY: The Guilford Press.

Dervin, B., & Nilan, M. (1986). Information needs and uses. *Annual Review of Information Science and Technology, 21,* 3-33.

Dervin, B. (1992). From the mind's eye of the user: The sense-making qualitative-quantitative methodology. *Qualitative Research in Information Management, 6,* 1-84.

Dervin, B. (1998). Sense-making theory and practice: an overview of user interests in knowledge seeking and use. *Journal of Knowledge Management, 2(2),* 36-46.

Dinet, J., Bastien, J. M., & Kitajima, M. (2010). Proceedings from IHM ’10: *What, where and how are young people looking for in a search engine results page?: Impact of typographical cues and prior domain knowledge*. Luxembourg, Luxembourg.

Dresang, E. T. (2006). Access: The information-seeking behaviors of youth in the digital environment. *Library Trends*, *54*(2), 178-196.

Druin, A. (2002). The role of children in the design of new technology. *Behaviour and Information Technology, 21*(1), 1-25.

Druin, A., Foss, E., Hatley, L., Golub, E., Guha, M. L., Fails, J., & Hutchinson, H. (2009). Proceedings from IDC '09: *How children search the internet with keyword interfaces*. Como, Italy.

Druin, A., Foss, E., Hutchinson, H., Golub, E., & Hatley, L. (2010). Proceedings from SIGCHI '10: *Children's roles using keyword search interfaces at home*. Atlanta, GA.

Ellis, D. (1989). A behavioural approach to information retrieval system design. *Journal of Documentation, 45*(3), 171-212.

Ellis, D. (1993). Modeling the information-seeking patterns of academic researchers: A grounded theory approach. *The Library Quarterly, 63*(4), 469-486.

Ellis, D. (2005). Ellis's model of information-seeking behaviors. In K. E. Fisher, S. Erdelez & L. McKechnie (Eds.), *Thoeries of information behaviors* (pp. 138-142). Medford, NJ: Information Today Inc.

Ellis, D., & Haugan, M. (1997). Modelling the information seeking patterns of engineers and research scientists in an industrial environment. *Journal of Documentation, 53*(4), 384-403.

Ellis, D., Cox, D., & Hall, K. (1993). A comparison of the information seeking patterns of researchers in the physical and social sciences. *Journal of Documentation, 49*(4), 356-369.

Eisenberg, M. B., & Berkowitz, R. E. (1990). *Information problem-solving: The big six skills approach to library & information skills instruction*. New York, NY: Ablex Publishing Corporation.

Eisenberg, M. B. (2008). Information literacy: Essential skills for the information age. *DESIDOC Journal of Library & Information Technology, 28*(2), 39-47.

Flanagin, A. J., & Metzger, M. J. (2010). *Kids and credibility: An empirical examination of youth, digital media use, and information credibility*. Cambridge, MA: The MIT Press.

Flewitt, R. (2005). Conducting research with young children: Some ethical considerations. *Early child development and care, 175*(6), 553-565.

Foss, E., Druin, A., Brewer, R., Lo, P., Sanchez, L., Golub, E., & Hutchinson, H. (2012). Children's search roles at home: Implications for designers, researchers, educators, and parents. *Journal of the American Society for Information Science and Technology, 63*(3), 558-573.

Foss, E., & Druin, A. (2014). Children's internet search: Using roles to understand children's search behaviors. *Synthesis Lectures on information concepts, retrieval, and services, 6*(2), 1-106.

Foster, A. (2005). Nonlinear information seeking. In K. E. Fisher, S. Erdelez & L. McKechnie (Eds.), *Thoeries of information behaviors* (pp. 254-258). Medford, NJ: Information Today Inc.

Gallahue, D. L., & Ozmun, J. C. (2006). *Understanding motor development: Infants, children, adolescents, adults.* McGraw-Hill Education. New York; NY.

Gant, D. B., Gant, J. P., & Johnson, C. L. (2002). *State web portals: Delivering and financing e-service*. PricewaterhouseCoopers Endowment for the Business of Government.

Gathercole, S. E., Pickering, S. J., Ambridge, B., & Wearing, H. (2004). The structure of working memory from 4 to 15 years of age. *Developmental Psychology, 40*(2), 177-190.

Google. (n.d.). Retrieved April 3, 2016, from http://www.google.com/

Gossen, T. (2016). *Search Engines for Children: Search User Interfaces and Information-Seeking Behaviour*. Berlin, Germany: Springer.

Gossen, T., Hempel, J., & Nürnberger, A. (2013). Find it if you can: usability case study of search engines for young users. *Personal and Ubiquitous Computing, 17*(8), 1593-1603.

Gossen, T., & Nürnberger, A. (2013). Specifics of information retrieval for young users: A survey. *Information Processing & Management, 49*(4), 739-756.

Gravetter, F., & Wallnau, L. (2011). *Essentials of statistics for the behaviorsal sciences.* Belmont, CA: Wadsworth, Cengage Learning.

Great Websites for Kids. (n.d.). Retrieved January 9, 2017, from http://gws.ala.org/node/8263#.VzqSTfkrLIU

Hanna, L., Risden, K., & Alexander, K. (1997). Guidelines for usability testing with children. *Interactions, 4*(5), 9-14.

Harper, M. (2011). *Reference sources and services for youth*. Chicago, IL: Neal-Schuman Publishers.

Hembrooke, H. A., Granka, L. A., Gay, G. K., & Liddy, E. D. (2005). The effects of expertise and feedback on search term selection and subsequent learning. *Journal of the American Society for Information Science and Technology*, *56*(8), 861-871.

Hirsh, S. G. (1997). How do children find information on different types of tasks? Children's use of the Science Library Catalog. *Library Trends, 45*(4), 725-745.

Hirsh, S. G. (1999). Children's relevance criteria and information seeking on electronic resources. *Journal of the American Society for Information Science, 50*(14), 1265-1283.

Hirsh, S. G. (2004). Domain knowledge and children's search behaviors. In M. K. Chelton & C. Cool (Eds.), *Youth information-seeking behaviors: theories, models, and issues* (Vol. 1) (pp. 241-270). Lanham, MD: The Scarecrow Press.

Holsti, O. R. (1969). Content analysis for the social sciences and humanities. Reading, MA: Addison-Wesley.

