NETWORKED GENERATION YOUTH'S INFORMATION SEEKING PROCESS: AN EXAMINATION OF COGNITIVE, AFFECTIVE, AND PHYSICAL INFORMATION SEEKING BEHAVIORS AND PROBLEM SOLVING TECHNIQUES

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This study investigated the information seeking process of the networked generation youth. Specifically, the researcher examined the cognitive, affective, and physical information seeking behaviors and problem solving techniques adolescent student users of the networked environment utilize to solve information needs.

Grounded in the theoretical context of the information seeking process in the networked environment, the research extended the user-centered approach to modeling the information seeking process of networked generation youth. A mixed model research design was used to address the research questions.

Phase 1 used an online questionnaire to solicit information from 125 students in Grades 7-12 regarding their understanding and use of networked environments, information seeking skills, and problem solving techniques. Phase 2 observed 12 students, two from each grade level, to gain an understanding into the information seeking process of networked generation youth. Participants completed information seeking scenarios of varying levels of complexity. As the participants completed the scenario, they engaged in talk-aloud verbal protocol to describe and explain their behaviors and techniques as they advanced through their information seeking process. Semi-structured interviews were conducted which provided an opportunity for the participants to clarify their information seeking experience.

A profile of students' networked environment knowledge and use in relationship to their information seeking process was created. Findings suggested that knowledge and experience influence networked generation youth's information seeking process in the networked environment. A subset of students were found to be experienced information seekers who applied various cognitive, affective, and physical information seeking behaviors and behavioral actions that guide them through their information seeking process. The study presented a preliminary model of the networked generation youth's information seeking process. The model provides a detailed map to networked generation youth's information seeking and problem solving.

The researcher brings to light experience users successful behaviors as well as areas where all students need assistance in understanding networked environments and their own information seeking. The study suggests ways in which educators can evaluate students and integrate the successful behaviors as well as assist students with the behaviors that hinder their process.

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DyKnow
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EBSCO Publishing
Ebscohost® Web-based bibliographic database service
Ipswich, MA
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ESPN Inc.
ESPN® Web-based sports information service
Briston, CT
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Expedia, Inc.
Expedia® Web-based travel services
Bellevue, WA
www.expedia.com

FreeWebs Corporation
Freewebs® Web hosting
Silver Spring MD
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GenevaLogic, Inc.
GenevaLogic® active learning environment
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GlobalSCAPE
CuteFTP® file transfer protocol software
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Google Inc.
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CHAPTER 1

INTRODUCTION

1.1 Statement of the Problem

In today's global information society students should develop information literacy skills that allow them to access, manage, integrate, evaluate, create, and communicate information at any point of need using a variety of technological formats. K-12 schools support information literacy skills development by designing information literacy programs to prepare students for information seeking in the digital age. Schools use the networked environment, an information environment resulting from the global Internet, web applications, and a range of networked information resources, to enhance information literacy skills development. Schools provide students with a plethora of networked information resources (e.g., online library catalogs, online database services, e-mail, informational Web pages, Web search tools, virtual learning environments, electronic information resources) to use not only on campus but also from home. Students use the networked environment not only for academic purpose but also for personal inquiry.

Many students have been using the networked environment since their primary grades or even before entering formal education. Networked generation youth are immersed in the environment. They know the environment by interacting with it (Turkle, 1995). These networked generation youth use the networked environment for communication, information gathering, commerce, and recreation and leisure activities. This environment is their first choice for use when locating information (Bilal, 2000, 2001, 2002; Fidel, et al., 1999; Hirsh, 1997, Large, Beheshti, Breuleux, and Renaud, 1994; Madden, Ford, Miller, and Levy, 2006; Shenton and Dixon, 2004; Vansickle, 2002). Educators have typically viewed students as novice information seekers in their ability to locate and disseminate information (Valenza, 2006); however, networked generation youth have a comfort and familiarity with the networked environment that cause them to bring about creative and evolving behaviors and problem solving techniques during information seeking not characteristic of previously studied school aged populations. Networked generation youth appear to possess individualistic mental models, experiences, abilities and preferences that they use to develop their own processes for defining tasks, controlling interactions with the networked environment, examining and extracting relevant information, assessing the progress, and determine when their information seeking process is complete.

This research examines how students address information needs while using the networked environment. The research looks at the types of behaviors and techniques exhibited and how the behaviors and techniques affect students' success in solving information needs. Specifically cognitive, physical, and affective behaviors and problem solving techniques are examined to determine how the behaviors and techniques affect the information seeking process of individuals who are consistently using the networked environment to solve information needs. The study of networked generation youth's information seeking behaviors and problem solving techniques utilized in the networked environment to address an information need provides educators with a holistic understanding to the information seeking process.

1.2 Background to the Research Problem

The focus of networked generation youth as information seekers is an important area of information science research as these youth have unique information needs and behaviors associated with their information seeking process. Interest in the information needs and seeking behaviors of young people using the networked environment has continued to increase among education, library, and information science research as young people connect to and utilize the networked environment at earlier ages. The body of literature available on children and adolescent information seeking has grown in the last 20 years. Initial studies examined children's and adolescent's search behaviors (e.g., search queries, keyboarding skills) using online catalogs, electronic encyclopedias, and the Web. These studies investigated searching methods children and adolescents use to find information and whether they possessed the abilities to search in the networked environment (see Borgman et al, 1995; Chen, 1993; Edyburn, 1988; Fidel et al., 1999; Hirsh, 1997; Kafia and Bates, 1997; Liebscher and Marchionini, 1988; Marchionini, 1989; Solomon, 1993). Studies of adolescents focused on their information seeking strategies rather than upon their information seeking process. Researchers studied the particular methods (e.g., search styles, moves made, assistance requested) used during the search for information. Researchers did not examine the overall process of how adolescents went about locating information including other behaviors (e.g., cognitive, affective, physical) and techniques employed during information seeking.

Large (2005) reported that a relatively active research agenda has been pursued, especially in the last few years, in relation to the information seeking behavior of youth

Internet users (specifically the Web). Researchers have examined individual differences in seeking behaviors (cognitive, physical, and affective behaviors), general knowledge, search knowledge, Internet preferences and perceptions, higher order thinking skills during use, decision making, and interface design for a targeted age group or gender (see Agosto, 2002, Bilal, 2000, 2001, 2002; Branch, 2001; Enochsson, 2005; Guinee, Eagleton, and Hall, 2003; Large & Besheshti, 2000; Large, Besheshti & Rahman, 2002; Lazonder, Biemans, & Woperies 2000; Madden, Ford, Miller, and Levy, 2006; Slone, 2003; Vansickle, 2000, 2002; Watson, 2001). These studies used qualitative and mixed method research design. Populations studied vary in age or grade level, number of participants, and in the tasks used. It is difficult to draw generalized conclusions from these studies. Researchers studied school-age youth from primary grades through senior high school levels with sample sizes ranging from four participants to multiple classes of students. Task initiation ranged from one fact-based task to an open-ended classroom research project.

Studies concentrating on information seeking behavior initially chose participants with novice information seeking skills. The students exhibited limited networked environment experience and underdeveloped Web searching skills (see Bilal, 2000, 2001, 2002; Large & Besheshti, 2000; Large, Besheshti & Rahman, 2002) Researchers typically limited participants to a particular search engine tool during the task initiation (Bilal, 2000, 2001, 2002; Large & Besheshti, 2000; Large, Besheshti & Rahman, 2002). The research that examined participants with varying levels of knowledge in electronic resources and Web usage limit their study to one grade or age level or the use of one type of electronic media (see Branch, 2001; Enochsson, 2005; Guinee, Eagleton, &

Hall, 2003; Slone, 2003; Vansickle, 2002). The results and discussions focused on searching strategies used and perceptions of Web use. Shenton and Dixon (2003a, 2003b, 2004) investigated young people’s use of multiple information resources but only explored generic information seeking patterns. Madden, Ford, Miller, and Levy (2006) examined multiple information resources used by children but they only looked at the way in which the secondary school children used and perceived the information resources. While the studies indicate similar patterns among youth in how they locate information based on their information seeking behaviors, researchers have not explored all the cognitive, physical or affective behaviors exhibited during the information seeking process nor how those behaviors relate to the user solving an information need in a networked environment.

When making conclusions on children and adolescent information seeking, researchers discussed the need to stimulate changes in the search systems’ interface design, reported on task initiations and relevancy of finding information, and proposed the creation of enhancement to instructional materials on information seeking skills for teaching students and educators. Researchers also emphasized the need for the development of a holistic model that incorporates the information seeking behaviors and information problem solving strategies of students for the understanding of the information seeking process of students using networked environments (Bilal 2002; Carey, 1998). The development of information seeking process models for students using the networked environment can enhance information literacy programs by informing educators on the steps students take to seek and solve an information need using the networked environment. Educators can incorporate that understanding into information literacy instructional development.

In summary, this brief look at the background to the problem illustrates that research on the information seeking process of adolescents is growing. Earlier researchers concentrated on “searching” skills and not other behaviors that may come into play during the seeking process. While current research discusses cognitive, physical, and affective behaviors, research has not examined the relationship between information seeking behaviors used and information problem solving techniques of youth utilizing a networked environment. There have only been allusions to the types of cognitive, physical, and affective behaviors and the problem solving approaches used during the information seeking process (see Bilal, 2000, 2001, 2002, 2005; Branch 2001, Shenton & Dixon, 2003b; Vansickle, 2000). Exploring cognitive, affective, and physical behaviors and problem solving techniques adolescents employ in the networked environment leads to a better understanding of the information seeking process used by adolescents as they solve information needs. This type of research adds to the body of literature on children’s and adolescents’ use of the networked resources including online catalogs, full-text databases, electronic encyclopedias, and Web-based resources by examining students’ searching skills, searching behaviors, search knowledge, and individual differences when locating information, all which informs the information seeking process.

1.3 Definitions

The following concepts and terms are used in this study, and the following provide definitions for these key concepts:

Information literacy is the ability to recognize when information is needed and to use information resources and technologies to locate, evaluate, interpret, and disseminate information effectively in every aspect of one's life throughout the person's lifetime (American Library Association, 1998). The American Library Association (2005, Information literacy defined, ¶ 1) states, "Information literacy forms the basis for lifelong learning. It is common to all disciplines, to all learning environments, and to all levels of education. It enables learners to master content and extend their investigations, become more self-directed, and assume greater control over their own learning."

Information literacy programs are developed to reflect the desired outcomes of preparing students to become effective information users. A program, established within the context of the mission of the institution, includes the creation of integrated curricular projects, lessons, or activities based on set standards that focus on teaching information literacy skills that enhance self-initiated learning and help develop students' higher order thinking, critical thinking, and problem solving skills. The developed information literacy skills result in a person being able to:

- Determine the extent of information needed
- Access the needed information effectively and efficiently
- Evaluate information and its sources critically
- Incorporate selected information into one's knowledge base
- Use information effectively to accomplish a specific purpose
- Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally. (American Library Association, 2005, Information literacy defined, ¶ 2).

Information needs are seen as "cognitive anomalies that require further information in order to be resolved" (Lueg, 2002, p. 8). In information seeking, a person looks to define their information need by understanding the types and amount of information needed based on previous knowledge and the information that can be acquired to gain further insight.

Information seeking is defined for this research as the process in which a person engages to search for, obtain, evaluate, and make use of information in order to solve an information need. It is an interactive process utilizing one's cognitive abilities, special knowledge and skills, and problem solving techniques. Information seeking is influenced by one's information use environment, one's attitudes and preferences, and the problems a person encounters.

Networked environment is "heterogeneous in that it hosts many different technologies, various data formats, multiple applications, and other networked life forms" (Moen, 2001, p. 87). In the context of information resources Bertot (2004) defines the networked environment as "the myriad of public, private, organizational, and other networks, systems, and applications used to provide users with access to electronic services and resources" (p. 11). The networked environment is a rapidly changing environment adaptive toward the needs of an organization or a user. Tobais (1998) describes the networked environment as "electronic information sources interconnected through the Internet" (p. 209). In this study, the networked environment includes the global Internet, Web applications, networked computer applications, and a range of networked information resources (e.g., online library catalog, online database services, e-mail, informational Web pages, Web search tools, and electronic information resources) typically available in a school's networked environment.

Networked generation is people who have grown up actively taking part in utilizing the networked environment from an early age. Using the term networked generation allows the group to include all peoples of varying generationally defined groups (i.e. generation X, Y, etc.) that are habitual users of the networked environment. Tapscott (1998) used the term networked generation to describe the generation of children that have grown up surrounded by networked technologies. He concludes that this generation learns, plays, and works differently from baby boomers. The members of this generation are confident users of digital tools, unfazed by change and innovation, are tolerant citizens of a global community, and equally comfortable working autonomously or in teams.

Problem solving techniques are the systematic procedures a person uses within their problem solving process. Stages used in the problem solving process include identifying the problem, gathering information, defining the problem, generating solution, selecting a solution, and evaluating solution. Within these stages, a person uses steps to work through the problem. For example, a person may use a brainstorming technique to think of ideas to generate a solution to a problem.

1.4 Purpose of the Study and Methodological Approach

The purpose of this research was to explore the information seeking process of networked generation youth to arrive at an understanding of how junior and senior high school adolescents access, acquire, interpret, and disseminate information using the networked environment. Grounded in the theoretical context of the information seeking process in the networked environment, the research extended the user-centered approach to modeling the information seeking patterns of networked generation youth. The objectives of the research were to:

a) Document how networked generation youth utilize the networked environment to solve an information need through their information seeking process,

b) Identify, describe, and categorize information seeking behaviors and problem solving techniques of adolescents as they use a networked environment,

c) Develop models that represent and describe the networked generation youth's information seeking process in a networked environment, and

d) Investigate how the study's results can assist in the development of appropriate information literacy programs.

This research contributed to an understanding of the information seeking process of networked generation youth with the goal of inspiring change in how educators incorporate networked resources in the educational process for information literacy development.

This study employed qualitative and quantitative approaches to examine, identify, and categorize the cognitive, affective, and physical information seeking behaviors and problem solving techniques networked generation youth use during the solving of an information need while utilizing the networked environment. Specifically this study:

a) Identified cognitive, affective, and physical information seeking behaviors networked generation youth exhibit during the solving of an information need in a networked environment,

b) Compared by grade level cognitive, affective, and physical information seeking behaviors networked generation youth exhibit during the solving of an information need in a networked environment.

c) Examined the ways networked generation youth's information seeking behaviors assist or deter their use in situations of information need,

d) Evaluated how networked generation youth construct their strategies for information problem solving in the network environment, and

e) Discovered the relationships among networked generation youth's problem solving techniques and the cognitive and affective behaviors exhibited in their information seeking process that play a role in how they complete an information need.

The research examined the networked generation youth from different grade levels to gain an understanding of variances in the information seeking process of groups of individuals who are drawn to use the networked environment for solving their information needs. The first phase of the study used a questionnaire to solicit information from junior and senior high school students on their knowledge and use of networked environments at school and home. The questionnaire contained open and closed ended questions. The student's knowledge and use of networked environments was scored and participant selection for the second phase of the study was determined based on the students overall score and responses given to the open-ended questions. Data were gathered on student's searching interests on the Internet that aided in the creation of scenarios used in the observation stage of the study.

The second phase of the study used observation and interview techniques to gain an understanding into the information seeking process of a sample of networked generation youth. The methods chosen generated rich, descriptive data about networked generation youth's information seeking process using the networked environment. The information seeking behaviors and problem solving techniques were drawn out by developing scenarios set up within an information need that contain tasks of varying complexity (Walker & Moen, 2001). The study examined information seeking behaviors by having each participant engage with four of Taylor's (1991) information needs to learn more about the patterns of the information seeking process these networked generation youth reveal and investigated whether they remain consistent or change across multiple information needs. The tasks were set up based on the type of information needed by the user to solve their need. These tasks include locating facts, confirming data, finding out how to perform a duty, and seeking information for personal accomplishment. While students completed the scenarios, talk-aloud verbal protocols captured their thoughts, feelings and actions. An exit interview took place upon the completion of the scenarios that provided an opportunity to clarify the students seeking experience.

Using data analysis techniques, behaviors were categorized into various strategies, tactics and moves. Patterns of cognitive, physical and affective behaviors and problem solving techniques were noted. Through categorizing the information behaviors and problem solving techniques, descriptions of the various seeking processes participants used to obtain the answer to their information need were made. How categorized behaviors can be used in learning about the information seeking process was also formulated.

1.5 Research Questions

Adolescent students gravitate toward the networked environment for finding information and develop skills from their experience in that environment. By examining networked generation youth's information seeking process, this research addressed the problem of whether the cognitive, affective, and physical information seeking behaviors and problem solving techniques adolescents use in the networked environment affects the solving of an information need. The objectives set for the research provided an opportunity to address networked generation youth’s information seeking process through a systematic, empirical process of inquiry. The objectives were carried out by addressing the following research questions:

RQ1 What cognitive, affective, and physical information seeking behaviors do networked generation youth exhibit during solving information needs in a networked environment?

RQ2 How do the cognitive, affective, and physical information seeking behaviors exhibited by networked generation youth for solving information needs in a networked environment differ among grade levels?

RQ3 In what ways do networked generation youth’s information seeking behaviors assist or deter solving information needs?

RQ4 How do networked generation youth construct strategies for information problem solving in the network environment?

RQ5 How do networked generation youth’s problem solving techniques relate to the cognitive and affective behaviors exhibited in their information seeking.

The research questions guided the selection of the methodological approaches that best addressed the research problem and accomplished the research objectives. Answering the research questions provided an understanding of networked generation youth’s information seeking process in the networked environment.

1.6 Significance of the Study

The goal of information literacy programs in K-12 education is to provide students with the abilities to use information resources and technologies to locate, interpret, and disseminate information in every aspect of their lives throughout their lifetime (American Library Association, 1998). This study explored how the cognitive, affective, and physical behaviors exhibited and problem solving techniques used in the information seeking process of the networked generation youth affected their solving of an information need. The findings can assist educators in the development of information literacy programs that teach information skills required for lifelong learning. This research identified and categorized the information seeking behaviors of the networked generation youth and how they approached an information need to determine what information seeking processes were used by a group of individuals that are habitual users of the networked environment. Educators can incorporate what networked generation youth know about and what problems they face using networked environments into the curriculum that teaches information seeking skills and problem solving techniques. The research also contributes to an individual's development of self-awareness for their information seeking process; how the behaviors and techniques they utilize affect the solving of an information need.

Understanding adolescent students' use of their information seeking process to complete a task and networked generation youth's ability to retrieve information in a networked environment assists educators in the development of curriculum needed to strengthen information literacy programs being developed specifically with the use of networked environment. This research examined adolescent students' specific seeking knowledge, perceptions, and interests in using networked environments. Findings from this research provide library media and technology specialists with topics for producing creative ways to develop networked environment research activities that will help students improve their information literacy skills. The research also informs those who work with adolescent students in schools and public libraries, as well as those who work with other groups (young children, adults, elderly) that are utilizing networked environments to locate information.

This study outlined a preliminary model of the networked generation youth's information seeking process in a networked environment. The model was built based on previously developed information seeking process models and on the student's perceptions of their own developed information seeking process used while interacting in the networked environment. The preliminary networked generation youth's information seeking process model may assist educators of information literacy programs in their awareness of how this population accesses, acquires, interprets, and disseminates information from their desired information environment. It provides a map to understand what types of information seeking behaviors and problem solving techniques students who are frequent users of the network environment use to solve an information need, which can help inform how educators teach and develop programs for information literacy.

1.7 Summary

Chapter 1 introduced networked generation youth's information seeking process as an area for study. Specifically, this research examined the cognitive, affective, and physical information seeking behaviors and problem solving techniques adolescent student users of the networked environment utilize to solve information needs. Networked generation youth demonstrated behaviors and techniques they use to solve an information need in the networked environment that as habitual users were different from other groups of children and adolescents previously studied.

This research on networked generation youth's information seeking process makes a significant contribution to the field of information science and information literacy education. The research also assists adolescents in their own understanding of the process they use to solve information needs. Grounded in the theoretical context of the information seeking process in the networked environment the research used a mixed model approach to complete the research objectives and answer the research questions. The next chapter presents a review of the literature relating to information seeking, children's and adolescents' information seeking in networked environments, factors that influence children and adolescents' information seeking, information seeking process, and information seeking process models, as well as the theoretical lens that guided the framework for the research methodology.

CHAPTER 2

LITERATURE REVIEW AND THEORETICAL LENS

This research was an information seeking study. The study examined the information seeking behaviors and problem solving techniques networked generation youth utilize in the networked environment, for the behaviors and techniques form the information seeking process affecting the outcome of an information need. Because networked generation adolescents have more experience and knowledge with using networked environments than other adolescents who have not been exposed to using networked environments at home or school, their information seeking process may reveal patterns that if adopted by others, could lead to a greater success for them as well. Watson (2001, limitations to the study, ¶ 1) stated that studying adolescents who are experienced networked environment users “can offer insights to those who care to motivate and extend students' learning.” This research builds on previous studies on children and adolescents’ information seeking by examining the factors that influence children and adolescents’ information seeking. The literature review also explores the information seeking process and the models developed within the user centered perspective. Finally, the chapter discusses information seeking in context, the theoretical lens that guides the research design.

2.1 Literature Review

The literature review provides a discussion of related literature that helped direct the development of the research questions. A definition of information seeking is presented based on summarized theories of information seeking. Secondly, previous studies on children and adolescent information seeking are discussed. The review of previous research focuses on the factors that influence student information seeking including experience, task, and behaviors. The study of children's information seeking process is discussed as well as implications from previous studies made by the researchers. Finally, this section examines numerous information seeking process models that have been developed within methodological frameworks that orient to a user-centered perspective to information seeking.

2.1.1 Information Seeking

Information seeking has been described as a process of searching, obtaining, and using information for a purpose when a person does not have sufficient prior knowledge (Vakkari, 1999). According to Brown (1991), information seeking is a goal-driven activity in which needs are satisfied through problem solving. Marchionini (1995) stated, "humans purposefully engage in information seeking in order to change their state of knowledge" (p. 5). He related information seeking to learning and problem solving since information seeking is often part of learning or problem solving but is also distinct. Information seeking is a special case of problem solving. It includes recognizing and interpreting the information problem, establishing a plan of action, conducting a search, evaluating the results, and if necessary, repeating the process (Marchionini, 1989). Information seeking, like learning, is a fundamental and high-level cognitive process. The difference between learning and information seeking is in the degree of retention desired. Learning demands retention while information seeking may be used to complete a temporary task. In both learning and information seeking the goal is to change knowledge. Marchionini theorized that information seeking is a goal-directed, interactive process guided by the strategies developed to complete the process. He explained that information seeking is dependent on the seeker, the problem, the search system, the domain, the setting, and the outcomes.

Kuhlthau (1993) also observed a relationship between information seeking and learning. She emphasized that information seeking entails holistic learning, which encompasses three realms of experience: cognitive (thoughts), physical (actions), and affective (feelings). She looked to understand information seeking from the user's perspective, stating that the individual's process of using information is an integral aspect that cannot be overlooked. Many of the researchers studying children and adolescent information seeking have used Kuhlthua's perspective as a framework for their studies on information seeking (e.g., see Bilal, 2000, 2001, 2002; Branch 2001; Latrobe & Havener, 1997; McNally, 2005; Vansickle, 2002).

Taylor (1991) defined the concept of the information seeking process through the recognition of problems and the processes of seeking resolution to these problems. He placed information seeking in the context of what he calls the *information use environment* or IUEs. Taylor (1991) described IUEs as "the set of those elements that (a) affect the flow and use of information messages into, within, and out of any definable entity; and (b) determine the criteria by which the value of information messages will be judged" (p. 218). He explained that the IUEs are the conditions within which users make choices about what information is useful to them at particular times. The choices are based not only on subject matter, but also on other elements of the situation within which a user lives and works. An IUE consist of sets of people, the structure of the typical problems of those sets of people, settings in which the typical problems are experienced, and the way in which problems are resolved.

For this study, information seeking was defined as the process in which a person engages to search for, obtain, evaluate, and make use of information in order to solve an information need. It is an interactive process utilizing one's cognitive abilities, special knowledge and skills, and problem solving techniques. Information seeking is influenced by one's information use environment, one's attitudes and preferences, and the problems a person encounters.

2.1.2 Children's and Adolescents' Information Seeking

Information seeking has generated extensive literature over the years. In contrast, research on children's and adolescent's information seeking in networked environments has become a focus of study as schools brought in new networked information technologies as tools for learning. Children and adolescents have been studied as a special category of information seekers because they approach an information system differently from adults and their demands upon that system can be rather different (Bilal, 2000, Large, Beheshti, & Breuleux, 1998; Walter, 1994). Researchers have explored the information seeking behaviors of various age groups using networked information technologies to complete a variety of tasks. Studies typically took place in a school environment and examined students' interaction with electronic multimedia resources, online public access catalogs (OPAC), and more recently in the past several years, the Web.

Many researchers have taken a system-oriented approach to studying children and adolescents' information seeking in networked environments. A system-oriented approach places the focus of study on information seeking from the system's perspective rather than paying attention to the users' way of conceptualizing seeking activities (Vakkari, 1999). System-oriented studies attempt to "systematically evaluate the ability of young users to effectively retrieve information from electronic information resources" (Cool, 2004, p. 17). Other researchers have used a user-centered approach to study information seeking in networked environments. This type of research looks at children and adolescent from a user's perspective, examining the behaviors that influence information seeking. As Watson (1998) states, "Our continued understanding of students' cognitive and affective development may offer a beginning framework for learning how to introduce, how to pace, and how to measure students' capabilities with using the technologies" (p. 1035). Emphasis on how the user interacts with a system is important in helping design better systems or developing instruction to teach the user how to best use the system. However, an emphasis on the user's process of inquiry provides a more complete understanding of information seeking. Findings from both types of studies provided a basis for the research on information seeking process in the networked environment by examining the factors that influence students' information seeking.

2.1.3 Children and Adolescents as Participants

Information seeking research involving children and adolescents has included participants as young as Grade 1 and as old as Grade 12. Researchers have grouped participants as elementary, middle or junior high, or high school students. Studies classified elementary children as students in Grades 1-6, although sixth grade students are also depicted as middle school students depending on the school environment.

Therefore, researchers may consider middle school students as those in sixth, seventh, or eight grades. Junior high school students are classified as adolescents in seventh and eighth grades, and occasionally include ninth grade students. High school students are typically adolescents enrolled in Grades 9-12. Researchers have studied the groups separately because their cognitive levels, developmental levels, and information needs vary (Walter, 1994).

Junior and senior high students are considered to be in what Piaget coined the formal operational stage (Woolfolk, 2001, Thomas, 2004). In the formal operational stage students have acquired the abilities to solve abstract problems in logical fashion. They have developed their hypothetico-deductive reasoning abilities, meaning students can consider a hypothetical situation and reason deductively. The student can generate different possibilities for a given situation, then deduce, and systematically evaluate specific solutions. Thomas (2004) wrote that children in this stage "are able to consider their own lives from different perspectives and to think about and evaluate their own thinking" (p. 69). As *formal thinkers*, these students may use various information behaviors and problem solving techniques in their information seeking process to solve an information need.

2.1.4 Factors Influencing Student Information Seeking

Many factors influence information seeking. The review of the literature focused on the experience students bring to the system, the task, and the behaviors exhibited during their search process.

2.1.4.1 Experience

Researchers classified students by their experience with system use and as information seekers, labeling participants as novice users for their lack of experience with a particular system or as naïve searchers for their inadequate information seeking skills. Early studies that explored novices' capabilities in using networked technologies found that students could successfully use electronic encyclopedias, databases, online catalogs, and the Web for information retrieval. Marchionini (1989) explored the information seeking strategies of novices using a full-text electronic encyclopedia. He studied third, fourth, and sixth grade students as they conducted two assigned searches and found that students of this age could use this technology with minimal training. The older students were more successful and took less time in completing the tasks than younger students. Students showed they were capable of utilizing many of the system features including the use of Boolean logic. Liebscher and Marchionini (1988) found that high school students could also be successful in using full-text encyclopedia databases with minimal training. Conversely, Edyburn (1988) and Large, Beheshti, Brueleux, and Renaud (1994) observed that while students are capable of conducting database searches, students need assistance with understanding how to enhance their searching skills.

Students in Chen's (1993) study were able to use an online catalog successfully to locate information despite their academic abilities. Although participants experienced difficulties with the system, Chen observed that the students performed with interest and persistence. Kafia and Bates (1997) reported in their study of elementary students' use of the Internet, all children were able to use Web sites and could learn to scroll through a site and use hypertext links to other sites. As with Marchionini's studies, the researchers found that older children possessed more sophisticated search techniques for finding resources. In general, the researchers concluded that the students' interest in Internet activities was high.

Not all researchers found this ease of use with novice student users interacting with the networked environment. Fidel et al. (1999) reported that while the high school students they studied enjoyed searching on the Web, they often had difficulty choosing search terms, using search engines, and evaluating resources. Large and Beheshti (2000) examined sixth grade elementary school students' behaviors in finding information for a class project on the Web. The study findings revealed that these novice users were inefficient in using the Web and possessed inadequate knowledge of navigating Web space. Students had trouble selecting suitable search terms and did not keep track of the search process. Bilal (2000, 2001, 2002) found that children encountered similar obstacles to those uncovered by researchers of OPAC and other electronic resources. Spelling, typographic errors, and choosing search terms were difficult for the children. Bilal reported that seventh grade students are motivated to use the Web, but lack the navigational skills to use it effectively and efficiently. Children also lacked skills in gathering information. Despite the lack of skills and problems encountered with using networked technologies, students showed a desire and preference to utilize the networked environment (Bilal, 2000; Fidel et al., 1999; Large, Beheshti, Breuleux, & Renaud, 1994). Students trusted multimedia information more than print information, viewing information delivered through video and sound as more credible than when delivered in print (Small & Ferreira, 1994).

As students became more familiar with the networked environment and began to utilize it in their own way, researchers examined the more experienced users to find out how these students utilize systems to address an information need. Solomon (1993) found that students became more proficient in using an OPAC as they gained experience in maneuvering effectively within the online environment. Watson (1998) interviewed nine students with over four years of computer experience to gather information about their own perceptions in using technology, specifically the Web as a tool and resource for school and leisure. The overall outlook of these students was one of openness, confidence, and ease in speaking about technology. Students felt comfortable in using electronic sources for both schoolwork and recreation. The researcher found that these eighth grade students exhibited a level of confidence when they spoke about their use of the Web. Students showed self-confidence and expressed authority with their understanding and use of technology because they had been using technology for numerous years in school. Access to computers and the Internet at school, home, or the public library allowed students to stay current with technology. Many of the students learned to use the Web on their own, searching by "trial and error". Feeling that everyone experiences similar expertise and frustration with computer use, they did not fear asking questions on how to use the Web and looked for peer support. Hirsh (1999) also found confident, experienced users of the networked resources as she studied fifth grade students enrolled in a school with a highly sophisticated technology program. Students were highly motivated to find information for their assigned research project, exhibiting a range of searching and navigating behaviors while using online catalogs, electronic encyclopedias, electronic databases, and the Web. Desang (1999) noted that the environment for youth has changed dramatically in the digital age. She called for a new paradigm for studying information seeking of youth that studies the tactics of already engaged and experienced youth in information seeking situations to predict successful information gathering practices for all information seekers.

Studies have explored the differences between novice and more experienced users of the networked environment. Kafia and Bates (1997) noted a disparity between elementary students who had prior experience with the Internet and those who did not. The students with prior experience were more knowledgeable about the features and tended to dominate the interaction with the computer when working with students who had little computer experience. They often controlled the search. Male students appeared to have more experience using the Internet than female students. Large, Beheshti, and Raman (2002) found that sixth grade boys were more active on the Web than sixth grade girls were when completing a school research project. Search techniques also varied by gender. Their analysis of search sessions reported that boys formulated queries comprising fewer keywords, spent less time on individual pages, clicked more hypertext links per minute, and gathered and saved information more often than the girls.

Lazonder, Biermans, and Woperies (2000) examined the differences between novice and experienced users in searching on the Web. Observing 25 students from two Dutch high schools while they performed three search tasks, researchers found that the data supported their hypothesis that experts would score higher than novice users on all performance measures that relate to locating Web sites. Experienced users were faster, produced a greater number of correct responses to the tasks, and needed fewer actions and less time to find relevant Web sites. Experts searched rather than browsed the Web and appeared to be more proficient in using search engines than novice users. However, the data supported the second hypothesis that Web experience would not affect performance on the task to locate information on a Web site. The researchers said that finding information on a Web site generally implies browsing, and research has shown little or no difference between novice and expert browsers. The researchers called for future studies on the qualitative differences in searching on the Web.

Watson (2001) revisited several participants from her 1998 study of eighth grade students' regarding their experience with technology to see if their perceptions still reflected confidence and competence. She asked students, now entering their penultimate year of high school, about the personal and school use of networked environment resources. Once again, she found that these particular students were regular users who felt comfortable and knowledgeable in their use of networked information environment resources for personal use. The students spoke about their use of the Internet for social communication activities (e-mail, instant messenger, chat, and Web television) and personal inquiry (hobbies, colleges, sports). Watson observed that since the previous study, the students had become more selective with and critical of the information they chose to encounter on the Internet. She stated, “One can see that these users become more expert because of their regular access and assessment of sites in which they are knowledgeable. The students display a level of critical thinking in their comments about use. Their decisions to accept or reject sites and to know why they do so show they have an understanding of how the web works” (Personal Use, ¶

1). However, while these students were provided with classroom computers since fifth grade, they expressed greater self-confidence and expertise in using the networked environment for their personal use than for their school use. The students felt they had not acquired adequate knowledge in how to use the local and distributed networked licensed (online magazines and document archives) resource databases available for school research. They were still learning to use their networked information environment by trial and error.

Vansickle (2002) examined tenth grade students' general and search knowledge in using the Web. Students in three different academic tracks of language arts completed a sixty-question survey that assessed their basic knowledge of the Web. The findings report that students are similar in terms of search knowledge (using URLs, basic keyword searches and phrases, Boolean logic, and search engines), but general knowledge (sending and receiving e-mail, downloading images and files, and setting bookmarks) of the Internet varied significantly among students in college preparatory and honors versus students in the technical track. The researcher attributed this to lack of computer and Internet access available to the technical track students at home. Students rated themselves as intermediate searchers, those who can complete a task on their own but usually get help from others. Students indicated that they have taught themselves how to use the Web or learned from friends. Vansickle stated that through self-teaching the students have developed their own style for searching the Web, but she questioned students' accuracy in understanding how to use the system and efficiency in system use.

Madden, Ford, Miller, and Levy (2006) studied 15 students aged 11 to 16 and found that the older students carried out more sophisticated searches than their younger counterparts. The researchers attributed this finding to the likelihood that the older students' cognitive abilities, vocabularies, and problem solving skills were more developed and that the older students would have had more training in the skills needed to use the internet as an information resource. The researchers noted that experience was not related to age alone as the younger students have had more opportunities in learning information technology skills than the older students had at the same age.

A limitation with conducting research with novice users is that as beginning users they come into the environment with inadequate skills and techniques and therefore are expected to have problems with information seeking. Experienced users possess a comfort and familiarity toward the networked environment. As self-taught individuals, they exhibit behaviors and utilize techniques that may influence their information seeking process. Researchers have not examined how students apply techniques taught to them in school or their own skills they have developed by learning through *trial and error*.