Hourcade, J. P., Bederson, B. B., Druin, A., & Guimbretière, F. (2004). Differences in pointing task performance between preschool children and adults using mice. *ACM Transactions on Computer-Human Interaction, 11*(4), 357-386.

Hsieh-Yee, I. (2001). Research on Web search behaviors. *Library & Information Science Research, 23*(2), 167-185.

Hutchinson, H. B., Rose, A., Bederson, B. B., Weeks, A. C., & Druin, A. (2005). The International Children's Digital Library: a case study in designing for a multilingual, multicultural, multigenerational audience. *Information Technology and Libraries*, *24*(1), 4-12.

Hutchinson, H. B., Bederson, B. B., & Druin, A. (2006). Proceedings from IDC ’06: *The evolution of the international children's digital library searching and browsing interface*. Tampere, Finland.

Hutchinson, H. B., Druin, A., & Bederson, B. B. (2007). Supporting elementary-age children's searching and browsing: Design and evaluation using the international children's digital library. *Journal of the American Society for Information Science and Technology, 58*(11), 1618-1630.

Ingwersen, P. (1996). Cognitive perspectives of information retrieval interaction: elements of a cognitive IR theory. *Journal of documentation*, *52*(1), 3-50.

Jochmann-Mannak, H., Huibers, T., & Sanders, T. (2008). Children’s information retrieval: Beyond examining search strategies and interfaces. The 2nd BCS-IRSG Symposium: Future Directions in Information Access. pp. 64-72.

Jochmann-Mannak, H., Huibers, T.,Lentz, L., & Sanders, T. (2010) Children searching information on the Internet: Performance on children's interfaces compared to Google. Workshop of the 33rd Annual International ACM SIGIR Conference on Research and Development in Information Retrieval, Geneva, Switzerland. pp. 27-35.

Kafai, Y., & Bates, M. J. (1997). Internet Web-Searching Instruction in the Elementary Classroom: Building a Foundation for Information Literacy. *School Library Media Quarterly, 25*(2), 103-111.

Kids.gov. (n.d.). Retrieved April 3, 2016, from www.kids.gov

Koh, K. (2011). *Proposing a theoretical framework for digital age youth information behaviors building upon radical change theory*. (Doctoral dissertation). Retrieved from The Florida State University diginole commons. (Paper 2849)

Knight, S. A., & Spink, A. (2008). Toward a Web search information behaviors model. In A. Spink & M. Zimmer (Eds.), *Web search: Multidisciplinary perspectives* (pp. 209-234). New York, NY: Springer.

Kuhlthau, C. C. (1991). Inside the search process: Information seeking from the user's perspective. *Journal of the American Society for Information Science, 42*(5), 361-371.

Kuhlthau, C. C. (2004). *Seeking meaning: A process approach to library and information services*. Westport, CT : Libraries Unlimited.

Kuhlthau, C. C., Heinström, J., & Todd, R. J. (2008). The'information search process' revisited: is the model still useful?. *Information Research, 13(4).* Retrieved from http://www.informationr.net/ir/13-4/paper355.html

Laplante, A. (2014). Social capital and academic help seeking: Late adolescents' use of people as information sources. In D. Bilal & J. Beheshti (Eds.), *New directions in children's and adolescents' information behaviors research* (pp. 67-103). West Yorkshire, UK: Emerald Group Publishing.

Large, A., Beheshti, J., & Rahman, T. (2002). Gender differences in collaborative web searching behaviors: An elementary school study. *Information Processing & Management, 38*(3), 427-443.

Large, A., Beheshti, J., Nesset, V., & Bowler, L. (2006). Proceedings from ASIS&T '06: *Web portal design guidelines as identified by children through the processes of design and evaluation*. Austin, TX.

Lowe, C., & Eisenberg, M, B. (2005). Big6 skills for information literacy. In K. E. Fisher, S. Erdelez & L. McKechnie (Eds.), *Thoeries of information behaviors* (pp. 63-68). Medford, NJ: Information Today Inc.

Macpherson, K. (2004). An information processing model of undergraduate electronic database information retrieval. *Journal of the American Society for Information Science and Technology, 55*(4), 333-347.

Madden, A. D., Ford, N. J., Miller, D., & Levy, P. (2006). Children's use of the internet for information-seeking: What strategies do they use, and what factors affect their performance?. *Journal of Documentation, 62*(6), 744-761.

Marchionini, G. (1989). Information-seeking strategies of novices using a full-text electronic encyclopedia. *Journal of the American Society for Information Science, 40*(1), 54-66.

Marchionini, G. (1995). *Information seeking in electronic environments*. New York, NY: Cambridge University Press.

Maxwell, J. A. (1992). Understanding and validity in qualitative research. *Harvard Educational Review, 62*(3), 279-301.

McNeil, N. M., & Alibali, M. W. (2005). Why won't you change your mind? Knowledge of operational patterns hinders learning and performance on equations. *Child Development, 76*(4), 883-899.

Meyers, E. M., Fisher, K. E., & Marcoux, E. (2007). Studying the everyday information behaviors of tweens: Notes from the field. *Library & Information Science Research, 29*(3), 310-331.

Meyers, E. M. (2009). Tip of the iceberg: Meaning, identity, and literacy in preteen virtual worlds. *Journal of Education for Library and Information Science, 50*(4), 226-236.

Miller, P. H. (2010). *Theories of developmental psychology.* New York, NY: Worth Publishers.

Nelson-Le Gall, S. (1981). Help-seeking: An understudied problem-solving skill in children. *Developmental Review, 1*(3), 224-246.

Nelson-Le Gall, S. (1985). Help-seeking behaviors in learning. *Review of research in education, 12*, 55-90.

Nelson-Le Gall, S. (1987). Necessary and unnecessary help-seeking in children. T*he Journal of Genetic Psychology, 14*8(1), 53-62.

Nelson-Le Gall, S., & Glor-Scheib, S. (1985). Help seeking in elementary classrooms: An observational study. *Contemporary Educational Psychology,10*(1), 58-71.

Nesset, V. (2014). Depicting the intersection between information-seeking behaviors and information literacy in the research process: A model. In D. Bilal & J. Beheshti (Eds.), *New directions in children's and adolescents' information behaviors research* (pp. 39-66). West Yorkshire, UK: Emerald Group Publishing.

Newman, R. S. (1990). Children's help-seeking in the classroom: The role of motivational factors and attitudes. *Journal of educational psychology, 82*(1), 71-80.

Newman, R. S. (2000). Social influences on the development of children's adaptive help seeking: The role of parents, teachers, and peers. *Developmental Review, 20*(3), 350-404.

Nielsen, J. (2010, September 13). *Children's Websites: Usability issues in designing for kids.* Retrieved from http://www.nngroup.com/articles/childrens-websites-usability-issues/

Nielsen, J. (2011, May 9). *Utilize available screen space.* Retrieved from https://www.nngroup.com/articles/utilize-available-screen-space/

Ormrod, J. E. (1999). *Human learning.* Upper Saddle River, NJ: Prentice-Hall, Inc.

Piaget, J., & Inhelder, B. (1969). *The psychology of the child.* New York: NY: Basic Books, Inc.

Pettigrew, K. E., Fidel, R., & Bruce, H. (2001). Conceptual frameworks in information behaviors. *Annual Review of Information Science and Technology, 35,* 43-78.

Prensky, M. (2001). Digital natives, digital immigrants part 1. On the horizon, 9(5), 1-6.

Purcell, K., Rainie, L., Heaps, A., Buchana, J., Friedrich, L., Jacklin, A., . . . Zickuhr, K. (2012). How teens do research in the digital world. *PEW Research*. Retrieved from http://www.pewinternet.org/files/old-media//Files/Reports/2012/PIP_TeacherSurveyReportWithMethodology110112.pdf

Puustinen, M., & Rouet, J. F. (2009). Learning with new technologies: Help seeking and information searching revisited. *Computers & Education, 53*(4), 1014-1019.

Reuter, K. (2007). Assessing aesthetic relevance: Children's book selection in a digital library. *Journal of the American Society for Information Science and Technology, 58*(12), 1745-1763.

Reuter, K., & Druin, A. (2004). Proceedings from ASIS&T ’04: *Bringing together children and books: An initial descriptive study of children's book searching and selection behaviors in a digital library*. Providence, RI.

Revelle, G., Druin, A., Platner, M., Bederson, B., Hourcade, J. P., & Sherman, L. (2002). A visual search tool for early elementary science students. *Journal of Science Education and Technology, 11*(1), 49-57.

Reynolds-Keefer, L., Johnson, R., Dickenson, T., & McFadden, L. (2009). Validity issues in the use of pictorial Likert scales. *Studies in Learning, Evaluation Innovation and Development, 6*(3), 15-24.

Roberts, P., Priest, H., & Traynor, M. (2006). Reliability and validity in research. *Nursing Standard, 20*(44), 41-45.

Ross, J. A. (2006). The reliability, validity, and utility of self-assessment. *Practical Assessment, Research, and Evaluation, 11*(10), 1-13.

Rutter, S., Ford, N., & Clough, P. (2015). How do children reformulate their search queries?. Information Research, 20(1). Retrieved from http://www.informationr.net/ir/20-1/isic2/isic31.html#.Vztp2PkrLIU

Sahib, N. G., Tombros, A., & Stockman, T. (2012). A comparative analysis of the information-seeking behaviors of visually impaired and sighted searchers. *Journal of the American Society for Information Science and Technology, 63*(2), 377-391.

Schacter, J., Chung, G. K., & Dorr, A. (1998). Children's Internet searching on complex problems: Performance and process analyses. *Journal of the American Society for Information Science, 49*(9), 840-849.

Seymour, T., Frantsvog, D., & Kumar, S. (2011). History of search engines. *International Journal of Management & Information Systems (IJMIS), 15*(4), 47-58.

Shaffer, D. R., & Kipp, K. (2010). *Developmental psychology: Childhood and adolescence*. Belmont, CA: Wadsworth Publishing Company.

Shenton, A. K. (2004a). Research into young people's information-seeking: Perspectives and methods. *Aslib Proceedings, 56*(4), 243-254.

Shenton, A. K. (2004b). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information, 22*(2), 63-75.

Shenton, A. K., & Dixon, P. (2003). Models of young people's information seeking. *Journal of Librarianship and Information Science, 35*(1), 5-22.

Shrager, J., & Siegler, R. S. (1998). SCADS: A model of children's strategy choices and strategy discoveries. *Psychological Science, 9*(5), 405-410.

Slone, D. J. (2000). Encounters with the OPAC: On-line searching in public libraries. *Journal of the American Society for Information Science, 51*(8), 757-773.

Siegler, R. S. (1996). *Emerging minds*. New York, NY: Oxford University Press, Inc.

Siegler, R. S. (2005). Children's learning. *American Psychologist, 60*(8), 769-778.

Siegler, R. S. & Alibali, M. W. (2005). *Children's thinking.* Upper Saddle River, NJ: Prentice-Hall, Inc.

Someren, M. V., Barnard, Y. F., & Sandberg, J. A. (1994). *The think aloud method: a practical approach to modelling cognitive processes*. London, UK: Academic Press.

Spears, L. I., & Mardis, M.A. (2014). A failure to connect: The elusive relationship between broadband access and children's information seeking in American academic research. In D. Bilal & J. Beheshti (Eds.), *New directions in children's and adolescents' information behaviors research* (pp. 217-263). West Yorkshire, UK: Emerald Group Publishing.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research* (Vol. 15). Newbury Park, CA: Sage.

Swanson, H. L. (1999). What develops in working memory? A life span perspective. *Developmental Psychology, 35*(4), 986-1000.

Tai, M., Woolf, B. P., & Arroyo, I. (2011). Proceedings from ICALT ’11: *Using the think aloud method to observe students' help-seeking behaviors in math tutoring software*. Athens, GA.

Tidline, T. J. (2005). Dervin’s sense-making. In K. E. Fisher, S. Erdelez & L. McKechnie (Eds.), *Thoeries of information behaviors* (pp. 113-117). Medford, NJ: Information Today Inc.

Theng, Y. L., Nasir, N. M., Thimbleby, H., Buchanan, G., Jones, M., Bainbridge, D., & Cassidy, N. (2000). Proceedings from ECDL ’00: *Children as design partners and testers for a children’s digital library*. Lisbon, Portugal.