2.1.4.2 Tasks

Information seeking is driven by an information need. Marchionini (1995) defines task as "the manifestation of an information seeker's problem and is what drives information seeking actions" (p. 36) Task can vary by type (open-ended vs. closed), nature (complex vs. simple), and the way they are administered (i.e., fully assigned, semi-assigned, fully self-generated). Studies on children and adolescent's information seeking tasks given to participants include simple fact-based tasks, assigned research projects, and fully self-generated tasks. Research has shown that the type of task a user is given influences the user's information seeking, information use, and success (Bilal 2000, 2001, 2002; Bilal and Bachir, 2007; Borgman et al., 1995; Edyburn, 1988; Hirsh, 1997; Madden, Ford, Miller, and Levy, 2006; Marchionini 1989, 1995; Schacter, Chung, and Dorr, 1998; Solomon, 1993; Vansickle, 2002).

Edyburn's (1988) participants completed four information retrieval tasks, based on two assigned and two student-generated questions. The tasks required factual information and ranged from simple to complex. He found that task played a significant predictor in students' success. Students were more successful when retrieving specific factual information in response to simple tasks and more successful completing the assigned rather than self-generated task. Schacter, Chung, and Dorr (1998) examined the effects of task structure on fifth and sixth grade students seeking information on the Internet. Tasks included well-defined and ill-defined searching task elements. The former can be solved by the application of logical process and tend to require factual data (i.e., closed tasks). Ill-defined searching tasks have variables that are not well understood and required more probabilistic information on how to proceed rather than factual data (i.e., open-ended tasks). The elementary students searched for information that was relevant for solving real world problems on crime in California. Schacter, Chung, and Dorr found that students were "reactive" information seekers, preferring browsing rather than employing systematic analytic-based keyword searching strategies. The students had difficulty finding relevant information. Unlike Edyburn (1988), Schacter, Chung, and Dorr concluded that students searched more effectively on the ill-defined searching task than on the well-defined finding task. The researchers attribute this phenomenon to the Internet's information infrastructure which holds more potential answers for ill-defined searching tasks and that the answers could be found by browsing which students are better at performing than analytic-based searching strategies required to complete the well-defined finding tasks. Bilal's (2000, 2001, 2002, 2005) examination of seventh grade children's cognitive, physical, and affective behaviors on fact-based, research, and fully self-generated tasks found that students preferred the fully self-generated task to the research and fact-based task. The students preferred the fully self-generated task for three reasons: satisfaction with search results, ability to choose the topics and modify them during searching, and challenge in finding information about a topic of interest. Students' search formulations, moves made within the system, feelings toward the assignment, and success varied by task. The researcher concluded that children are more motivated, challenged, and engaged in completing a task when they select topics that interest them.

Information seeking tasks can also vary by the level of complexity (i.e., how hard it is to find information on the topic). Large, Beheshti, Breuleux, and Renaud's (1994) elementary students completed four tasks of different complexity after a short training session. Complexity was defined by the number of search terms the task contained. The authors found that task complexity affected retrieval time. Hirsh (1997) also found considerable variation in elementary school children's success rates on assigned search tasks due to the complexity of the tasks. Fifth grade students performed eight search tasks that varied in terms of science and technology topics and complexity levels. Hirsh found that students were most successful in finding materials on the simple tasks than the complex tasks.

Task affects student information seeking; however, researchers noted that task can also be influenced. Researchers found that students' motivation, system knowledge and navigational skills, domain knowledge, experimental conditions, system design, and overall structure of using a hypermedia system affected student performance in completion of the task (Bilal 2002; Bilal & Bachir, 2007; Borgman et. al, 1995; Hirsh, 1997; Liebscher & Marchionini, 1988; Madden, Ford, Miller, & Levy, 2006). In the second phase of Vansickle's (2001) study, two students from each academic track completed four hierarchically ordered search tasks. In examining the search session, the researcher noted that not all students have developed a sense of problem solving. Students lacked abilities in identifying faulty search logic and appropriate revision strategies and showed limited decision-making skills during task completion. Hirsh (1999) advised that for future studies, "the search tasks assigned to students for class projects or experiments need to take into account student's knowledge of the topic area, probable student interest in the topics, and complexity and ambiguity of the topic" (p. 1278).

2.1.4.3 Information Seeking Behaviors

When examining students' information seeking behaviors researchers often looked at the strategies participants apply in an information environment and the problems encountered when applying such strategies. Researchers have classified strategies as the methods used to find information. Marchionini (1995) separated strategies into two types, *gross strategies* and *search strategies* (p.7). Gross strategies in information seeking include consulting one's long-term memory; asking friends, colleagues, or experts; consulting personal collections of books, periodicals, and files, conducting empirical investigations; and applying formal systems (e.g., libraries, research firms, government agencies, electronic networks). Search strategies are defined by how a person expresses information needs to an information retrieval system (Bilal, 2000, 2001). Strategies used in information seeking include analytical strategy and browse strategy. Analytical strategies (also called keyword searching) depend on planning, selecting specific terminology, applying keyword terms that represent the concept related to the problem, and using Boolean operators to formulate precise queries (Marchionini, 1995). Analytical strategies can be simple (use of one keyword term) or complex (combining multiple keyword terms). Browsing is a process of scanning information and selecting choices. Browsing includes scanning, observing, navigating and monitoring information. Browsing relies on recognition knowledge and requires less well-defined search objectives than analytical searching (Borgman et al, 1995). Researchers stated that children and adolescent's strategies are heuristic in that they are highly reactive rather than planned when approaching a problem while searching in the networked environment (Fidel et al., 1999; Marchionini, 1989, Shenton & Dixon, 2003a; Valenza, 2006). Students preferred browsing to the more complex analytical strategy approach (Bilal, 2000, 2001, 2002; Bilal & Bachir, 2007; Large & Beheshti, 2000; Marchionini, 1989; Small & Ferreira, 1994) and applied skimming and scanning techniques to analyze information (Agosto, 2002; Fidel et al., 1999; Hirsh, 1999; Marchionini, 1989; Liebscher & Marchionini, 1988; Watson, 1998).

Liebscher and Marchionini (1988) stated that both analytical and browsing strategies proved effective for finding relevant information by high school students searching electronic encyclopedias, yet each strategy demonstrated distinct advantages and disadvantages. The analytical strategy required less time and fewer queries. However, students experienced difficulties in learning and applying the strategy, and therefore, the demand of higher cognitive understanding was greater. The browsing strategy was easily applied and led students to a significant amount of data. However, the amount of data retrieved can lead to user fatigue if the user attempts to scan and skim all the data. Adolescents using the Web felt that browsing and skimming allow them to investigate ideas (Watson, 1998).

Hirsh (1997) compared fifth grade children's use of browsing and keyword search strategies on an advanced version of the Science Library Catalog (SLC) as they performed eight search tasks. The advanced version of the system combined the hierarchical browsing features of earlier versions of SLC with keyword capabilities that did not require correct spelling, searching alphabetical lists, or using Boolean logic. Children's success on this system varied by the strategies they used and the tasks to be completed. Children most frequently used a single strategy, browse only, or keyword search only to look for a topic. The most common use of multiple strategies was to perform a browse-keyword search. Children used browsing strategies to begin information seeking and keyword search strategies to end information seeking. The researcher found a significant relationship between strategy and general success. Children used mixed methods in which they switched back and forth between strategies when they had trouble finding the topic in the system. Children who performed keyword only or browse-keyword search were more likely to have successful results than children who performed searches using browsing only or a mixed search strategy. Children abandoned close to 40% of all search sessions when they used a mixed search strategy that started with browsing, switched to keyword searching, and returned to browsing. Hirsh concluded that fifth grade children were able to use browsing and keyword search strategies successfully, relying on browsing to familiarize themselves with the system then graduating to keyword methods after they are comfortable with the system. Children's search behavior suggests that many used the keyword search strategies as a backup strategy when they reached an impasse with browsing. Browsing may be easier for children who have less computer experience. Bilal and Bachir (2007) found that children used browsing to locate material the first time they used the International Children's Digital Library to find books.

Fidel et al. (1999) noted patterns in students searching strategies as they sought information on the Web for a homework assignment. Sessions began with keyword searching or entering an address in the URL bar. Patterns included students scanning sites quickly, skimming results, and use of landmarks. A landmark was defined as a "comfort zone" or home base Web site students returned to when they got lost in their search. Students used the Back command to activate their landmark. Students often repeated past experiences when beginning a search or followed the suggestion of peers, teachers, and librarians. In Bilal's (2000, 2001, 2002) studies students using a Web search engine began search strategy formulation with an initial keyword search using multiple concepts while subsequent searches used concrete terms or concepts. Students also used single concepts and natural language searching. Students shifted between browsing and keyword searches, typically preferring browsing. Shenton and Dixon (2003a, 2004) reported that "habitual patterns" developed among CD-ROM and Internet users during resource selection. Most of the students had favorite CD-ROM encyclopedias or Internet search engines that they used during an information search session.

Guinee, Eagleton, and Hall (2003) found that many students' initial strategy when researching on the Internet is to start with what they know. Students in their study repeated use of using familiar Web sites, locating Web sites using the "dot-com formula", and using one or two search terms to describe the research topic. Madden, Ford, Miller and Levy (2006) reported similar finding while examining students' strategies as students used the Internet for information seeking. Students initially began their searches by using familiar URLs or trying to locate URLs that sounded appropriate by inventing URLs. Students used the refining search techniques whereby they entered a term, scanned the results, and then modified their search. Students also relied on supplementary tools (search tool's auto-generated spell checkers) and Boolean operators. Enochsson (2005) identified six different skills students perceived as fundamental when seeking information on the Web. These included knowledge of language, knowledge of technology, knowledge of how to formulate search strategies, how search engines work, setting goals (e.g., knowing what to look for), and being critical of information found.

Solomon (1993) stated that cognitive abilities and developmental levels influenced the search moves children make. He found that children were more successful when they used simple concrete terms rather than abstract concepts when searching on an OPAC system. The researcher noted that breakdowns occur in participants' search skills (formulating search strategies and revising search queries) and system use skills (terminology used did not match system's controlled vocabulary) which affect student information seeking. Breakdowns are considered failures in information retrieval.

Chen (1993) found breakdowns in students' search behavior while investigating high school students using an online catalog. The study's most extensive analysis focused on the types of errors students made. The researcher considered two types of errors: *impact errors*, which were errors in the final answers on the search problem sheets; and *potential errors*, which were errors students made during the search process that they detected and corrected before recording their final answers. The results indicated that students made five types of errors: typographical and spelling errors, errors in using the system, errors in generating search terms, errors in using information, and errors in recording the results. The researcher noted patterns that emerged from students' repeated attempts to improve their search results. These patterns included two techniques, switching search types and rephrasing search terms. When students rephrased search terms they changed terms from the specific to general, used similar or synonymous terms after initial searches failed, and adopted different concepts or terms to continue a search. Chen (1993) concluded that the nature and types of errors students made suggest that some of their difficulties stemmed from their lack of general information seeking and language skills. Students' conceptual and mechanical problems with the online catalog affected their ability to complete their information query correctly. Spelling, typing, usage, reading ability and vocabulary also created breakdown in using the system. Children's typing, spelling, vocabulary, and Boolean logic skills also had potential to limit students' abilities to find appropriate resources in Kafia and Bates' (1997), Bilal's (2000, 2001, 2002), and Madden, Ford, Miller, and Levy (2006) studies of Web use. Edyburn (1988) reported that students' keyboard and reference skills also play a significant predictor in their retrieval success.

Hirsh (1999) found that although students were frequent users of the Web and electronic resources, they lacked a clear understanding of the more advanced search and navigational features available. Students did not keep track of their search strategies or sites visited and would typically begin a subsequent search session by typing in new search query, which often led to unsuccessful results. Large and Beheshti (2000) also concluded that students had trouble selecting suitable search terms and did not keep track of the search process when completing a research assignment on the Web. They would often start a search over by repeating the same strategy. Students used browsing methods more than keyword search strategies to locate the desired information. In completing the tasks, they used faulty search logic and inappropriate revisions strategies.

Bilal (2000, 2001, 2002) observed the cognitive and physical behaviors that influence students' information seeking. The researcher noted that these behaviors varied by success level. Successful students made fewer and more relevant keyword searches, while unsuccessful students browsed, looped (repeated searches), and backtracked more while completing a task. Their processes varied with searching, looping, backtracking, scrolling, navigation, target location and duration, and exploratory moves. At times, the students' process was chaotic which often caused them to encounter task switching, frequent looping, frequent backtracking, and deviation from task searching.

Shenton (2007) examined generic patterns of children's information seeking as opposed to the highly specialized breakdowns presented by previously discussed research. Based on data from collected from 12 focus groups and 112 individual interviews of children in primary through high school levels during the year 2000, the researcher found the factors associated with information seeking failure to be actions in need/source mismatch, knowledge deficiency, skills shortcomings, psychological barriers, and social unease and inhibitions. Students experienced failures when selecting sources that were inappropriate to the nature of the topic on which information was sought, the source's information was not as specialized as desired, the source's information was unsuitable in its perspective to the problem, the source's information was of an unsatisfactory level, the source's information was intrinsically flawed, or the source's information was unavailable to the user when needed. Failures in information seeking also occurred due to deficiencies in students' knowledge of the topic, alternative courses of information seeking actions, strategies for using sources, and bibliographic conventions and aids. Inefficient skills with sources used also impeded information seeking. On a social level, Shenton found that students' lack of trust in others as serving as information sources prevented comprehensive information seeking actions. In addition, on a psychological level Shenton concluded that students experienced failure because they were not sure that the desired information existed and ended a search early or felt overwhelmed by the demands of the information seeking process.

Students feel frustrated when breakdowns occur in their information seeking. This frustration may inhibit task completion. Frustration occurs when students experience equipment failures, search failures, a slow loading time on the network, or cannot find the answer to their query (Bilal, 2000, 2001, 2002, 2005; Fidel et al., 1999; Hirsh, 1999; Large & Behshti, 2000, Shenton & Dixon, 2003a). Researchers have examined the affective behaviors that students experience during information seeking. Bilal (2000, 2001, 2002, 2005) studied the affective behaviors of seventh grade students as they used a Web search engine to complete multiple search tasks. She reports that children enjoy using the Web for its ease of use over other types of resources. The use of the Web is a motivating factor for students, providing positive affective responses such as self-confidence, persistence, patience, enjoyment, comfort, and challenge. However, the Web can lead to frustration and confusion for students, especially when the system is slow, fails to produce results, or children experience difficulty in finding answers. Researchers found students exhibit negative feelings of confusion, frustration, uncertainty, and doubt in their information seeking (Agosto, 2002, Bilal 2000, 2001, 2002, 2005; Enochsson, 2005; Branch 2001; Shenton & Dixon, 2003a; Watson, 1998).

Large and Behshti (2000) found that students were overwhelmed by the amount of information on the Web and they were not satisfied that the information found was the best information available to complete their task. Shenton and Dixon (2003a, 2004) also found this to be true with the students they surveyed. McNally (2005) stated that students hold conflicting and complementary ideas about the Internet’s usefulness. Students tolerated perceived inadequacies but did not see those shortcomings as a problem. Watson (1998) found experienced Web users showed frustration when they could not locate information, but they expressed an understanding that the Web can be overwhelming. Students valued the availability of current and specific information on the

Web, but understood the time and patience it takes to locate information that would be useful to them. Students understood the need to focus on a question when searching for information, but they found shaping the question to be a challenge. Students exhibited a level of confidence with using the Internet as a tool, but they lacked a clear understanding of how to use it as an information resource. When locating specific information on the Web, students did not discuss the accuracy and adequacy of the information they found when talking about their search process with the researcher.

Shenton and Dixon (2003a, 2004) also noted a concern with the fact that students pay “little attention” to the accuracy of the information retrieved from a selected resource especially considering the questionable authority of the information found on the Internet. The researchers concluded from the students interviewed that young people engage in simplistic searches and are generally intent on finding sufficient information to meet their need while expending as little effort as possible. Madden, Ford, Miller, and Levy (2006) expressed concern with students technical knowledge in Internet searching and lack of discrimination in the selection of Web sites. They concluded that student need to be made more aware of the structure of the Web and how much can be learned from an informed reading of a URL.

Watson (1998) observed that while students’ positive attitudes and self-confidence provided a dimension of youthful users, it might not indicate success in their information seeking overall. Her study further noted the importance of understanding student information behaviors for enhancing information literacy instruction. Valenza (2006) reconfirmed Watson’s observations, finding through research and experience, that students despite their feelings of self-efficacy, do not have the sophisticated skills or understandings needed to navigate complex information environments and to evaluate the information that they find. Students have limited understanding of the way information is organized, the way results are returned, and differences in search interfaces. She called for educators to find scalable strategies to ensure that students become competent information seekers and users. Educators need to work to remove intellectual, physical, and affective barriers and build on students' existing knowledge.

2.1.5 Information Seeking Process

Designing studies to examine information seeking behaviors is important so researchers can learn the unique ways students approach the networked environment to meet their information needs. Research indicated that children's search experience online is multidimensional, engaging them in cognitive, behavioral, and affective activities (Thomas, 2004). While studies have examined students' cognitive, physical, and affective behaviors exhibited in their information seeking process, the focus has primarily been placed on the "searching" behaviors and problems that occur from student's use of such behaviors. The studies have not investigated the overall process students use in their information seeking and at what point their behaviors and problem solving techniques utilized within the networked environment affect the solving of an information need. An exception to this is Branch's (2001) examination of information seeking processes that junior high students employed using CD-ROM encyclopedias. Similar to previous studies discussed above, Branch found the factors that influenced the information seeking process include search strategy selection, skimming and scanning skills, computer experience, reading ability, seeking assistance, patience, persistence, and system knowledge. The researcher also observed students using a variety of techniques to complete 12 different search tasks. Students in the study tended to use the same strategies during searching. Users of simple searches applied that technique on all of the tasks. Branch found that students developed a pattern completing the tasks that included the students entering a search term, reviewing results lists, skimming the list for a relevant topic, reviewing selected article by skimming or reading, and finding answers within the chosen article. At times students' search process was interrupted when no results happened after entering a search term. This caused frustration or confusion for the students leading them to seek assistance with search term selection. The researcher noted that affective states of uncertainty, doubt, clarity, relief, and satisfaction, also influenced students' seeking process; however, she did not explore in detail at which point or to what degree these states influenced the process.