Van den Haak, M. J., & De Jong, M. D. (2003). Proceedings from IPCC ’03: *Exploring two methods of usability testing: Concurrent versus retrospective think-aloud protocols*. Orlando, FL.

Vakkari, P. (2003). Task-based information searching. *Annual review of information science and technology, 37*(1), 413-464.

Vasta, R. (1979). *Studying children: An introduction to research methods*. San Francisco, CA: W.H. Freeman.

Weiler, A. (2005). Information-seeking behaviors in Generation Y students: Motivation, critical thinking, and learning theory. *The Journal of Academic Librarianship, 31(1),* 46-53.

Wendler, D., Rackoff, J. E., Emanuel, E. J., & Grady, C. (2002). The ethics of paying for children's participation in research. *The Journal of pediatrics, 141*(2), 166-171.

White, R. W., Dumais, S. T., & Teevan, J. (2009). Proceedings from WSDM'09: *Characterizing the influence of domain expertise on web search behaviors.* Barcelona, Spain.

Wildemuth, B. M. (2004). The effects of domain knowledge on search tactic formulation. *Journal of the American society for Information Science and Technology, 55*(3), 246-258.

Willoughby, T., Anderson, S. A., Wood, E., Mueller, J., & Ross, C. (2009). Fast searching for information on the Internet to use in a learning context: The impact of domain knowledge. *Computers & Education*, *52*(3), 640-648.

Wilson, T. D. (2000). Human information behaviors. *Informing science*, *3*(2), 49-56.

Winter, G. (2000). A comparative discussion of the notion of validity in qualitative and quantitative research. *The qualitative report, 4*(3/4), Retrieved from http://www.nova.edu/ssss/QR/QR4-3/winter.html

Wood, D. (2001). Scaffolding, contingent tutoring, and computer-supported learning. *International Journal of Artificial Intelligence in Education, 12*(3), 280-293.

Wood, H., & Wood, D. (1999). Help seeking, learning and contingent tutoring. *Computers & Education, 33*(2), 153-169.

Wu, L. (2011). *Users' help-seeking behaviors within the context of computer task accomplishment: An exploratory study*. (Doctoral dissertation). Retrieved from University of Tennessee.

Xie, I. (2009). Dimensions of tasks: influences on information-seeking and retrieving process. *Journal of Documentation, 65*(3), 339-366.

Xie, I. (2010). Information searching and search models. In M. J. Bates & M. N. Maack (Eds.), *Encyclopedia of library and information science* (pp. 2592-2604). New York, NY: CRC Press.

Xie, I., & Cool, C. (2006). Toward a better understanding of help seeking behaviors: An evaluation of help mechanisms in two IR systems. *Proceedings of the American Society for Information Science and Technology*, *43*(1), 1-16.

Xie, I., & Cool, C. (2009). Understanding help seeking within the context of searching digital libraries. *Journal of the American Society for Information Science and Technology, 60*(3), 477-494.

Xie, I., Babu, R., Joo, S., & Fuller, P. (2015). Using digital libraries non-visually: understanding the help-seeking situations of blind users. *Information Research, 20*(2). Retrieved from http://www.informationr.net/ir/20-2/paper673.html#.VzttBvkrLIU

Zhang, X., Anghelescu, H. G., & Yuan, X. (2005). Domain Knowledge, Search Behaviour, and Search Effectiveness of Engineering and Science Students: An Exploratory Study. *Information Research: An International Electronic Journal, 10(2).* Retrieved from http://files.eric.ed.gov/fulltext/EJ1082015.pdf

Zeng, Q. T., Crowell, J., Plovnick, R. M., Kim, E., Ngo, L., & Dibble, E. (2006). Assisting consumer health information retrieval with query recommendations. *Journal of the American Medical Informatics Association*,*13*(1), 80-90.

Zohrabi, M. (2013). Mixed method research: Instruments, validity, reliability and reporting findings. *Theory and Practice in Language Studies, 3*(2), 254-262.

Appendix A: Recruitment Flyer

# PARTICIPANT NEEDED

## Children 3rd – 5th Graders

This research study is to investigate children's help-seeking behaviors on the web and to investigate children's use of search features in search engines.

**Benefits:**
Children will provide valuable views in creating kid-friendly search engines that will give help when they need.

Children will learn and experience how to search information in Google and a web portal for kids.

**Child will get a certificate of participation and a $50 Walmart gift card to thank them for his/her time.**

**Confidentiality and Anonymity Protected!**

**Study Stage**

Pre-Questionnaire

Quiz & Self-survey

Search Tasks

Post-Interview

The Entire Process will take 90 minutes! (Just One Visit to UWM Campus)

To take part in this research study or for more information, please contact at **hanh@uwm.edu**

# Appendix B: Participant Assent Form

**UNIVERSITY OF WISCONSIN – MILWAUKEE**
**ASSENT TO PARTICIPATE IN RESEARCH**

**Study title:** Understanding Children's Help-Seeking Behaviors: Effects of Domain Knowledge
**Person in Charge of Study:**

We are doing a research study. A research study is a way to learn more things. We are trying to learn more about children's help seeking behaviors on the web. If you decide that you want to be part of this study, you will be asked to work on the following.

- You will fill in a questionnaire which consists of your demographic information and information resource uses (10 minutes).
- You will fill in a questionnaire which consists of questions on George Washington (10 minutes).
- You will fill in a self-assessment which consists of questions on how you are familiar with the subject of George Washington (5 minutes).
- You will conduct two search tasks including audio/ video recording using Google and Kids.gov sites (40 minutes).
- You will be interviewed about your search experience and perceptions of the system features (15 minutes)

There is no serious risk occurring for you in participation in the research. You will be observed while performing searches and your search performance, computer monitor screen and voice will be recorded.

We hope to learn something that will help other people someday.

You don't have to be in this study. It is up to you and no one will be mad at you. If you say yes now, but change your mind later, that's okay too. Just let us know.

When we are finished with this study we will write a report about what was learned. This report will not include your name or that you were in the study.

If you decide you want to be in this study, please print and sign your name.

I, _____, want to be in this research study.
(Print your name here)

_____ _____
(Sign your name here) (Date)

**Principal Investigator (or Designee)**
*I have given this research subject information on the study that is accurate and sufficient for the subject to fully understand the nature, risks and benefits of the study.*

_____ _____
Printed Name of Person Obtaining Consent Role on Study

_____ _____
Signature of Person Obtaining Consent Date

# Appendix C: Parental Consent Form

**UNIVERSITY OF WISCONSIN – MILWAUKEE**
**PARENTAL CONSENT FOR CHILD TO PARTICIPATE IN RESEARCH**

**1. General Information**

**Study title:** Understanding Children's Help-Seeking Behaviors: Effects of Domain Knowledge
**Person in Charge of Study (Principal Investigator):**

**2. Study Description**

Your child is being asked to participate in a research study. Your child's participation is completely voluntary. Your child does not have to participate if you do not want him/her to participate.

**Study description:**
Purpose of this study is to investigate the process of children's interactions with information search systems. This study is to investigate effects of children's domain knowledge on help-seeking and understand their help-seeking behaviors in information search systems. Your child's participation will take about 90 minutes to complete.

**3. Study Procedures**

**What will I be asked to do if I participate in the study?**
After the initial contact, the research team emails you and your child a consent and an assent forms which include information explaining the research procedures, benefits and risks of the study. If you are satisfied with the requirements of this study, your child will be asked to participate in the study. You will sign the consent form and your child will sign the assent form when you come to the Information Intelligence & Architecture (IIA) Research Lab at UWM School of Information Studies.

- Your child fill in a questionnaire which consists of his/her demographic information and information resource uses (10 minutes).
- Your child will fill in a questionnaire which consists of questions on George Washington (10 minutes).
- Your child will fill in a self-assessment which consists of questions on how he/she is familiar with the subject of George Washington (5 minutes).
- Your child is going to perform two search tasks using Google and Kids.gov sites. The searches will be logged and audio/video will be recorded for later analysis (40 minutes).
- Your child will be asked to "think aloud" about what he/she is doing and why he/she is doing that way while searching. Your child's think-aloud will be recorded.
- Your child will be observed during the search process, and his/her behaviors will be recorded by the researcher.

- After all the searches are done, your child will be interviewed about his/her search experiences and perceptions of the system features (15 minutes).

This visit will take about 90 minutes.

**4. Risks and Minimizing Risks**

**What risks will my child face by participating in this study?**
There is no serious risk occurring for children in participation in the research. Your child may experience embarrassment or anxiety due to being observed while performing searches. We will try to minimize the risk.

**5. Benefits**

**Will my child receive any benefit from my participation in this study?**
Valuable insights of your child will help develop child-friendly search sites. The long term benefit of the study will be the design of better information search systems that will help children effectively retrieve information based on the results of the study. This is a rewarding experience to participant.

**6. Study Costs and Compensation**

**Will I or my child be charged anything to participate in this study?**
Your child will not be responsible for any of the costs from taking part in this research study.

**Will my child be given anything for being in the study?**
Once the experiment is completed, your child will be given a $ 50 gift card and a certificate as a token of appreciation for the participation in the study.
Participants are responsible for parking and transit costs and your child will not be given a $50 gift card for partial completion or incompletion of the experiment.

**7. Confidentiality**

**What happens to the information collected?**

All information collected about your child during the course of this study will be kept confidential to the extent permitted by law. We may decide to present findings to others, or publish our results in scientific journals or at scientific conferences. Information that identifies your child personally will not be released without your written permission. Only the authorized research team members will have access to the information. However, the Institutional Review Board at UW-Milwaukee or appropriate federal agencies like the Office for Human Research Protections may review your child's study related records.

- The collected data will be confidential and only revealing each participant's number (e.g. participant No.1, participant No.2, participant No.3 … participant No.30).

- All data, including name and associated demographic data, collected from participants will be stored and kept in locked area by the researchers in the School of Information Studies at the University of Wisconsin-Milwaukee. The screen recording files will also be stored on a password protected computer by the principal investigator at the School of Information Studies. All data will be stored with a coded participant identification number. Coded data will be made available for use in the analysis by the research team.
- All the information collected for this study and the identifying information of the individuals will be destroyed after the study is complete.

**8. Alternatives**

**Are there alternatives to participating in the study?**

There are no known alternatives available to your child other than not taking part in this study.

**9. Voluntary Participation and Withdrawal**

**What happens if I decide not to allow my child to be in this study?**
Your child's participation in this study is entirely voluntary. You may choose not allow your child to take part in this study. If you decide to allow your child to take part, you can change your mind later and withdraw him/her from the study. In addition, your child will also be asked whether he/she would like to participate in the research study by reading and signing an assent form which describes the study. Your child will be free to not answer any questions or withdraw at any time. Your and your child's decision will not change any present or future relationships with the University of Wisconsin Milwaukee. If your child withdraws from the study, all information collected will be destroyed.

**10. Questions**

**Who do I contact for questions about this study?**
For more information about the study or the study procedures or treatments, or to withdraw your child from the study, contact:

**Who do I contact for questions about my child's rights or complaints about my child's treatment as a research subject?**
The Institutional Review Board may ask your name, but all complaints are kept in confidence.

Institutional Review Board
Human Research Protection Program
Department of University Safety and Assurances
University of Wisconsin – Milwaukee
P.O. Box 413
Milwaukee, WI 53201
(414) 229-3173

**11. Audio or Video recording or Photographs**

**Consent to Audio/Video Recording:**

*It is okay to audiotape/videotape my child while he/she is in this study and use my child's audiotaped/videotaped data in the research.*

Please initial: ____Yes ____No

**12. Signatures**

**Parental/Guardian Consent:**

*I have read or had read to me this entire consent form, including the risks and benefits. I have had all of my questions answered. I understand that I may withdraw my child from the study at any time. I am not giving up any legal rights by signing this form. I am signing below to give consent for my child to participate in this study.*

_____
Printed Name of Child Participant

_____
Printed Name of Parent/Guardian

_____ _____
Signature of Parent/Guardian Date

**Principal Investigator (or Designee)**

*I have given this research subject information on the study that is accurate and sufficient for the subject to fully understand the nature, risks and benefits of the study.*