Shenton and Dixon (2003a, 2003b, 2004) also looked at patterns in information seeking but took a general approach to examining information seeking process in their investigations of English children in primary through high school levels. Shenton and Dixon (2003b) created a model based on general patterns of information seeking. The model posits that during information seeking children begin by describing the initiation of an information need. Children then identify an overall direction, identify a source, locate a source, and access information. The process concludes with making decisions with regard to the completion of a search, which included outcomes and future action, required. The researchers created smaller models to describe the process based on sources used (books, CD-ROM, Internet, or other people) during the information seeking process. None of the models explored in detail the cognitive, affective, or physical behaviors the children encounter during information seeking.

2.1.6 Implications from Research

Each of the above studies adds to the knowledge of how children's and adolescents' information seeking behaviors and problem solving techniques affect information seeking. Proposals for systems development or instructional design to enhance user services have been made by researchers in relationship to the information seeking behaviors exhibited from the users examined in the studies of children and adolescents. Researchers continually call for an emphasis on training in the use of a system, instruction that develops students' information seeking skills, or enhancement in information literacy instruction focusing on developing students' information searching techniques. Branch (2002) suggested junior high students need more information literacy instruction with their searching techniques and need to be taught how to deal with their affective behaviors during searching. Bilal (2002) asked information professionals to develop formal Web training programs that incorporate use of models of the information seeking process. She concluded that the affective aspect of information seeking should be incorporated into teaching information literacy skills. Bilal (2002, 2005) called for a new model of information seeking that integrates a user's feelings, thoughts, and actions with problem solving, to derive a holistic model on which to build effective information literacy skills programs for children.

Many authors have presented instructional models for user education that incorporate aspects of the information seeking process (see Eisenberg and Berkowitz, 1990; Kuhlthau, 1993; Stripling, 1995) Some of these models take a teaching perspective, describing the various components of information seeking to be taught as consecutive steps. Others describe various skills for students to learn, or objectives for students to reach through such instruction. These information seeking instructional models have been used to identifying the “right” skills and knowledge that people ought to possess, as well as the “right” steps that people ought to go through to seek and use information effectively. While these models and many others have formed an important framework for the design of information literacy programs for students, gaps exist between what programs teach and what students know from their own developed information seeking skills and behaviors in learning to use the networked environment through trial and error. This research attempted to explore the gap by examining the information seeking process of the networked generation youth and developing a holistic model of the information seeking process that includes the information seeking behaviors and problem solving techniques students employ in the networked environment.

2.1.7 Information Seeking Process Models

Researchers create models to describe and explain circumstances that predict actions by individuals to find information of some kind (Case, 2002). Models are often defined in relation to theories. A large portion of current theory and research in information seeking is within the behavioral tradition. The behavioral approach in information seeking identifies “what users do when”. In other words, it looks to understand a person’s choices, feelings, comprehensions, and actions during information seeking. Many models of information seeking exist, but this section focuses on information seeking process models that have been developed within methodological frameworks that orient to a user-centered perspective to information seeking including models created by Ellis (1989), Ellis, Cox and Hall (1993), and Ellis and Haugan (1997), Kuhlthau (1993), Marchionini (1995), Nahl (1997), and Wilson (1999).

2.1.7.1 Ellis' Behavioral Model

Ellis (1989), Ellis, Cox and Hall (1993),and Ellis and Haugan (1997) used the Glaser and Strauss 'grounded theory approach' to propose a behavioral model that describes the information seeking patterns of social scientists, physical scientists, and engineers. Originally, the model was intended to help design information retrieval systems; however, the model was later extended to study different types of professionals' information seeking behaviors. The model described a set of common information seeking activities that were broken down into basic behavioral characteristics from the patterns of an individuals' information seeking. Ellis, Cox and Hall (1993) named and defined these activities as:

> Starting: activities characteristic of the initial information seeking;
>
> Chaining: following footnotes and citations in known materials;
>
> Browsing: scanning information in an area of potential interest;
>
> Differentiating: using differences between sources as filters on the nature and quality of the material examined;
>
> Monitoring: maintaining awareness of developments in a field through the monitoring of particular sources;
>
> Extracting: systematically working through a particular source to locate material of interest;
>
> Verifying: activities associated with checking the accuracy of information;
>
> Ending: completing information seeking through a final search. (p. 359).

The activities do not occur in the order presented in the model. Ellis (1993) noted that, "the model does not attempt to define the interaction and interrelationships between the categories or the order which they are carried out. The nature of the relationship between the features of the models can only be described in relation to specific information seeking patterns” (p. 359). The actual order in which a person seeks information depends on the unique circumstances of the information activities of the person concerned at a particular point in time. The strength of Ellis’ behavioral model is its focus on individual human behavior on the information seeking process. Wolcott (1998) adapted Ellis’ behavioral model as a method to examine seventh grade students’ information seeking process while searching the Web for a classroom and library research project. He found that each student developed unique strategic patterns, yet all also used repeated patterns of behavior. Wolcott confirmed Ellis's classification of activities as a starting point in the development of understanding children's information seeking on the Web. He stated that information seeking appears to be highly dependent on the interplay between the specific problem and individual characteristics and knowledge of the seeker. Choo, Detlor, and Turnbull (2000) applied the model to the Web defining the activities in relationship to Web searching. Meho and Tibbo (2003) revised Ellis’s information behavior model to confirm and update activities based on current changes in information technology. While confirming Ellis’ activities, Meho and Tibbo added additional features including “accessing, networking, and information managing” (p. 570). Accessing deals with the ability to obtain the materials or resources that are identified and located through starting, chaining, browsing, monitoring, extracting, and networking. Networking was characterized by activities associated with communicating and maintaining online relationships to assist in gathering information. Information management deals with organizing the information collected.

2.1.7.2 Kuhlthau's Information Search Process (ISP) Model

Kuhlthau's (1993) adopted a phenomenological approach to understanding information seeking, describing the information search process as experienced in six stages of thoughts, feelings, and actions. She maintained that information seeking is a complex learning process that occurs in a series of phases or sequential stages. Each stage represents the task considered most appropriate to moving the process to the subsequent stage. Kuhlthau identified six stages of information seeking as initiation, selection, exploration, formulation, collection, and presentation. Kuhlthau derived her six-stage model from the common patterns, which emerged within the context of the constructivist theory of learning based on the "uncertainty principle". The constructivist theory of learning supposes that "we construct our own unique personal worlds, and that construction involves the total person incorporating thinking, feeling, and acting in a dynamic process of learning" (Kuhlthau, 1993, p. 14). Kuhlthau suggested that a person moves from the initial state of information need to the goal state of resolution by a series of choices made through a complex interplay within the three realms of cognitive (thoughts), physical (actions) and affective (feelings) behaviors.

Information seeking behaviors can be influenced by experience, knowledge, interest, information available, the problem and time allotted for resolution. Primary to the behaviors is a sense of uncertainty. Kuhlthau (1993) defined uncertainty as "a cognitive state that commonly causes affective symptoms of anxiety and lack of confidence" (p. 111). She revealed that uncertainty and anxiety can be expected in the early stages of information seeking. Uncertainty initiates the process of information seeking due to a lack of understanding to a problem. The affective symptoms of uncertainty, confusion, and frustration are associated with vague, unclear thoughts about a topic or question. However, as a person's thoughts become more clearly focused their feelings of confidence increases. Kuhlthau completed studies of information seeking within the traditional library environment as an approach to library and information services. The ISP model was developed as a research process for assisting students in their writing process. She has related her model to the networked environment in the context of digital libraries (see Kuhtlhau, 1997).

2.1.7.3 Nahl's Affective, Cognitive, and Sensorimotor (ACS) Model

Nahl (1997) also follows the behavioral tradition in social and information sciences adopting a taxonomic approach to examine information seeking. The taxonomic approach provides a methodology that allows objective measurement procedures for identifying and cataloging the levels and subcomponents of information behaviors in the affective (feelings), cognitive (thoughts), and sensorimotor (actions) domains. Nahl defined affective behavior as "behavioral acts that relate to feelings, interests, values, motivation, purposes and goals; cognitive behavior as "behavioral acts that relate to cognition, knowledge comprehension, problem solving, critical interpretation; and sensorimotor behavior as "behavioral acts that are externally observable, visual perception, speaking, navigating" (p.13-14). She stated that the three behavioral domains are involved in every human act. In developing the ACS model, Nahl followed the assumption that affective variables always accompany cognitive and motor behavior and provide a filter for making cognitive decisions. She explained that low confidence and low motivation negatively affect cognitive decisions directly in searching. In this approach, everything that a searcher can feel or choose (A), think or infer (C), and overtly see or do (S), is termed "information behavior," as long as the focus is the information environment and how it dynamically influences searchers (Nahl, 1997, p. 14). The order of the ACS domains indicates that to begin with, there are intentions or information needs (A), which lead to thoughts about solutions (C), which finally leads to some related overt action (S). The three levels of information behaviors are described as orientation, interaction, and internalization. The levels are both sequential and continuous, and the individuals operate at all three levels in any information situation.

Nahl's concentration has been on the importance of user's affective behaviors. She stated, "Viable information environments designed for every person must provide for the fact that cognitive skills cannot develop without the simultaneous development of affective skills" (Nahl, 2001, ¶ 1). The ACS model is intended to be exhaustive and applicable to any user environment. Her focus with this model has been instruction of novice users for electronic and Internet resources. Nahl maintained that by understanding the complex interactions and behaviors users exhibit during information seeking helps them understand their information skills. Her model has provided a way for library instruction to concentrate on the user during information seeking and provides researchers with methods to categorize cognitive, affective, and physical (sensorimotor) information behaviors.

2.1.7.4 Marchionini's Information Process Model

Marchionini (1995) employed a problem solving approach to understanding information seeking process in the electronic environment. He perceives information seeking as a purposeful activity driven by an information problem (e.g., a task). The information problem may be simple or complex but must initiate a conscious activity to move toward a goal. While the problem initiates conscious activity to move toward a goal, the solution may or may not be found. Information seeking begins with recognition and acceptance of the problem and continues until the problem is resolved or abandoned. Marchionini identified eight processes of information seeking: recognizing and accepting a problem exists, defining the problem, selecting the resource(s) for search, articulating the problem in terms of search strategy, executing a search, examining the results of this articulated problem, extracting the desired information in useful forms, and reflecting on the problem and stopping the process of inquiry. The information seeking process is both systematic and opportunistic. The degree to which search is executed depends on the strategic decisions that the information seeker makes and how the information seeking factors (the seeker, the problem, the search system, the domain, the setting, and the outcomes) interact as the search progresses. Marchionini's model emphasizes a nonlinear, evolving, iterative, and opportunistic nature of the information seeking process.

2.1.7.5 Wilson's Problem Solving Model

Wilson (1999) linked models from information searching and seeking to posit a model based on the goal directed behavior of problem solving. Wilson considered information seeking as a problem-solving process driven by the need to reducing uncertainty. He related the cause of uncertainty to a problem. The problem is defined as an individual faced with a “problematic situation”. Wilson stated that the solution of the problem, the resolution of the discrepancy, and the advance from uncertainty to certainty then becomes goal directed behavior of the person. On the way to the goal, the individual moves from uncertainty to increasing certainty though the stages of the problem-resolution process. The stages in the problem-resolution process are identifiable and recognizable to the individual. The stages are: problem identification (where the person is asking the question, ‘what kind of problem do I have?’), problem definition (‘Exactly what is the nature of my problem?’), problem resolution (‘How do I find the answer to my problem’) and potentially, solution statement (‘This is the answer to the problem’, or, if a pragmatic, rather than theoretically-based resolution has been formed, ‘This is how we are going to deal with the problem’) (p. 266). Wilson hypothesized that each stage sees the successive resolution of more uncertainty, and where uncertainty fails to be resolved at any one stage, it may result in a feedback loop to the previous stage for further resolution. To resolve the uncertainty that takes place within the problem-solving process, Wilson brought in Kuhlthau’s stages in the ISP model (initiation, selection, exploration, formulation, collection, and presentation) to describe how a person might move from uncertainty to certainty. He also included Ellis’ behavioral model as the basis for an “in-depth analysis of the reiterated search activities that may take place at each stage of the problem-solving process” (Wilson, 1999, p. 267). However, Wilson’s model does not integrate cognitive, affective, and physical behaviors into the process, which are important in obtaining a holistic view of the information seeking process (Bilal, 2002).

Each of the models presented provides a description of the steps of and actions involved in information seeking. The models support the notion that users exhibit common characteristics of information behaviors at different stages of the information seeking process. Kuhlthau and Nahl showed that the cognitive, affective and physical states are a driving force in any information seeking process. Marchionini and Wilson conveyed the need to understand information seeking from a problem-solving perspective. Although a number of scholars have understood information seeking to include elements of problem solving, there has been little effort made to investigate the relationship between problem solving techniques and information seeking behaviors in information science literature (Kim & Allen, 2002). This study examined, identified, and categorized cognitive, physical and affective behaviors and problem solving techniques of the networked generation youth as they make use of the networked environment to solve information needs. An integrated model, described in chapter 5, was developed that illustrates the networked generation youth information seeking process in the networked environment.

2.2 Theoretical Lens

The following sections establish a theoretical lens that guided the research. The research was guided through information seeking in context. Information seeking in context employs a user-centered perspective to understand the networked generation youth information use environment. This theoretical lens shaped what was looked at and the questions asked regarding networked generation youth's information seeking process in the networked environment.

2.2.1 Research in Context

Researchers apply many different theoretical approaches to define and measure the information seeking process. This research was guided by the concept of information seeking in context. Case (2002) described context as “a person’s situation, background, and environment that partly determines one’s perceptions during information seeking. Context will affect the choice of sources that are attended to and meanings that are derived” (p. 108). Context is an important concept for information seeking research because it places an emphasis on studying the encountering and seeking of information and the interpretation of meaning from that information (Case, 2002). Taylor (1991) examined information seeking in context through the information use environment: the people, their problems, the problem setting, and how they resolve the problem. Research into context highlights a user-centered perspective to the study of the information seeking process that emphasizes real users with information needs prompted by situations arising in daily living. The user-centered perspective of information seeking takes root in the work of scholars from communication, computer science, education, information science, and psychology.

According to Marchionini (1995), “the framework for information seeking is human centered in that the information seeker defines the task, controls the interaction with the search system, examines and extracts relevant information, assess the progress, and determines when the information seeking process is complete” (p. 33). This user-centered perspective places the information seeker at the center of the information seeking process, focusing on how the seeker controls the process of information seeking. Marchionini (1995) viewed information seeking process as a human centered problem solving activity. The information seeking process is driven by people's need for information so they can interact with the environment. His user-centered perspective emerges from three beliefs about human existence: life is active, analog, and accumulative. Life is active means a person lives and learns by their environmental experiences. Life as an analog process means that it is continuous and periodic. The environment is continually influencing the flow of information and it is up to the individual to receive reactively or proactively that information. How a person interacts with the information depends on their prior experiences in the environment and their abilities to seek, accept, and process the information over time. Marchionini's (1995) experiential understanding of life originates from the philosophies and learning theory of John Dewey and psychological views of Jean Piaget.

By turning the attention to the user's perspective of information seeking, Kuhlthau (1993) suggested "we become aware of an active personal process" (p. 4). Kuhlthau takes a constructivist view of information seeking which offers insight into what the user experiences. The process of construction within the information seeking involves fitting information in with what one already knows and extending this knowledge to create new perspectives (Kulhthau, 1993). Kulhthau, Marchionini, and other researchers of information seeking derive their understanding of information seeking from Brenda Dervin's sense-making theory. Sense-making emphasizes communication and the needs, characteristics, and actions of information seekers (Dervin & Nilan, 1986).

Dervin's communication theory, called sense-making, has been influential in focusing attention toward a user-centered perspective of the information seeking process. Dervin (1999) states that sense-making "starts with the fundamental assumption of the philosophical approach of phenomenology – that the actor is inherently involved in her observations, which must be understood by her perspectives and horizons" (p. 44). The sense-making theory is grounded in the constructivist learning theories of John Dewey, George Kelly, and Jerome Bruner by incorporating their notions of life as an encounter with problems and discontinuities in knowledge, and the view that information is something created through interactions with the obstacles in the progress through life (Dervin, 1999). Sense-making focuses on how individuals use the observations of others as well as their own to construct their pictures of reality and use these pictures to provide insight into their continuing human dilemma. Dervin (1999) believes that "information is a tool designed by human beings to make sense of a reality assumed to be both chaotic and orderly" (p. 39). The individual makes sense from their own realities looking for meaning, rather than the right answer, and views information as a way of learning and finding meaning or as a process of construction (Dervin, 1983).

Sense-making is implemented within the sense-making triangle, which encapsulates the sense-making metaphor in a picture of the human (individually or collectively) moving from a situation (time-space) across a gap by making a bridge, and then moving onto the other side of the bridge (Dervin, 1983). The three points of this triangle, therefore, are situation, gap/bridge, and outcome. In the context information seeking process, this model posits that users go through three phases in making sense of the world by facing and solving information problems (Marchionini, 1995; Wilson, 1999). A person exists within the context of an information problem, called the situation. The person finds a gap between what they understand and what they need to know in order to make sense of their current situation. These gaps are then manifested by questions. The answers or hypothesis for these gaps, outcomes, are then used to move to the next situation. The sense-making model produces detailed knowledge of the strategies by which individuals cope with problematic situations. The application of the sense-making model places a high value on the insights gained by the persons under study, as they reconstruct their solutions to past problems (Case, 2002).