_____ _____
Printed Name of Person Obtaining Consent Study Role

_____ _____
Signature of Person Obtaining Consent Date

# Appendix D: IRB Application Approval

UNIVERSITY of WISCONSIN
UWMILWAUKEE

*IRB Manager*
*Institutional Review Board*
Engelmann 270
P. O. Box 413

**Melissa Spadanuda**

Milwaukee, WI 53201-0413
(414) 229-3173 *phone*
(414) 229-6729 *fax*

http://www.irb.uwm.edu
spadanud@uwm.edu

**Department of University Safety & Assurances**

**New Study - Notice of IRB Expedited Approval**

**Date:** November 25, 2015

**To:** Iris Xie, PhD

**Dept:** School of Information Studies

**Cc:** Hye Jung Han

**IRB#:** 16.147

**Title:** Understanding Children's Help Seeking Behaviors: Effects of Domain Knowledge

After review of your research protocol by the University of Wisconsin – Milwaukee Institutional Review Board, your protocol has been approved as minimal risk Expedited under Category 6 and 7 as governed by 45 CFR 46.110.

In addition, your protocol has been granted **Level 3** confidentiality for Payments to Research Subjects per UWM Accounting Services Procedure: 2.4.6.

This protocol has been approved on **November 25, 2015** for one year. IRB approval will expire on **November 24, 2016**. If you plan to continue any research related activities (e.g., enrollment of subjects, study interventions, data analysis, etc.) past the date of IRB expiration, a continuation for IRB approval must be filed by the submission deadline. If the study is closed or completed before the IRB expiration date, please notify the IRB by completing and submitting the Continuing Review form found in IRBManager.

Any proposed changes to the protocol must be reviewed by the IRB before implementation, unless the change is specifically necessary to eliminate apparent immediate hazards to the subjects. It is the principal investigator's responsibility to adhere to the policies and guidelines set forth by the UWM IRB, maintain proper documentation of study records and promptly report to the IRB any adverse

events which require reporting. The principal investigator is also responsible for ensuring that all study staff receive appropriate training in the ethical guidelines of conducting human subjects research.

As Principal Investigator, it is your responsibility to adhere to UWM and UW System Policies, and any applicable state and federal laws governing activities which are independent of IRB review/approval (e.g., FERPA, Radiation Safety, UWM Data Security, UW System policy on Prizes, Awards and Gifts, state gambling laws, etc.). When conducting research at institutions outside of UWM, be sure to obtain permission and/or approval as required by their policies.

Contact the IRB office if you have any further questions. Thank you for your cooperation and best wishes for a successful project.

Respectfully,

Melissa C. Spadanuda

IRB Manager

# Appendix E: Pre-Questionnaire

## Pre-Questionnaire

**Age**

| 8 | 9 | 10 |
|---|---|---|

**Grade**

| 3rd | 4th | 5th |
|---|---|---|

**Gender**

| Girl | Boy |
|---|---|

**Race/Ethnicity**

| African American | Asian or Pacific Islander | White | Hispanic/Latino |
|---|---|---|---|
| American Indian or Alaskan Native | Other | | |

1. **At what age did you start to use the Internet?**

2. **How often do you use the Internet?**
   1=Never use,
   2=Rarely use (Less than once a month)
   3=Occasionally use (Once or twice a month)
   4=Often use (Once or twice a week)
   5=Use daily (Every day or almost every day)

3. **What are the main purposes that you use the Internet? Please rank your top 3 choices.**

| Purposes in Using the Internet | Rank top 3 choices |
|---|---|
| Use the internet for school work | |
| Use the internet for school work | |
| Watch video (e.g. Youtube) | |
| Listen Books (e.g. Audio books, Storytelling) | |
| Read Books (e.g. Ebooks) | |
| Download/upload images or music | |
| Send/receive email or phone calls (e.g. skype) | |
| Play Games | |
| Connect a Social Networking site (e.g. Facebook, Instagram) | |
| Other (Please Specify) | |

4. **Which of these devices do you use for the Internet?**

   A. Your own PC (Desktop computer)
   B. Your own laptop
   C. A PC shared with other members of your family
   D. A laptop shared with other members of your family
   E. A mobile phone (e.g. iphone, galaxy phone)
   F. Tablets (e.g. ipad, Galaxy tab)
   G. Other (Please specify)

**5. Which search site do you use MOST OFTEN?**

A. Google
B. Bing
C. Yahoo
D. Ask
E. Other (Please specify)

**6. How often do you use the site you mentioned above?**

1=Never use
2=Rarely use (Less than once a month)
3=Occasionally use (Once or twice a month)
4=Often use (Once or twice a week)
5=Use daily (Every day or almost every day)

**7. How often do you use the following help features?**

| Help Features | Never Use | Rarely use | Occasionally use | Often use | Use daily |
|---|---|---|---|---|---|
| Auto complete | | | | | |
| Did you mean | | | | | |
| Searches related to | | | | | |
| Search tools | | | | | |
| Results Snippets (Preview) | | | | | |
| Help page | | | | | |
| Site Index | | | | | |
| Other (Please Specify) | | | | | |

**8. What kind of problems do you have while searching? Please rank your top 3 choices.**

| Purposes in Using the Internet | Rank top 3 choices |
|---|---|
| Fail to Create search terms | |
| Too many results | |
| Too few relevant results | |
| Cannot understand if the retrieved result is correct or not | |
| Images aren't loading | |
| Slow Downloading | |
| Links aren't working | |
| Deviation of pages you are exploring | |
| Other (Please Specify) | |

**9. When you have problems while searching, how do you solve the problems (Select all that apply)?**

A. Play myself to solve the problems
B. Use Help Tools
C. Ask Somebody
D. Quit Searching
E. Other (Please Specify)

# Appendix F: Instruction for Search Tasks

In this study, **our goal is to examine the experiences of children in searching for information using a search engine and a kids-friendly portal site**. We ask you first to explore Google and Kids.gov.sites and then to perform two search tasks while thinking aloud. We will capture your verbalizations, and later analyze it to identify what aspects of the design are not user-friendly. We will then try to identify design improvements that will make information seeking from a search engine and a kids-friendly portal site barrier-free for children. **This is not a test of your skills. Rather, it is a test of how well the system is designed.**

As you perform the tasks, **please keep talking about your thoughts and problems while searching.**

**You can ask for help from the research observer when you get stuck and unable to move forward.**

Keeping this in mind, please visit the website of the Google and Kids.gov available at:
https://www.google.com/
https://kids.usa.gov/

First please spend about **5 minutes exploring each site** to get a basic understanding how the search engine and kids portal site work.