Sense-making allows the individual to construct and design movements through time and space, bridging gaps, and moving on. Sense-making conceptualizes the individual as centered and de-centered; ordered and chaotic; cognitive, physical, spiritual, and emotional; and potentially differing in all these dimensions across time and across space (Dervin, 1999). As individuals move across time-space, both rigidities and flexibilities are possible. Dervin (1999) calls for a focus on predicting the patterns of flexibilities in the information seeking process, not on predicting patterns in rigidities that have been predominant in the information theories. This research applies the understanding of the sense-making theory to the context of the networked generation youth through examining this group from a user-centered perspective by identifying and categorizing networked generation youth's cognitive, affective and physical behaviors and problem solving techniques used in their information seeking process.

2.2.2 Context: Networked Generation Youth and the Networked Environment

This research focused on a holistic perspective to study information seeking process in the context of networked generation youth and their utilization of the networked environment to solve an information need. Taylor posits that by using a specific group, one can examine the commonalties of how that group resolves information needs through their information seeking process. This is completed within

Taylor's (1991) information use environment (IUE). Taylor (1991) explored three IUEs (engineers, legislators, practicing physicians) to illustrate different kinds of information needs and users, varying types of problems, and significant differences between what each regarded as information and accepts as problem resolution.

Case (2002) explained that "information needs do not arise in a vacuum, but rather owe their existence to some history, purpose, and influence. The seeker exists in an environment that partially determines, constrains, and supports the types of needs and inquiries that arise. The seeker also has his or her own memories, predispositions, and motivations—an internal environment of influence" (p. 226). Taylor (1991) compiled eight classes of information use generated by the needs perceived by groups of users in particular situations. The classes of information use include:

> Enlightenment: The desire for context information or ideas in order to make sense of a situation.
>
> Problem understanding: The need for better comprehension of particular problems.
>
> Instrumental: The need to find out what to do and/or how to do something.
>
> Factual: The need for and consequent provision of precise data.
>
> Confirmational: The need to verify a piece of information.
>
> Projective: The need to be future oriented, concerned with estimates and probabilities.
>
> Motivational: The need to find additional information based on personal involvement with a task.
>
> Personal or political: The desire to control relationships, status, reputation, personal fulfillment. (p. 230).

The classes are of varying levels and generate different ways a given set of users view problems and what they anticipate as resolution. For example, the networked generation youth act in a particular way toward an information need that is reflective in their information behavior. The perceptions and anticipations to the problems are a “built-in but unconscious means of controlling the amount of information used” (Taylor, 1991, p. 229). Problems created within different classes of information use pose different requirements on the type of information perceived as necessary, and for this reason different uses to which information is put in the process of resolution (Taylor, 1991). As stated in chapter 1, networked generation youth appear to possess unique mental models, experiences, abilities and preferences that they use to develop their own processes for defining tasks, controlling interaction with the networked environment, examining and extracting relevant information, assessing the progress, and determining when the information seeking process is complete. For this research, studying adolescent students provided an opportunity to investigate information seeking processes from a set of users in the networked generation IUE where utilizing networked environments is inherent for locating information to resolve an information need.

2.2.3 Networked Generation Youth’s Networked Information Environment

Networked generation youth, some of whom have been online for over a decade, are among the networked information environment’s first natives (Plotnikoff, 2003). Their networked information environment includes access to a multitude of resources including locally available resources (e.g., the local library catalogs, locally licensed databases/CD-ROM products), distributed resources (e.g., national or state supported databases, other libraries' catalogs), and Internet resources such as Web search engines, Web directories, Web pages, and communication tools (e.g., e-mail, chat rooms, instant messenger, Web television, and message boards) from high speed connections at school, home, and on the road. A “net savvy” group, these adolescents use the networked information environment as a means for leisure activities, social activity, and information gathering. Networked generation youth’s networked information environment is an integral part in their information seeking.

The networked generation continues to become more sophisticated in use of networked environments. A 2005 PEW/Internet study reports that 87% of American youth aged 12 to 17 use the Internet, which is a 24% increase since their 2000 study (see Lenhart, Madden, & Hitlin, 2005). The researchers found that the scope of teens’ online lives have broadened in use for communication, gaming, commerce, and information gathering. Silicon Valley, considered the “computer innovator” capital of the world, presents a glimpse into their networked generation youth’s networked information environment. A survey of more than 800 Silicon Valley children ages 10 to 17, conducted by the Mercury News in partnership with the Kaiser Family Foundation, finds that the networked environment is “a powerful and often ubiquitous presence in school, at home and in the social lives of almost all” (Plotnikoff, 2003, ¶ 3). The survey (see San Jose Mercury News/Kaiser Family Foundation, 2003) paints a multifaceted picture of a generation growing up in a digital culture. Silicon Valley networked generation youth use networked information resources to play games, download music, shop, locate information on movies, music, careers, colleges, and health issues, talk with friends and relatives, create personal Web pages, and complete homework. They consider the

Internet as the most important resource for schoolwork often completing assignments using the school's networked information resources in the library, computer labs and from home.

Silicon Valley's networked generation youth write computer programs, create digital files, presentations, movies, and music, assemble computer networks, help fix or set up computers, and teach others how to use networked information resources. The Internet's communication tools are one of networked generation youth's main forms of social interaction. Many teenagers are wired for communications at all times. They may have access to high-speed Internet connections at home and school, and carry laptops, personal digital assistants, handheld devices that connect to the Internet, cell phones, or pagers. Communicating with others is an important aspect for these teenagers. They have created their own online social network. Outside of direct contact, they rely on chat, instant messaging, or e-mail as the primary way to keep in touch with friends, relatives, and strangers. Teenagers spend several hours of their day communicating with others by instant messaging or entering chat rooms and message boards. These networked generation youth understand the importance of learning to use the networked environment in their early years because they feel it will be an important part of their future and an integral building block for their career plans.

Networked generation youth look to networked information environments as tool for information seeking, the Internet is used an extension of their personality, to show their friends who they are, what they care about, and to build connections with other like-minded people (Goodman, 2007). Goodman, when examining teen's online behaviors, stated that networked generation youth look for networked services that offer levels of interactivity, multimedia, and communication. Networked generation youth have experience using social networks sites, video sharing sites, instant messaging sites, videoconferencing sites, and blogging. Geck (2006) reported that networked generation youth have been exposed to many high-tech influences, and today's high-speed digital devices enable them to always be connected to the Internet, their friends, and others. She stated that this connectivity permits teens to communicate and collaborate in real-time regardless of physical location; to access a wealth of diverse information, including vast digital collections; and to author or contribute content instantaneously to Web sites and Weblogs. Geck concluded that because these young people know no other reality than their Internet-based world, they are likely to have heightened technical expectations, attitudes, and beliefs.

The profiles presented above represent many of today's networked generation youth around the country. This research, although conducted in 2004 prior to the proliferation of social networking services, provided an opportunity to gather information about these individuals to create ways of furthering the relationship between user and the networked environment by examining networked generation youth information seeking process.

2.3 Summary

Graue and Walsh (1998) stated the importance of studying children in context arguing that,

> Children's contexts have changed dramatically in recent years as social, cultural, and economic factors have modified the resources and tools in their lives. Children cannot possible remain untouched by their contexts. Just as their contexts are shaped by their presence, children and their contexts mutually constitute each other. There is need for studies that locate children's experience

> in a specific culture and historical contexts. This approach provides a locally grounded perspective on the experiences of particular individuals that can be linked to other descriptions. This is then linked theoretically and a good grasp of the theories used to frame inquiry. (p. 7-8).

As the networked environment was integrated into schools, students were asked to use it for their schoolwork. Young people are growing up with the networked environment, experiencing the network environment expansion and utilizing the network not just for schoolwork but also for their own personal curiosities. The networked information environment is part of their culture, shaping how they locate and use information. This research studied adolescents in the context of the networked environment, examining this networked generation's information seeking process.

The literature review discussed researchers' investigations of young people's interactions with information systems available through the networked environment as those systems were integrated into schools. Researchers examined students' experience levels and information seeking behaviors exhibited while using particular networked information resources (e.g., online public access catalog, electronic databases, Internet Web resources) to complete an information need. This research examined youth who possess the qualities of experienced users of the networked environment, for these users may employ behaviors and techniques habitual to their selected information seeking environment. This investigation provided insight into how a specific group of people makes use of the networked environment to resolve an information need. The activities, experiences, and behaviors of networked generation youth found in this study were compared to previous research on children and adolescents' information seeking.

Researchers listed the activities students performed and discussed the behaviors students revealed during task completion. They also explored how the task (problem) affected information seeking. Research has shown that the type of task a user is given influences the user's information seeking, information use, and success. Young people are more motivated, challenged, and engaged in completing a task when they select topics that interest them. Scenarios developed for this study include tasks of varying levels of complexity based on students' personal interests to engage the student's information seeking process. Scenario use provided a method to elicit the behaviors and techniques networked generation youth use in completing an information problem in the networked environment. This research examined the information seeking behaviors and problem-solving techniques to appreciate the full range of student's information seeking process in both academic and personal context with the aim of furthering our understanding of the user and helping educators develop programs to enhance learning.

Several information seeking process models were presented in the literature review. All models were developed in the context of the user, but use different perspectives to describe information seeking. Table 1 shows the context in which the authors placed their model and the perspective they follow. Each model describes the information process, but the researchers concentrate on different aspects that influence information seeking.

Table 1

Information Seeking Process Models

Model	Context	Perspective
Ellis' behavioral model	Professional users	Activities in information seeking
Kuhlthau's information search process (ISP) model	User doing research in library	Uncertainty, Cognitive, affective, and physical behaviors
Nahl's affective, cognitive and sensorimotor (ACS) model	Novice user doing research using Internet in library	Cognitive, affective, and sensorimotor (physical) behaviors
Marchionini's information process model	User in electronic environment	Problem solving
Wilson's problem solving model	Professional users	Problem solving integrated with uncertainty and activities

While Ellis' Model provides a list of activities a user may follow in information seeking, Kuhlthau points out the uncertainty the user faces in information seeking. Nahl and Kuhlthau examine the importance of exploring information seeking from the cognitive, affective and physical behaviors users experience during information seeking which will help educators and user understand the process used to locate information in a library setting. Marchionini places a problem solving perspective into the information seeking process emphasizing that the problem initiates the process in the electronic environment. Wilson also takes this problem solving perspective and integrates the activities and uncertainty involved in information seeking. These perspectives were used as starting points in developing a preliminary model of the networked generation youth's information seeking process in the networked environment (presented in chapter 5). This preliminary model adheres to the concept that during information seeking the user is faced with a need, and while resolving that need the user follows activities, experiences uncertainty, and exhibits behaviors that affect the information seeking process. The problem solving techniques and information seeking behaviors employed to resolve the need are dependent on the complexity of the need.

Chapter 3 describes the general research approach, the research design, and the data collection and analysis strategies that were used in this research to investigate networked generation youth's information seeking process in the networked environment.

CHAPTER 3

RESEARCH APPROACH AND DESIGN

This research studied the information seeking process of networked generation youth. Using descriptive and exploratory research approaches, the research described networked generation youth's information seeking process in the networked environment and explored how networked generation youth utilized the networked environment for personal and academic inquiry. The study employed a mixed model research design to identify, describe, and categorize the cognitive, affective, and physical behaviors and problem solving techniques networked generation youth utilize in the networked environment that characterize their information seeking process. The research used a questionnaire, observations, and interviews to investigate networked generation youth information seeking process. The objectives of the study were to:

a) Document how networked generation youth utilize the networked environment to solve an information need through their information seeking process,

b) Identify, describe, and categorize information seeking behaviors and problem solving techniques of adolescents as they use a networked environment,

c) Develop models that represent and describe the networked generation youth's information seeking process in a networked environment, and

d) Investigate how the study's results can assist in the development of appropriate information literacy programs.

This research is a pragmatic investigation of networked generation youth's information seeking behaviors and problem solving techniques. In pragmatic research, the researcher places the problem as the center of the investigation and uses multiple approaches to understand the problem. Through the application of multiple methods in the research design, the results of this study meet the objectives of the research and contribute to an understanding of networked generation youth's information seeking process in the networked environment. The following sections describe the mixed model research approach, the research design, the data collection techniques, and data analysis procedures that were used to address the research questions.

3.1 Mixed Model Research Approach

This research used a mixed model approach to address networked generation youth's information seeking process in the networked environment. I chose this approach because it focuses on context and states the importance in placing the research problem at the center of the study (Tashakkori & Teddlie, 1998). The mixed model approach also offers the opportunity to examine the problem from a holistic perspective by integrating alternate theories and approaches into the phases of study (Tashakkori & Teddlie, 1998).

Tashakkori and Teddlie (1998) define mixed model studies as "studies that are products of the pragmatist paradigm and that combine the qualitative and quantitative approaches within different phases of the research process" (p. 19). The authors explained that a mixed model approach may use single applications of approaches or multiple applications of approaches within phases of the study. These multiple applications are mixed studies because they include both qualitative and quantitative elements in all stages of the research process (Tashakkori & Teddlie, 1998). An example of mixed model study is a research project that uses data collection that surveys a large group of people and then selects a few individuals for observation to gain a deeper understanding to the thoughts and feelings of these individuals regarding the topic. The decision to use qualitative or quantitative methods (or both) depends upon the research questions and the design of the research (Creswell, 2003, Tashakkori & Teddlie, 1998).

> Creswell (2003) presents three questions central to the design of research:
>
> What knowledge claims are being made by the researcher (including a theoretical perspective)?
>
> What strategies of inquiry will inform the procedures?
>
> What methods of data collection and analysis will be used? (p. 5)

According to Creswell (2003) when a researcher states a knowledge claim this means that during the investigation, the researcher approaches a research problem with certain theories about "what they will learn" and "how they will learn" (p. 6). This knowledge claim, also called paradigm, provides a structured way of looking at the world (Kuhn, 1970). Guba and Lincoln (1994) declare that a paradigm makes assumptions about the relationship of the knower to the known, the nature of reality, and the role of value in inquiry. In the pragmatic paradigm, knowledge claims "arise out of actions, situations, and consequence rather than antecedent conditions" (Creswell, 2003 p 11). Pragmatists focus on the research problem and use multiple methods to gain an understanding of the problem (Creswell, 2003; Tashakkori & Teddlie 1998). Instead of concentrating on the methods, the research questions are most important. The types of research questions guide the selection of methods used to approach the problem (Creswell, 2003; Tashakkori & Teddlie 1998). Pragmatism embraces both "objective" and "subjective" points of view for the research. Tashakkori and Teddlie (1998) explain that “at some point the knower and the known must be interactive, while at others, one may more easily stand apart from what one is studying” (p. 26)

Chapter 1 placed the problem, networked generation youth’s information seeking process, as the central concern of the research. Specifically the research addresses the need to examine how students’ cognitive, affective, and physical behaviors and problem solving techniques affect the information seeking process of individuals who consistently use a networked environment to solve their information needs. Following a pragmatic approach, the research problem remains the focus of study, developing the research questions, directing the adoption of a user-centered theory that helps frame the study, and guiding the selection of methods and tools that answer the research questions.

Pragmatism does not adhere itself to one particular philosophy and reality (Creswell, 2003; Tashakkori & Teddlie, 1998). Researchers follow both qualitative and quantitative assumptions while conducting research. They select the methods, techniques, and procedures of research that best meet the needs and purposes of addressing the research problem. Pragmatists believe that values play a large role in conducting research and in drawing conclusions from their studies. They examine the “what” and “how” to research based on their own value systems (Tashakkori & Teddlie, 1998). Pragmatists agree that research always occurs in context. In this way, mixed model studies may include a theoretical lens that links inquiry to the social way of life of the group (Creswell, 2003). Creswell (2003) defines theoretical lens as the theories that guide the researcher to select the important issues to examine and the people that need to be studied. The theoretical lens also indicates the role the researcher plays in the study and how the final accounts need to be written.

This research placed the study of young people's information seeking process in the context of the networked generation youth in the networked environment because the networked environment has become an integral part of these adolescents everyday information use environment. As stated in chapter 2, children should be studied in context, because "Just as their contexts are shaped by their presence, children and their contexts mutually constitute each other" (Graue & Walsh, 1998, p. 13). The pragmatic approach supports the study in context and allows for the selection of multiple data collection techniques. While some researchers suggest the study of context using qualitative (interpretive, naturalistic, ethnographic, constructivist) approaches to address the research problem (Graue & Walsh, 1998), the pragmatic approach calls for the use of either or both qualitative and quantitative approaches. As Tashakkori and Teddlie (1998) explain, "The best method is the one that answers the research questions most efficiently and with foremost inference quality (trustworthiness, internal validity)" (p. 167). This research used a mixed model research design because it provided the opportunity to use qualitative and quantitative techniques and analysis simultaneously in multiple phases of the research design where they best fit the researcher's need to answer the research questions.

The subsequent sections discuss the application of a mixed model approach in the research design, the data collection techniques, data preparation procedures and analysis, and synthesis procedures that were used to answer the research questions.

3.2 Research Design

The following section provides an explanation of the research design. Figure 1 presents the research design. The design demonstrates the procedures that were carried out to accomplish the objectives of the research and answer the research questions.

Preliminary to the design of the proposed research, I conducted a literature review (see chapter 2) in the area of information seeking. The literature review examined information seeking, the information seeking process, and previous research on children and adolescent information seeking in the networked environment. The literature review supported the need to study networked generation youth information seeking process in the networked environment. Chapter 2 also established a theoretical lens that guided the research, information seeking in context. A user-centered perspective was employed to understand networked generation youth's information seeking process in the networked environment. In addition, Walker & Moen's (2001) exploratory study influenced the design of the study.

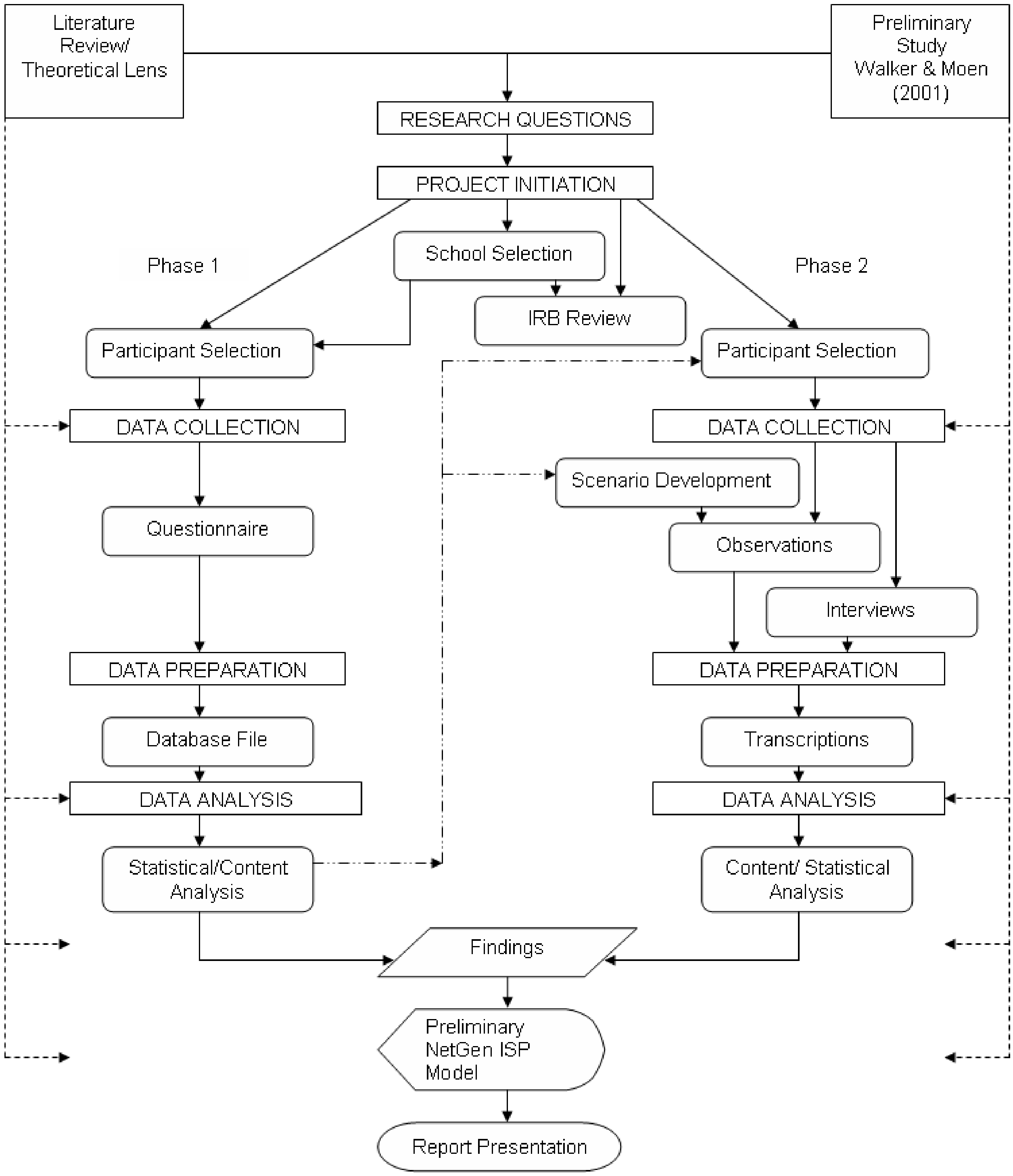

Figure 1. Research design graph.

This research addressed five research questions that relate to the networked generation youth information seeking process in the networked environment. I developed the questions based on the literature review of children's and adolescent's information seeking and the insights gained from Walker & Moen's (2001) study on identifying and categorizing networked generation information seeking behaviors in the networked environment. The research addressed the following questions:

RQ1 What cognitive, affective, and physical information seeking behaviors do networked generation youth exhibit during solving information needs in a networked environment?

RQ2 How do the cognitive, affective, and physical information seeking behaviors exhibited by networked generation youth for solving information needs in a networked environment differ among grade levels?

RQ3 In what ways do networked generation youth's information seeking behaviors assist or deter solving information needs?

RQ4 How do networked generation youth construct strategies for information problem solving in the network environment?

RQ5 How do networked generation youth's problem solving techniques relate to the cognitive and affective behaviors exhibited in their information seeking.

Adopting the pragmatic approach to research design, the research questions guided the planning of the project initiation stage, data collection stage, and the data analysis and inferences stage of the research. The following timeline shows the progression of the study from initiation to data collection:

October 2003 - School Selection
November 2003 - Institutional Review Board Review
December 2003 - Test Networked Environment Questionnaire
January 2004 - Participant Selection: Phase 1
January - February 2004 - Obtain student and parental consent
January - February 2004 - Data Collection Phase 1: Administer NEQ
February 2004 - Analyze questionnaire for selection of participants for Phase 2
March 2004 - Participants Selection: Phase 2
March 2004 - Scenarios Development: Phase 2

March 2004 Test Scenarios
March - April 2004 - Data Collection Phase 2: Scenarios and Exit Interviews

The project initiation began in October 2003 with selection of a school according to the following criteria: (a) the availability of a networked environment with Internet connection that had been supported for numerous years, (b) the school's commitment to integrate networked technologies into the curriculum, (c) the school's policy on computer and Internet use for personal use (i.e., e-mail, Internet searching) during school hours, and (d) the school administration's willingness to participate in the study.

The school was selected and the participating school's administration granted written permission for use of their facility. Approval was sought from the Institutional Review Board for the Protection of Human Subjects (IRB) at the Office of Research Services at The University of North Texas. IRB required a formal review of the study. In November 2003, a formal review took place due to the use of human subjects, specifically the inclusion of adolescents. After IRB approval of the study, the questionnaire was pre-tested to assess the reliability of the instrument.

The next step was selection of individual classes. Classes were selected according to the following criteria: (a) the integration of networked technologies into the classroom curriculum, (b) the teachers' willingness to allow student participation in the study, and (c) the students' willingness to participate in the study and their reputation for skillfulness in using networked resources. To protect the rights of the participants, students were given an explanation of the study and asked to participate. A Human Subjects Research Consent Form and Parental Consent Letter with Use of Human Subjects Child Assent Form to be signed by the parents and student before participating in the study were distributed (see Appendixes A and B for copies of the forms). Dates were set up for students to participate in Phase 1. Upon receipt of signed consent forms, teachers gave students their ids and password for Phase 1. After the completion of Phase 1, the flow of the design moved back up to project initiation for the selection of a smaller subset of students who participated in Phase 2. Upon agreement to continue with the study, dates were set up with students for their participation in the observation and interview stages of Phase 2.

I used two phases of data collection, preparation, and analysis in the research design to address the research questions. The second phase of the study was dependent on the findings and the materials developed from the Phase 1, characteristic in a mixed model approach. Phase 1 used quantitative and qualitative elements in a questionnaire where information gleaned helped select a subset of students for participation in Phase 2. The questionnaire contained closed and open-ended questions to obtain specific data on their knowledge of networked environments and descriptive data on students' use of and interests in the networked environment. Data from the closed questions were analyzed using statistical analysis. Subsequent to coding the open-ended questions, the data was examined using content analysis. Data gathered from the questionnaire were also used to create the information seeking scenarios for use in the observation stage of Phase 2. Findings from the analyzed data in Phase 1 provided an understanding of networked generation youth's knowledge and use of the networked environment and informed the creation of the preliminary networked generation information seeking process model.

Qualitative and quantitative data collection and analysis occurred in Phase 2. Data were collected from observation and semi-structured interviews. Observations of networked generation youth completing information seeking scenarios using the networked environment presented a modified naturalistic account (Lincoln & Guba, 1985) of networked generation youth's information seeking process. During observations, I collected data using talk-aloud verbal protocols. Verbal protocols allowed the students to speak freely about information seeking behaviors and problem solving techniques they use to resolve an information need. Semi-structured interviews provided personal insight into the information seeking process of actual participants and offered a way to clarify any actions taken during observation. During the observation stage, I used a triangulation of data collection techniques to address trustworthiness in the study. Protocol Analysis was used to collect the observation data in several formats including audio, video, and transaction logs. Interviews were recorded using an audio format. Data were transcribed, analyzed, and coded for analysis. Coded data were analyzed to identify strategies, tactics, moves, and patterns in the data to inform the findings of the study and influence the development of the preliminary networked generation information seeking process model. Chapter 4 presents the findings in a descriptive, narrative form.

A preliminary model of networked generation youth information seeking process was developed based on the findings from the data collection, preparation, analysis, and synthesis procedures. The development of the model was also influenced by previous research on children and adolescent information seeking in the networked environment and the information seeking models described in the literature review and the previous findings from Walker and Moen (2001).

Throughout the research design, the researcher introduced elements that check for the accuracy and credibility of the findings in the study (i.e., internal validity). Creswell (2003) declares that “trustworthiness is used to establish whether the findings are accurate from the standpoint of the researcher, the participant, or the reader of an account” (p. 196). Numerous strategies have been developed to maintain trustworthiness. The following strategies are used to ensure the accuracy of the findings (Creswell, 2003; Tashakkori & Teddlie, 1998; Erlandson et al, 1993):

- I spent prolonged time at the participating school to develop an in-depth understanding of the networked generation youth environment under study. This allowed me to convey details about the school site and the students that lend credibility to the narrative account (Tashakkori & Teddlie, 1998).

- Triangulation of data collection techniques. Data were collected through multiple sources that included questionnaire, observation, and semi-structured interviews. Within the data collection procedures multiple techniques were used to acquire the data. Open-ended and close-ended questions were used on the questionnaire to provide alternate measures of discovering analogous information. The observation stage used multiple data collection techniques to capture the information seeking process. During the interview stage questions were posed from the NEQ questionnaire as well as semi-structured interview questions. These multiple methods were used to strengthen internal validity of each measure and help eliminate biases that might result from relying exclusively on any one data collection method or source (Gall, Borg, & Gall, 1996).

- Persistent observation occurred to provide a way to identify the characteristics and aspects of the social scene that are the most relevant to the particular question being pursued (Tashakkori & Teddlie, 1998). This level of involvement was reflected in the detailed description that I developed to describe the networked generation youth information seeking process.

- Member checks were used to determine the accuracy of the qualitative findings through taking specific descriptions back to participants and determining whether these participants felt that they are accurate (Erlandson, et al, 1993). This occurred during the interview stage of the study as I verified the behaviors and techniques participants use in their information seeking process to complete the information seeking scenarios.

- Peer debriefing took place throughout the development of the research. Academic professionals in the area of information science and computer education and cognitive systems provided feedback that refined and redirected the inquiry process.

- Purposive sampling was used to select the participant for the study. This sampling technique is used to maximize the range of detailed information that can be obtained from and about the context of networked generation youth being studied (Erlandson et al, 1993). Erlandson et al (1993) state that “Because the foundation of transferability is an adequate description of the sending context, the search for data must be guided by processes that will provide rich detail about it….This requires a sampling procedure that is governed by emerging insights about what is relevant to the study and purposively seeks both the typical and the divergent data that these insights suggest” (p. 33).

- Thick description provides evidence for the transferability of interpretations and conclusion from the findings in the study (Erlandson, et al, 1993; Tashakkori & Teddlie, 1998). I collected detailed descriptions of data in context of the networked generation youth and reported them with sufficient detail and precision to allow judgments about transferability. Through narrative writing, readers were brought vicariously into the context being described by providing direct accounts of the participants’ observation and interview sessions.

The participant selection, data collection and analysis procedures presented in the next section provides detailed description of the events that took place that continue to confirm trustworthiness of the study methods.

3.3 Participant Selection, Data Collection Techniques, and Data Analysis Procedures

This section includes a detailed description of participant selection, the data collection techniques, and data analysis procedures that took place during the two phases in the research design.

3.3.1 Participant Selection

Adolescents enrolled in Grades 7-12 participated in this study. These adolescents were chosen because they possessed an understanding of the basic functions of the networked environment and used networked information environment resources in their daily lives. Additionally, each participant possessed the basic information literacy skills necessary to gain access to information available with electronic media. Because a user makes judgments about what information is useful to them at the time of need, the study required the participants to possess skills in being active, experienced, and critical users of information. This requirement allowed me to examine the participants' various processes while seeking information rather than giving emphasis specifically to the level of experience (novice, proficient, etc.) the members of the group possess.

Potential participants for this study were drawn from students in Grades 7-12 at a private coeducational Pre-K through Grade 12 day school with an enrollment of approximately 1200 students. The school supported a networked environment that was integrated into the curriculum. Along with the networked computer facilities provided for student use at the school, all students were required to have computer access at home. Internet use was available to students throughout the school day and members of the upper school (Grades 9-12) were provided with school email accounts accessible through a Web mail system. All students were provided personal accounts and storage space on the school server. Students were also provided with a shared drive on the network server so collaboration could take place among classes, teacher to student, or students to students. The library and computer labs offered flexible schedules for students to utilize the networked environment.

Initial contact with the school began through the director of the library via e-mail. I outlined the study and sought the director's interest in hosting a study through the library. The director of the library expressed willingness to host the study and contacted the director of curricular programs for school permission. A meeting was scheduled with the director of curricular programs to discuss the study and seek the school's permission. The school was in a curricular review process and desired the study results to assist in evaluating the information and network literacy skills of the proposed grade levels included in the study. The director of curricular programs offered to be the point of contact between all parties that agreed to participate in the study.

Participants were selected based on stratified purposive sampling to maximize discovery of the networked generation youth's information seeking process in the networked environment. A stratified sample includes dividing the sampling frame into subgroups from which samples are separately selected (Dane, 1990). In purposive sampling the goal is to select cases that are likely to be "information rich" with respect to the purposes of the study (Gall, Borg & Gall, 1996). A purposive sample is one that is selected by the researcher systematically. The researcher attempts to select the sample based on the information known about the individuals/group (Tashakkori & Teddlie, 1998).

In the first phase of the study, the administration selected two classes from each grade level to complete the online questionnaire. At the participating school, the total student population of students enrolled in Grades 7-12 is approximately 630 students. The student/teacher ratio is 18:1, so two classes from each grade level was desired to obtain an adequate response rate when seeking student participation. Studying the adolescents from different grade levels provided me with the opportunity to gain an understanding of the information seeking process of a group of individuals who are in the formal operational stage of learning and accustomed to using the networked environment for solving their information needs. Studying multiple grade level also increased the variance of behaviors and techniques for study. The director of curricular programs contacted the teachers via e-mail requesting participation. There was an overwhelming response from teachers willing to allow class participation. The director of curricular programs chose the final list of classes to participate based on the study criteria.

Teachers were sent a packet that included a letter explaining the study and directions to read to the students. All students in the selected classes were given packets that included the human subject's research consent form and parental consent letter (see Appendix A and B). The administration included a letter in the packet explaining school support of the study. Students examined the documents while the study procedures were read aloud. The method and goals of the study were explained and questions were answered. Students were made aware that they could withdraw from the study at any point in time without any consequences. One hundred ninety-eight packets were sent home to parents. Only students who obtained parental consent and signed a human subject's consent form were allowed to complete the online questionnaire. The online questionnaire was completed by 125 students. Questionnaires were scored and marked to determine the participant's continued eligibility for the second phase of the study (see Data Analysis Procedures).

I selected participants in the second phase of the study based on the level of knowledge and experience demonstrated in the questionnaire and agreement to continue with participation in the study. Twelve students, two per grade level, were selected. According to Patton (1990), "there are no rules for sample size" in purposive sampling. The researcher is looking more for quality than quantity, more for information richness than information volume. In previous children's studies with qualitative approaches in the research design the number of participants varied. Sample size ranged from one to fifty-two participants.

In their preliminary study, Walker & Moen (2001) found that using twelve participants provided adequate data on information seeking behaviors of networked generation youth; therefore, for this study, twelve participants provided an opportunity to discover a rich set of behaviors and techniques that describe networked generation youth information seeking process. By using twelve participants, I could observe each class of information need being performed twice within each grade level. This would allow me to maximize variation of information seeking behaviors and techniques among all participants, among grade levels, and among students within a particular grade level (see Information Seeking Instrument Development). I selected the two students from each grade level that scored the highest overall scores on the Phase 1 questionnaire to participate in Phase 2. I sent the list of students selected to the director of curricular programs who confirmed the students' continued participation and scheduled times for the students to participate.

3.3.2 Data Collection Techniques

The study used a questionnaire, observations, and interviews to obtain the cognitive, affective, and physical information seeking behaviors and problem solving technique students utilize in the networked environment. Utilizing these multiple data collection techniques allowed for triangulation of the data providing reliability and validity to the information gleaned from the participants (Tashakkori & Teddlie, 1998).

3.3.2.1 Networked Environment Questionnaire (NEQ)

The Phase 1 questionnaire provided an opportunity to solicit information from students regarding their understanding and use of networked environments, information seeking skills, and problem solving techniques. In the first phase of the study, members of the chosen classes completed a 29 question online questionnaire. Placing the questionnaire online provided the first opportunity for students to show their competence in using the networked environment. The questionnaire contained closed and open-ended questions to collect data pertaining to the students' knowledge, abilities, and comfort level in using networked environments to locate information and their knowledge of information literacy skills and problem solving techniques (see Networked Environment Questionnaire Development below). The questionnaire also sought to examine students' information seeking interests in the networked environment. See Appendix C for a copy of the questionnaire.