After that, please complete the following two tasks in Google and Kids.gov. **(You can spend about 10 minutes in conducting each task in each site.)**

1) Find relevant information about George Washington's trip outside of America. **a) When and where is George Washington's trip outside of America, b) With whom did George Washington go on a trip outside of America?**

2) George Washington's Farewell Address was a letter written by George Washington. **What did George Washington urge the American people to do in his Farewell Address? Please list more than two.**

# Appendix G: Post-Interview

**Post-Interview**

**[Search Evaluation]**

Overall how do you rate your finding of the questions you searched in Google?

T1- George Washington's trip outside of America

1-Very Difficult (☹☹☹) 2- Difficult (☹☹) 3- Neutral (😐) 4- Easy (☺☺) 5 -Very easy (☺☺☺)

T2- George Washington's Farewell Address

1- Very Difficult (☹☹☹) 2- Difficult (☹☹) 3- Neutral (😐) 4- Easy (☺☺) 5- Very easy (☺☺☺)

Overall how do you rate your finding of the questions you searched in Kids. gov?

T1- George Washington's trip outside of American

1- Very Difficult (☹☹☹) 2- Difficult (☹☹) 3- Neutral (😐) 4- Easy (☺☺) 5- Very easy (☺☺☺)

T2- George Washington's Farewell Address

1- Very Difficult (☹☹☹) 2- Difficult (☹☹) 3- Neutral (😐) 4- Easy (☺☺) 5- Very easy (☺☺☺)

**[Overall system assessment: Ease-of-use]**

1. How easy is Google to use?

1- Very Difficult (☹☹☹) 2- Difficult (☹☹) 3- Neutral (😐) 4- Easy (☺☺) 5- Very easy (☺☺☺)

1-a. Why do you think Google is easy or hard to use?

2. How easy is Kids.gov to use?

1- Very Difficult (☹☹☹) 2- Difficult (☹☹) 3- Neutral (😐) 4- Easy (☺☺) 5- Very easy (☺☺☺)

2-a. Why do you think Kids.gov is easy or hard to use?

**[Overall System assessment: Satisfaction]**

1. Please rate your satisfaction level in using Google?

1- Very dissatisfied (☹☹☹)
2- Dissatisfied (☹☹)
3- Unsure (😐)
4- Satisfied (☺☺)
5- Very satisfied (☺☺☺)

1-a. why?

2. Please rate your satisfaction level in using Google help features?

1- Very dissatisfied (☹☹☹)
2- Dissatisfied (☹☹)
3- Unsure (😐)
4- Satisfied (☺☺)
5- Very satisfied (☺☺☺)

2-a. why?

3. Please rate the satisfaction level in using Kids.gov?
1- Very dissatisfied (☹☹☹)
2- Dissatisfied (☹☹)
3- Unsure (😐)
4- Satisfied (☺☺)
5- Very satisfied (☺☺☺)

3-a. why?

4. Please rate your satisfaction level in using Kids.gov help features?
1- Very dissatisfied (☹☹☹)
2- Dissatisfied (☹☹)
3- Unsure (😐)
4- Satisfied (☺☺)
5- Very satisfied (☺☺☺)

4-a. why?

**[Desired Help feature suggestion]**

1. Are there any help features you would like to use that are not mentioned above for Google?

2. Can you give any suggestions regarding the help features when you use keywords in Google?

3. Can you give any suggestions regarding the help features when you check search results in Google?

4. Are there any help features you would like to use that are not mentioned above for Kids.gov?

5. Can you give any suggestions regarding the help features when you use keywords in Kids.gov?

6. Can you give any suggestions regarding the help features when you check search results in Kids.gov?

**[Overall evaluation of domain knowledge and help use]**

1. How much does your background knowledge about George Washington guide when you search George Washington's trip outside of America?

1- Very unhelpful (☹☹☹)
2- Unhelpful (☹☹)
3- Unsure (😐)
4- Helpful (☺☺)
5- Very helpful(☺☺☺)

2. How much does your background knowledge about George Washington guide when you search George Washington's Farewell Address?

1- Very unhelpful (☹☹☹)
2- Unhelpful (☹☹)
3- Unsure (😐)
4- Helpful (☺☺)
5- Very helpful(☺☺☺)

3. How much does your background knowledge about George Washington guide your use of Help (feature)?
1- Very unhelpful (☹☹☹)
2- Unhelpful (☹☹)
3- Unsure (😐)
4- Helpful (☺☺)
5- Very helpful(☺☺☺)

**[Overall experience/ final thoughts]**

Is there anything else you would like to tell me or any thoughts about what you did here today?

# Appendix H: Code Definitions

| Category | Definition | Subcategory | Definition |
|---|---|---|---|
| Cognitive help-seeking situation at query formulation stage | Behaviors that relate to thinking and knowledge at query formulation stage | Limited visibility of help features | Difficulty locating existing help features |
| | | Spelling errors | Misspelled keywords |
| | | Difficulty in formulating queries | Difficulty with how to start and formulate keywords due to lack of domain knowledge |
| Physical help-seeking situation at query formulation stage | Behaviors that relate to visual and motor skills at query formulation stage | Size of search box | Difficulty locating search box due to small size |
| Emotional help-seeking situation at query formulation stage | Behaviors that relate to negative feelings at query formulation stage | Anxiety while formulating queries | Anxious feeling due to difficulty formulating keywords |
| Cognitive help-seeking situation at result evaluation stage | Behaviors that relate to thinking and knowledge at result evaluation stage | Mismatched reading level | Difficulty reading adult-oriented text level |
| | | Comfortability with system knowledge | Difficulty in evaluating search results due to lack of system knowledge |
| | | Negative effect of lack of domain knowledge | Difficulty in evaluating search results due to lack of domain knowledge |
| Physical help-seeking situation at result evaluation stage | Behaviors that relate to visual and motor skills at result evaluation stage | Too many irrelevant results | Problems having too many irrelevant items in a result list |
| | | Too-small fonts | Difficulty reading search results due to small size of fonts |
| | | Navigational confusion | Difficulty reading search results due to unnecessary navigational items and customization options |
| Emotional help-seeking situation at result evaluation stage | Behaviors that relate to negative feelings at result evaluation stage | Anxiety by system error messages | Anxious feeling due to system error messages |
| | | Frustration with poor system performance | Frustration with poor system performance |
| | | Confusion with similar pronouns | Confusion with similar pronouns |