Each class selected for participation was given an explanation of the study. Students were given a parental letter of consent and a use of human subjects child assent/consent form that they were required to take home for a parent and self-signature. After signed agreements (student and parental consent) were returned, the teacher scheduled a date in the computer lab for the students to complete the questionnaire. On the scheduled day, the students were taken to the school's computer lab and given a sheet of paper with the NEQ Web site URL and an individualized user id and password that was needed to gain access to the online questionnaire. The user id and password allowed for recognition of a particular student's questionnaire completion and attempted to provide reliability to the concern that the data collected were from the actual students being studied.

Participants were given 40 minutes to complete the questionnaire once logged into the system. Placing a time limit on the questionnaire caused the student to answer quickly, leaving less time for second-guessing and less time for locating the “correct answers” on other networked resources; again providing reliability to the questionnaire technique being utilized. Once the student pressed the submit button on the last questionnaire page the student was automatically logged off the questionnaire and received an acknowledgement of participation. The responses were captured in a database file that was placed on the participating school’s network server. The data from the database file were exported into a spreadsheet software file for scoring and analysis. The results from the questionnaire controlled the selection of participants for the second phase of the study and assisted in the customization of topics for the information seeking instrument used in the observation portion of the study.

3.3.2.2 Networked Environment Questionnaire Development

The networked environment questionnaire (NEQ) development was based on the questionnaire developed by Walker and Moen (2001) for an exploratory study on adolescents’ information seeking behaviors, observations of adolescents using the networked environment, and the concepts related to network literacy. The questions developed helped determine what type of networked competencies and seeking capabilities the students possessed and provided insight into information seeking interests of the adolescents being studied. The use of the NEQ helped me select those individuals who possessed the knowledge and skills in using the networked environment effectively for the observational stage of the study. I prepared the self-administered NEQ for online distribution.

Scholars use the term *network literate* to describe a person who has the skills and knowledge to utilize the networked environment effectively. McClure (1994) defines network literacy as the ability to identify, access, and use electronic information from the network. He suggests that network literacy should include one's knowledge of the range, organization, and uses of networked resources. A networked literate person should also understand the role of networked information in problem solving. McClure states that a specific set of skills is involved; for example, how to retrieve specific types of information from networks, how to combine networked sources and, finally how to utilize them in problem solving.

Savolainen (2002) uses the term network competence to describe the ability to adapt effectively to the networked environment to achieve desired outcomes. He defines network competence in the context of information seeking as "the master of four major requirements areas: awareness of networked information resources and their organization, skillful use of the information and communication tools to access networked sources, judgment of the relevance of information, and use of computer-mediated communication tools" (Savolainen, 2002, p. 211). For example, students must know how to deal with the selection and use of a particular networked resource (e.g., Web search tool, online library catalog, online electronic database) to find related information for a school history project that will provide them with the most accurate data to assist in the completion of the project. Students then must know how to evaluate, select, and transport the data that pertains to their specific needs and synthesize it into their project. I used Savolainen's definition of network competence in the context of information seeking to guide the questionnaire development.

Divided into five parts, the 29 question instrument collected data about potential participants' demographics, network competencies, information literacy skills, problem solving approaches, and information seeking interests related to the networked environment. Part 1 included five closed questions with categorical responses. The demographic questions asked about age, grade, and gender, years attended at the study's school site, and availability of home computer with Internet access. Contact information was also requested to be used if chosen for Phase 2.

Part 2 examined networked environment content knowledge. Three questions sought definitions for basic terminology, one open-ended and two closed. Two questions, one open-ended and one closed with a continuous scaled response set, asked the participants to classify ability. Part 3 contained seven questions examining networked environment use. One question inquired about average Internet use for personal, school, and daily usage using categorical closed questions. One question included eight continuous scaled closed and eight open-ended questions surveying networked services usage. Three open-ended questions sought information on Internet tools and school networked resources used. One closed question asked participants to rank their top 10 Internet search categories, from a list of 16 categories given, and provide examples for each. In addition, one continuous scaled closed question asked participants to self-assess their ability in locating information using the networked environment.

Part 4 contained eight questions examining networked resources knowledge. Seven categorical closed questions sought knowledge regarding information location, search tools, and Boolean operators. Two of these closed questions were conditional and if answered with a particular response, participants were directed to include an open-ended response. One open-ended question queried students on what school network resources were available at home. Part 5 examined networked environment problem solving techniques. The section included three open-ended questions that reflected students' use of problem solving in the networked environment and a closed question that asked participant to rank the type of instruction received. See Appendix C for the full questionnaire.

The eighteen questions from Walker and Moen's (2001) Internet questionnaire were used in the development of the NEQ. Reliability of the instrument had been established through test-retest measure. Additionally, the instrument had been administered to several groups of adolescents and mean scores compared. Multiple uses of the questions on the instrument demonstrate its reliability in providing measures of internal consistency (Creswell, 2003). For the NEQ, I changed the categories to reflect the networked generation youth's networked information environment which includes locally available resources (e.g., the local library catalogs, locally licensed databases/CD-ROM products), distributed resources (e.g., national or state supported databases, other libraries' catalogs), and Internet resources such as Web search engines, Web directories, Web pages, and communication tools (e.g., e-mail, chat rooms, instant messenger, Web television, and message boards). Various selection choices were changed in several questions to reflect added networked information resources available to students or new network terminology used by the computer science field.

Eleven questions were added to glean an understanding of student knowledge and use of the networked environment. Questions included topics on network terminology, information seeking character assessment, self-assessment ability, and problem-solving approaches related to the networked environment. These topics allowed me to examine how often or for what purpose the individual used the networked environment and what tools they used while seeking information. The topics also sought to explore students' awareness and use of the different networked information services available on their school's network environment and how they utilized the tools to solve problems.

I solicited verbal comments on the new questions from a group of adolescents regarding their understanding and clarity of the questions. A pretest of the questionnaire took place among a sample of networked generation youth. Pre-testing allowed adolescent respondents to make criticisms and recommendations for improving the questionnaire. I conducted a *cognitive interview* that asked the participant to *think aloud* as they examined questions. In this technique, I asked a question, and then probed with follow-up questions to learn how the question was understood and whether its meaning varied for different respondents. The questions were revised and retested until the members of the pretest sample understood them accurately. Pre-testing the questionnaire assists in the measurement of the reliability and validity of the instrument.

Reliability is a guarantee that the instrument or measure is consistent. This means that reliability is a matter of whether a particular technique if applied repeatedly to the same object yields the same result each time (Babbie, 1990). To measure the reliability of the NEQ, I administered the questionnaire to a sample of networked generation youth. The responses were compared for consistency. Whenever a new questionnaire is developed an indication of its internal consistency (i.e., the extent to which there is cohesiveness or interrelatedness among the items) is desired (Isaac & Michael, 1995). Internal consistency reliability was determined using Cronbach's alpha (α) on questions in sections II, III, and IV, which measure multiple indicators of the same construct, networked generation youth's networked environment knowledge and use.

Questionnaires must yield reliable data from which a researcher can draw inferences that have strong validity (Gall, Borg, & Gall, 1996). Content validity of the networked competencies and information seeking capabilities included in the questionnaire is established based on the use of Walker and Moen's (2001) previously validated questions, the literature review regarding networked competencies, review of the relevant literature that found results obtained with similar surveys and comparable questions, and the researcher's observations of adolescents as they use the networked environment. Face validity was obtained through a committee of experts. Additionally, an interview session was conducted with a professor experienced in survey research both to identify any features of the questionnaire that were unclear or structurally weak as well as to review the validity of the content. Lastly, the content of the questionnaire was reviewed in the pre-test with a sample of networked generation youth.

3.3.2.3 Observation

Observational strategies are particularly useful when researchers want to link behaviors to rationales for behaviors (Hert, 2001). This study used participant observation to actively observe students in a modified naturalistic environment (Lincoln & Guba, 1985). The main objective of the researcher using participant observation is to document the behaviors and interaction patterns as they occur in the participants' natural setting (Tashakkori & Teddlie, 1998). This is accomplished via a technique called verbal protocols. Verbal protocols are widely used in user-centered studies and are an essential technique to use when studying children and adolescent information seeking process (Branch, 2000). Verbal protocols are useful when researchers are interested in gaining information about the psychological or cognitive process for users' actions, which cannot be directly observed (Ericsson, 1993). The evaluator asks the respondent to think-aloud as he or she is using a system saying anything that occurs to him or her. Verbal protocols during observations are generally combined with observations of other aspects of an interaction (Hert, 2001).

To capture all the data from the cognitive (thoughts), affective (feelings) and physical (actions) behaviors and problem solving techniques of the participants provided through this verbal protocol process, I used audio and video recordings and computer monitoring software. The desire to capture all behaviors and techniques performed while the participants seek information using networked computer technologies directed the decision to audiotape and videotape the sessions as well as use monitoring software. The audiotape captured the verbalized thoughts and feelings while the videotape captured the actions of the participants as well as the computer screen.

Monitoring software captured all movements on the networked system including networked programs used, mouse and keystroke movements, Web logs with detailed URLs, and screenshots in specified times made by the participants that they did not describe aloud during their session. The monitoring software also provided transaction logs for analysis. I chose Spector Pro® Version 5.0 monitoring software. Spector Pro was chosen for its ability to take automatic, periodic snapshots of whatever is on the computer screen and record all incoming and outgoing emails, chat conversations, instant messages, keystrokes typed, Web sites visited, programs and their associated windows that are opened, and peer to peer file sharing activity. The school administration approved the monitoring software selected. For the privacy and confidentiality of all students attending the school, monitoring software was only loaded onto the computer being used for the study and only turned on during the participant observation sessions. Once the observation stage of the study was complete, the monitoring software was removed from the computer. Hand-written notes were taken to supplement the electronic devices and provided data for the questions asked in the exit interview.

During the observation stage of the study, the 12 participants selected from the pool of students who participated in the first phase of the study completed four information seeking scenarios (see Information Seeking Instrument Development below). The research used scenarios as a means to help students demonstrate the cognitive, affective, and physical behaviors and problem solving techniques they use in their information seeking process. Scenarios are beneficial in stimulating the interests of the participants and making them feel that the session was designed for them. Scenarios are developed as narratives of specific situations that incorporate students' interests based on the results from the questionnaire completed in Phase 1. Using scenarios provides a holistic picture based on students' true-to-life practices associated with information seeking and sharing and with information technology use (Bishop, Mehara, Bazzell, & Smith, 2001).

Each participant completed two observation sessions. The students worked with two different scenarios each session, completing four information scenarios (i.e., one for each information need). During each session, the participant entered the designated research room (a quiet study room located in the library), the computer was turned on and the equipment set in place. Each participant began each session with the computer set to the school's network login screen. At the beginning of the first observation session, I explained the data collection procedures and gave the participant the opportunity to practice the verbal protocol technique. Once the participant felt comfortable with the verbal protocol process, I started the video and audio recorders and monitoring software. I gave the participant the first scenario set based on the instrumental class of need. Under the instrumental class of need were two different scenarios. The participant was asked to read over the explanation of the instrumental class of need and the scenarios then select a scenario to complete. Figure 2 shows an example of the scenario sheet given to Participant G7-1-1. Upon selection of the scenario, the participant was asked to read the question for the audiotape and offered the chance to clarify any uncertainties they had regarding the scenario. I asked questions to assist participants in beginning the talk-aloud verbal protocol.

Scenario Sheet

Participant G7-1-1
Scenario Group 1 – Instrumental

An instrumental scenario is a problem where there is a need to find out what to do and/or how to do something.

Select one of the following scenarios to complete:

1. You have invited a group of friends over to your house to watch movies. You are planning on providing some snacks but one of your friends is diabetic and another does not like popcorn so you want to find a couple of recipes that everyone can enjoy. First, find out what types of snacks a diabetic can eat then print or download two recipes that you all can make together.

2. Watching the weather report you learn you live in the part of the country know as "Tornado Alley". Concerned for your family's safety, you want to find out why tornadoes are common to this area and where your state ranks in number of tornadoes per year. You also want to learn what steps you should take in the event a tornado is sighted in your area. Save the information you find to create a Tornado Safety Procedure List for your family.

Questions the researcher will ask:

Which scenario did you choose?
Why did you choose the scenario you chose?
How will you go about completing the scenario?

Begin to talk through how you are completing the chosen scenario.

Figure 2. Example of scenario sheet given to Participant G7-1-1 during Phase 2.

As the participants completed the scenario, they engaged in the talk-aloud verbal protocol to describe and explain their behaviors and techniques as they advanced through their information seeking process. Participants verbalized their steps while seeking information specific to the tasks. Participants were given 15 minutes to complete their chosen scenario. Once they completed the scenario or the time had expired, the participants moved on to the second class of information need. The participants were given the second scenario set based on the factual class of need. The participants selected the next scenario for completion and followed their process for scenario completion. At the end of the first observational session, the participants were allowed to ask any questions and were given an explanation of the procedures for the next observation session.

At the beginning of the second observational session, the participants were asked if they had any questions regarding the first session then were given the confirmational information class of need scenario set. Participants selected a scenario for completion. Participants again were given 15 minutes to complete their chosen scenario. Once they completed the scenario or the time had expired, the participant moved on to the motivational information class of need and selected the last scenario for completion. After the participant completed the second observational session, an exit interview was conducted. Each participant completed four scenarios, each representing a different information class of need.

3.3.2.4 Information Seeking Instrument Development

I prepared eight scenarios, two each from four of Taylor's (1999) information classes of need (instrumental, factual, confirmational, and motivational). Scenario topic development was based on the students' information seeking interests gleaned from the results of the NEQ. The Information Seeking Scenarios required participants to complete tasks of varying levels of complexity. Scenario completion demonstrated the evolution of their seeking process. The different scenarios encouraged participants to perform a variety of seeking behaviors and problem solving techniques they commonly use while trying to acquire information from the networked environment. The following is an example of a scenario:

> You are working as a summer intern for Texas' local sports radio station, “The Ticket”. Your assignment for today requires you to research baseball players' statistical information for tomorrow’s game between the Texas Rangers and the New York Yankees. During inning changes, the announcers usually converse about various players and how they performed in seasons past. Your task is to find a listing of the opposing baseball players’ statistics.

Scenarios are developed as narratives of specific situations that incorporate networked generation youth’s information seeking interests. In an exploratory study, Walker and Moen (2001) utilized four of Taylor’s (1999) classes of information need to test the use of a scenario method for identifying information seeking behaviors of adolescents; however, each participant only worked with two classes. Although participants only completed two scenarios, scenario use produced a rich set of data that demonstrated participants’ range of information seeking behaviors. Walker and Moen were able to categorize these behaviors into the strategies, tactics, moves, and patterns of information seeking behaviors. The classes (instrumental, factual, confirmational, and motivational) provided participants with situation narratives that they could possibly encounter in their daily activities. Participants maintained positive attitudes toward completing the scenarios, often relating the scenario tasks to real life problems of their own. Participants used the information seeking behaviors they would frequently use in dealing with their own everyday problems to complete the scenarios. This is essential in providing researchers with trustworthy data on networked generation youths’ information seeking process. Walker and Moen (2001) concluded that scenarios are essential in engaging the participant’s desire to utilize their various information seeking behaviors for a researcher to examine. This research used the same four classes of information need to develop scenarios that lay out the complexity of the task. However, the study had each participant engage in completing scenarios from all four classes to learn more about the patterns of the information seeking process this group of networked generation youth reveal and investigate whether the patterns remain consistent or change across multiple information needs.

The study limited the number of classes to the chosen four because the others (enlightenment, problem understanding, projective, and personal or political) are more philosophical in nature. These classes are more reflective and may require a greater depth of the networked generation youth's own personal understanding that may be difficult to measure in continuous information seeking sessions. The following four classes informed the development of the scenarios the participants used to stimulate various information seeking behaviors and problem solving techniques. Examples are provided to show the types of tasks that can be integrated into a scenario:

Instrumental: The need to find out what to do and/or how to do something.
Example Task: Find a recipe on how to make oatmeal raisin nut cookies and an image to show what your cookies should look like after you bake them.

Factual: The need for and consequent provision of precise data.
Example Task: When did Nolan Ryan pitch his first no-hitter game?

Confirmational: The need to verify a piece of information.
Example Task: Herbert Hoover was the 25th President of the United States of America.

Motivational: The need to find additional information based on personal involvement with a task.
Example Task: Now that you have found the answer to the question about Nolan Ryan's first no–hitter, what other things about his career do you find interesting.

The chosen classes (instrumental, factual, confirmational, and motivational) work well for creating scenarios that can be completed in the networked generation youth's networked information environment. The classes also relate to the types of task used by other researchers studying children and adolescent's information seeking as discussed in the literature review including factual, research, or self-generated questions. The tasks are based on the type of information needed by the users to solve their problem. Marchionini (1995) states, "The task includes an articulation, usually stated as a question, and the mental and physical behaviors of interacting with search systems and reflecting on outcomes" (p. 36). Chapter 2 revealed that the complexity of the task influences information seeking. The process a person goes through to complete the task determines the complexity of the task (Marchionini, 1995). Marchionini explains that as information seekers define the information problem, they identify constructs and terminology to create their seeking process. These constructs and terminology vary in number and in degree of abstractness, and these variations determine the complexity of the task. The task then drives the information-seeking actions, which allows for the expansion of their behavioral process to resolve the information problem.