# Curriculum Vitae

**Hyejung Han**
School of Information Studies
University of Wisconsin-Milwaukee
Milwaukee, WI, 53211

## Education

| | | |
|---|---|---|
| **PhD Candidate** | School of Information Studies<br>University of Wisconsin – Milwaukee | Sep 2012~ Aug 2017 |
| **MLIS** | School of Information Studies<br>University of Wisconsin – Milwaukee | 2012 |
| **BA** | Department of Spanish Interpretation and Translation<br>Hankuk University of Foreign Studies, Seoul, Korea | 2002 |

## Publications

### Peer-Reviewed Journal Articles

Han, H., & Wolfram, D. (2015). An exploration of search session patterns in an image-based digital library. *Journal of Information Science*, DOI:10.1177/0165551515598952 (One of top journals in LIS)

Han, H., Joo, S, & Wolfram, D. (2014). Using transaction logs to better understand user search session patterns in an image-based digital library. *Journal of the Korean Biblia Society for Library and Information Science, 25*(1).

Jeong, W., & Han, H. (2012). Usability study on newspaper mobile web sites. *OCLC Systems & Services*, *28*(4), 180-198.

### Peer-Reviewed Conference Proceedings

Jeong, W., Han, H. & Ridenour, L. (2015). Case study of waiting list on WPLC digital library. *Proceedings of the Joint Conference on Digital Libraries.* Knoxville, TN. June 21-25.

Jeong, W., & Han, H. (2014). Transformation Newbery award books in Chinese, Japanese and Korean translations. *Proceedings of the American Society for Information Science and Technology*. Seattle. WA. November 9-12.

Han, H., & Wolfram, D. (2014). Identifying search patterns in an image-based digital library. *Proceedings of the American Society for Information Science and Technology.* Seattle. WA. November 9-12.

Han, H., Jeong. W., & Wolfram, D. (2014). Log Analysis of Academic Digital Library: User Query Patterns. *Proceedings of the 2014 iConference. Berlin, Germany.*

Han, H., Joo, S, & Wolfram, D. (2013). Tales from transaction logs: User search session patterns in an image-based digital library. In K. Hodges, E. Meyers, & H. O'Brien (Eds.), Tales from the Edge: Narrative Voices in Information Research and Practice. Paper presented at The Canadian Association for Information Science, Victoria College, Victoria, 6-8 June. Victoria, BC.

Jeong, W., Kapusniak, R., & Han, H. (2013). The Usability Study on the Multicultural Children's Book Project of the National Library for Children and Young Adults (NLCY) in Korea. *Proceedings of the 2013 iConference.* Fort Worth, TX.

Jeong, W, & Han, H. (2013). Global Collaboration of SOIS (School of Information Studies, University of Wisconsin - Milwaukee). Workshop on Global Collaboration of Information Schools, *IFLA 2013 Satellite Meeting in Singapore*, August 15.

Han, H., & Jeong. W. (2012). Mobile Web interface of academic Libraries. *Proceedings of the American Society for Information Science and Technology*, 49(1), 1-4.

Jeong, W., & Han, H. (2011) Usability study on mobile web newspaper sites. *Proceedings of the American Society for Information Science and Technology.* New Orleans. LA. October 9-12.

**Presentation**

Han, H. (2017). Understanding Children's Help-Seeking Behaviors: Effects of Domain Knowledge. The ALISE Jean Tague-Sutcliffe Doctoral Student Poster Competition. 17-20, January, Atlanta, GA.

Kapusniak, R, Han, H, & Jeong, W. (2013). Digital Inclusion Survey City of Milwaukee 638 Interviews, Information Behaviors on the Move: Information Needs, Seeking, and Use in the Era of Mobile Technologies, ASIS&T SIG-USE Symposium, November 2, Montreal, Canada.

Jeong, W., & Han, H. (2013, August). Survey of Newbery Medal Awarded Books Translated in Chinese, Japanese and Korean. The **I**nternational **F**ederation of **L**ibrary **A**ssociations and Institutions (IFLA). Singapore.

Han, H., Joo, S, & Wolfram, D. (2013). Tales from transaction logs: User search session patterns in an image-based digital library. In K. Hodges, E. Meyers, & H. O'Brien (Eds.), Tales from the Edge: Narrative Voices in Information Research and Practice. Paper presented at The Canadian Association for Information Science, Victoria College, Victoria, 6-8 June. Victoria, BC.

## Project & Research Experiences

**University of Wisconsin-Milwaukee, School of Information Studies**

- Project of Universal Accessibility of Sighted and Blind Users in Digital Libraries
- Children's Book Translation Project
- Project of Digital Inclusion in City of Milwaukee

- Project of Investigating Users' Search Patterns in the University of Wisconsin-Milwaukee Libraries Digital Collections

## Teaching Experience

**Instructor,** School of Information Studies, University of Wisconsin-Milwaukee

**INFOST 682: Digital Libraries** (Fall 2015)

**Teaching Assistant,** School of Information Studies, University of Wisconsin-Milwaukee

**INFOST 571: Information Access & Retrieval** (Spring 2016)

**INFOST 682: Digital Libraries** (Spring 2016)

**INFOST 682: Digital Libraries** (Spring 2015)

**INFOST 682: Digital Libraries** (Fall 2014)

## Honors and Awards

- Distinguished Dissertation Fellowship (DDF) Award at UWM 2016-17
- Chancellor's Award 2012-2016
- iConference 2016 Doctoral Colloquium 2016
- SOIS Research Award 2013-14
- Graduate Student Travel Award 2011, 2014
- Hankuk University of Foreign Studies Scholarship 2001