Question 16 on the NEQ asked participants to rank their top ten seeking interests when searching for information using the Internet. Response data were copied into a worksheet in the spreadsheet software. A frequency count of the responses indicated a value order of which search activities were ranked the highest among all participants. Table 2 shows how Phase 1 participants ranked their Internet searching interests. Entertainment, music, research for school, news, sports, and shopping were among the top six. These topics were used to create the scenarios. Since the participants would be given a choice of which scenario to complete, I created the alternate scenarios using the lower ranked seeking interests. These interests were used to investigate which type of scenario participants would choose and if one type of seeking interest would produce more seeking behaviors and problem solving techniques. See Appendix D for a copy of the scenarios and the types of task participants completed.

Table 2

Internet Seeking Interests of Phase 1 Participants

Rank	Internet Search Topics
1	Entertainment (Video Games, Movies, TV, etc)
2	Music (Musical Groups, Songs, etc)
3	Research for School
4	News (Current Events, Weather, Headlines)
5	Sports (General sports, Hockey, Football, Soccer, etc)
6	Shopping (Books, Clothes, Games, Goods and Services, Toys, etc)
7	Colleges and Universities
8	Hobbies (Stamp Collecting, Drawing, Painting, etc)
8	Reference (Dictionaries, Phone Numbers, Almanacs, etc)
10	Fashion and Beauty (Fashion, Clothing, etc)
11	Travel (Vacations, Destinations, Cruises, etc)
12	Computer Technology
13	Food (Cooking, Recipes, etc)
13	Transportation (Boats, Cars, Planes, Trucks, etc)
15	Health Information (Diseases, Medicine, Fitness, etc)
16	Finance (Business, Money, Stocks, etc)

3.3.2.5 Exit Interviews

Interviews are an excellent vehicle for capturing data on attitudes and perceptions, providing one-to-one interaction between the researcher and the participant being studied (Hert, 2001; Tashakkori & Teddlie, 1998). The interview provided an opportunity to clarify questions or actions that occurred during the observation stage of the study. It also offered an opportunity to uncover additional information regarding the participants’ information seeking process. Upon completing the information seeking scenarios, participants proceeded to an audiotaped semi-structured interview session where they had an opportunity to clarify any actions taken in completing the tasks. The interview also allowed me to uncover additional information, reasons and explanations for the participant's information seeking behaviors or problem solving techniques utilized.

The exit interview included basic questions about behaviors participants exhibited while completing the scenarios. It also sought to discover where the participant learned their skills used during the session and if the skills performed are similar as skills used in everyday information seeking. As in the NEQ, I inquired about the type of skills the participant thought expert users possess to be able to locate information on networked environments. Walker and Moen (2001) showed in their exit interview session that the questions evolved from one participant to the next. For this study, while general questions regarding skills were similar, each exit interview also contained an open style of questioning that depended on the seeking behaviors and problem solving techniques of the participants. Notes were taken during the interview session to supplement the audiotape transcriptions. See Appendix E for a copy of the questions used in the semi-structured interview session.

3.3.2.6 Data Preparation

I prepared data from the questionnaires, talk-aloud verbal protocols, and exit interviews for analysis. Table 3 shows the data sources, contents, and storage mechanisms that were used to hold the data. The online environment allowed the NEQ questionnaire data to be automatically stored into a database file. Adequate provision were provided to ensure the safety of data collected. The data were placed in computer files that were password protected on a networked system. Once the data collection process was complete, the data were transferred to a computer storage system that was only accessible to me. The network drive holding the data was reformatted.

Table 3

Data Sources, Contents, and Storage Mechanisms

Data Sources	Contents	Storage Mechanisms
Networked Environment Questionnaire	Closed-ended questions Open-ended questions	Database file Exported into spreadsheet file
Observation Stage (Talk-Aloud Protocol Analysis) - Audio tape	Participant verbal thoughts and Researcher questions	Transcribe from audio tape to text file.
Observation Stage (Talk-Aloud Protocol Analysis)- Video tape	Participants navigational path	Manually logged from video tape to text file.
Observation Stage (Talk-Aloud Protocol Analysis)- Monitoring Software	Transaction logs of keystrokes, mouse movements, and Internet URLs, e-mail transactions, instant messenger transactions, file uploads and file downloads Screen Snapshots	Saved in log file and integrated into text file. Saved jpeg files.
Interview Stage- Audio tape	Researcher questions and Participant comments	Transcribe from audio tape to text file.

For the closed questions, coding was set up to output numerical values into the questions' fields. I assigned the numerical values according to a set of criteria (see Data Analysis below). Open-ended responses were output to the database file verbatim. All data from the database file were exported into the spreadsheet software for analysis. A field was added next to the open-ended questions that were to be used in the final score. The responses were then given a numerical value according to set criteria (see

Data Analysis below). A Final Score field was added to the spreadsheet software file to calculate the final score. The Final Score was used to select participants for Phase 2. Questionnaire data were also split into worksheets for analyzing the Internet information seeking interests of the participants to create scenarios for the observation stage of the study.

I transcribed the data from the participants' scenario sessions, monitoring software, and exit interview to prepare the data for coding and analysis. First, audio recordings were transcribed into a text file. Second, I transcribed the videotaped continuously captured movements into the created text file. As the VCR played the participant's recorded video sessions, the transcriber manually logged the participant's navigational path, each action of the user and the system, among the transcribed audio data in the text file. Finally, the transaction-logged data from the monitoring software were integrated into the text file. The audio, video, and monitoring software data were synchronized according to the steps taken by the participant and the questions asked and comments made by the researcher. Each data file included the participant's scenario sessions. Abbreviations were used to represent the audio from the participants and researcher and video and monitoring software from the participants with a P, R, V, and M respectively. Researcher notes were placed in brackets. Figure 3 shows an example of the Transcription data file for Participant 7-1.

Transcription-Information Seeking Process
Source: Audio Tape # 7-1 / Video #7-1 /Monitoring Software Files 7-1

Participant 7-1

Sex:	Female (2)
Age:	12

Grade: 7th
Yrs. At School 4
Classified Level of Abilities: Experienced (3)
Final Score: 93
Verbal Score: 19

Session 7-1-1

Instrumental Scenario: The need to find out what to do and/or how to do something.
Selected Scenario: # 2

Researcher explains type of scenario and asks student to select the scenario they would like to complete between the two choices given. The researcher then asks the student to read aloud the one they would like to complete.

P: Okay I am going to do number 2.

R: And, why did you choose number 2?

P: Um… because I know exactly what Web site to go to and the first one is a little bit easier and I can just go to Google but this one is a different Web site and I want to try something different.

R: Okay, please read the question a loud.

P7-1 reads through scenario aloud.

R: How are you going to go about…

P: I am going to go to Weather.com.

V: P7-1 has Internet Explorer opened to Google.com [completed a practice search scenario prior to selecting the first scenario].

M: 03/23/04 01:58:58 PM participant71 0:03:14 0:03:14 0:03:14 Web http://www.google.com/
Google

V: P7-1 highlights the URL in the address bar by clicking the cursor on the URL and types in weather.com.

M: [Google - Microsoft Internet Explorer]
<01:59 PM><Backspace: 2 >weather.com <Enter >
<02:02 PM>

V: The page loads to www.weather.com.

M: 03/23/04 02:02:12 PM participant71 0:00:00 0:00:00 0:00:00
Web http://www.w2.weather.com/common/jump.html?/index.html
http://www.w2.weather.com/common/jump.html?/index.html
03/23/04 02:02:12 PM participant71 0:00:07 0:00:07 0:00:07 Web
http://www.w2.weather.com/common/jump3.html?/index.html
http://www.w2.weather.com/common/jump3.html?/index.html
03/23/04 02:02:19 PM participant71 0:00:14 0:00:14 0:00:14 Web
http://www.weather.com/index.html
weather.com

P: and okay …

V: P7-1 moves the cursor around the page and then scrolls over selections in a drop down menu box. P7-1 moves the cursor back up to the top of the page. P7-1 scans over navigation links on the top of the page.

P: I am going to go to weather tools…

V: P7-1 selects the link titled Weather Tools. The page loads.

M: 03/23/04 02:02:33 PM participant71 0:00:22 0:00:22 0:00:22
Web http://www.weather.com/services/?from=globalnav
Wireless Weather Updates- Palm Pilot or Cellular Phone

P: Okay.

Figure 3. Transcription data file example.

The exit interview portions of the transcribed data from participants were copied into a separate file for analysis and comparison between sections in the participants' NEQ. Adequate provisions were provided to protect the privacy of subjects and to maintain the confidentiality of data through the use of alternate names and number codes when compiling the data and presenting the findings.

3.3.3 Data Analysis Procedures

Data analysis procedures included qualitative and quantitative methods. Analysis procedures were chosen based on the type of data collected. While the results are presented in chapter 4, detailed descriptions of the analysis methods are discussed below for the data analysis procedures that were integral to participant selection for Phase 2, information seeking scenario development for Phase 2, and the development of a model that represent the information seeking process of the networked generation youth.

3.3.3.1 Data Analysis Procedures for Participant Selection

For participant selection for Phase 2, a final score was calculated from selected questions on the NEQ. The questions selected were those that measured networked environment and information literacy competencies and understanding. The highest possible obtainable score was 117. Each close-ended response was assigned a numeric value. For example, Question 7 allowed multiple selection choices for the question “A URL is,” and had a possible 6-point return rate. The first option, “Uniform Resource Locators” was assigned a value of three, as it is the most accurate choice. The second choice, “Web Address unique only to one Web site,” was assigned a value of two because it provided a definition of the term. The third choice, “Mickey@aol.com,” was assigned no value because it is an inaccurate statement. The final choice, “http://www.dogpile.com,” was assigned a value of one because it was an example of a URL. A participant’s score for this question depended on which response choices were selected.

Open-ended responses were scored based on a low to high value, zero being the lowest value, meaning the participant did not respond to the question and up to a value of 3 for an in-depth response to the questions. Table 4 provides and example of participants’ responses and the values assigned. For example, Question 6 asked, “Describe what a network is and give an example.” I assigned a value between 0-3 based on the level of information and example provided. A value of zero was assigned if no response or an incorrect response was provided. A value of one was assigned if a basic concept or just an example was given. I assigned a value of two if the concept was explained well. And, I a value of three if a comprehensive definition and an example was provided. The response values were added together to obtain a final score. See Appendix F for networked environment questionnaire scored questions values. The final scores were sorted in descending order. The students with the two highest scores from each grade level were selected to participate in Phase 2. The third and fourth highest scores in each class were selected as alternates.

Table 4

Open-Ended Data Preparation Example

Q6. Describe what a network is and give an example	Value Assigned
No response or incorrect response	0
A network is a grouping of similar things, which are connected in some form through initiation or location	1
A network is the place where all the computers are connected together.	2
A network is a group computers linked together electronically, usually by a hub or a switch. The purpose of a network is to allow computers to communicate, so they may share files, printers, or serve as a server providing a website or [I]nternet access. An example is the Greenhill school network which is many computers linked together through various switches. The Internet is also one big network of many computers.	3

A verbal score was also calculated. The verbal score was calculated from scored values of the open-ended questions that measured knowledge (Q6), understanding (Q9), and use of the networked environment (Q15, Q19) and problem solving techniques (Q26, Q27, Q28). The highest possible obtainable score was 21. The verbal score was calculated in order to compare final score to how well students could verbalize their knowledge, understanding, and use of the networked environment.

3.3.3.2 Analysis for Information Seeking Scenario Development

I also analyzed the questionnaire data to gather input on the type of search activities participants conduct when using the Internet. Question 16 asked each participant to rank the top 10 types of information they search for on the Internet either at home or school. The question contained ten drop down menu boxes containing sixteen information search categories. Each category was assigned a number that upon selection was stored in the ten answer fields in the database. The data were exported into a worksheet in the spreadsheet software. Frequencies were calculated to indicate which search activities ranked the highest among the participants. The scenarios used in the observation stage of the study were created using the data.

3.3.3.3 Analysis of NEQ Data for Information Seeking Process Model Development

An objective of the research was to develop models that represent and describe the networked generation youth's information seeking process in a networked environment. Questions 26-28 on the NEQ directed participants to describe the steps they would take to complete a particular information need. Data analysis of the responses consisted of identifying the types of problem solving techniques used in response to the questions and categorizing the techniques. Data analysis was completed using the constant comparison method. The constant comparative method involves two general processes: (a) unitizing, or breaking the text into units of information that will serve as the basis for defining categories, and (b) categorizing, or bringing together into provisional categories those units that relate to the same content, devising rules that describe category properties, and rendering each category set internally consistent and the entire set mutually exclusive (Lincoln & Guba, 1985, pp. 347-351).

The analytic process was based on immersion in the data and repeated sorting, coding, and comparisons. Analysis began with open coding, which is naming and categorizing units through close examination of text, a particular word, sentence, or phrase (Strauss & Corbin, 1990). A line-by-line analysis was completed for each participant response. Units were labeled. For example, Question 26 asked participants to describe what steps they would take to find information on the presidential candidates proposing to run in the 2004 election using their school's networked environment. A student wrote the following response:

> i would go on www.google.com and i would type in 2004 presedential [sic] candidates. and then i would find which one that fit. or i would go to the www.washingtonpost.com then got [sic] from there.

This participant response was broken down by phrase. A label was created after an action or verbalized thought (unit). The unit, "i would go on www.google.com" indicates the participant would select Google™ search as a resource. Google is a search engine. The label created was *resource selection: search engine: google*. In the next phrase, "and i would type in 2004 presedential [sic] candidates," the participant indicates conducting a keyword search using multiple keywords as a strategy. Therefore, the label *search strategy: multiple keywords* was assigned. The analysis continued by examining the next phrase, "then i would find which one that fit". Here there are multiple actions happening in the phrase so I concentrated on the words *find* and *fit*. The participant wants to locate a resource (find) but will have to examine results in order to select one (fit). Two labels were assigned here, *resource location* and *resource examination*. The word "or" indicates that the participant may use an alternate technique to locate the information. This was labeled as *multiple options given*. As for a prior unit, the phrase, "i would go to the www.washingtonpost.com" was labeled *resource selection*; however, since it is a specific news Web site the secondary label *specific Web site: news source* was added. Finally, the phrase "then got [sic] from there" was labeled *browse* as the phrase indicates the participant will follow a direction when the participant gains access to the site.

The units were then compared and contrasted, placed in groups, and categorized. Categories were named by relating units to information seeking and problem solving terminology used in the field of library science and education. Strauss and Corbin (1990) state that there is an advantage to borrowing terms from a technical field; the terms are loaded with analytic meaning and already well developed. Using borrowed terms also assisted in relating developed categories to already defined information seeking and problem solving processes. I returned to the data and changed labeled units to the created categories as needed. Next, axial coding followed. Strauss and Corbin (1990) define axial coding as relating subcategories to categories.

At the end of a category, the problem solving process was coded. In the problem solving technique column, the problem solving process category was placed before the created categories (techniques). The techniques then became subcategories of the processes. Table 5 displays an example of the addition of problem solving process coding for Question 26. The problem solving processes identified in Marchionini's

(1995) information process model were used as categories. These included define problem (DP), select tool (ST), create search strategy/formulate query(CSS/FQ), execute query (EQ), examine results (ER), extract information (EI), and reflect/stop (R). In addition, the patterns Walker and Moen (2001) found when examining adolescent's information seeking process while using the Web were used. Patterns included assistance utilization (AU), knowledge application (KA), ordered behaviors (OB), and personal interest utilization (PIU).

Table 5

Problem Solving Technique Coding Example

Questions	Response	Problem Solving Techniques
Q26. Describe in the box what steps you would take to find information on the presidential candidates proposing to run in the 2004 election using your school's networked environment?	"i would go on www.google.com **ST** and i would type in 2004 presedential [sic] candidates. **CSS/FQ** and then i would find **RS** which one that fit. **ER** or **PP** i would go to the www.washingtonpost.com **ST** then got [sic] from there" **CSS/FQ**	**Planning Process**: Formulate Multiple Options **Select Tool**: Networked Resource: Search Engine: Google **Create Search Strategy /Formulate Query**: Analytical:Keyword(s) **Resource Selection/Location** **Examine Results**: Evaluate Information **Select Tool:** Networked Resource: Specific Web Site: News Source **Create Search Strategy /Formulate Query**: Browse

The categories that did not fit in predefined larger categories were labeled. The new labels were extracted and categories created. This process required continual revisions and modifications until all units were placed into an appropriate category and the inclusion of additional units into a category provided no new information (Strauss & Corbin, 1990). Table 6 shows a coding process example for questions 26, 27, and 28. In the problem solving technique column, new categories and subcategories were added as they developed. The steps participants articulated became the starting point for the networked generation information seeking process model. A list of problem solving techniques was generated throughout the process. When coding the problem solving techniques for the observation data this list was used as a guide. See Appendix G for the list of codes.

Table 6

Problem Solving Technique Coding Example

Questions	Response	Problem Solving Techniques
Q26. Describe in the box what steps you would take to find information on the presidential candidates proposing to run in the 2004 election using your school's networked environment?	"First **PP**, I would gather the people that I want to recerch [sic] and make a list of them. **DP** second, I would Go to a search engine. **ST** Third, I would type thier [sic] names in **CSS/FQ** and select a good website. **RS** then, I would write down the information that I wanted to use." **EI**	**Planning Process**: Lists out in steps **Define Problem**: gathers needed info /make list **Select Tool**: Networked Resource: Search Engine **Create Search Strategy** /**Formulate Query**: Analytical: Specific Names **Resource Selection/Location**: link on result list; Web page: by user determined relevance **Extract Information**: Record Data
Q27. How would you look up information on what is playing at your local movie theater this weekend?	"I would go to moviefone.com **ST** and enter my zip code so that I can find the movie theater	**Select Tool**: Networked Resource: Specific Web Site: Commercial

	closest to me. **EQ** Then I would choose the theater I wanted to go to based on what is playing at each theater and them times in which the movie is being shown. **RS** If I know that I am definately [sic] going to that theater at that time **R** I would go ahead and buy the tickets so that I just have to pick them up at the box office." **SP**	**Execute Query**: Modify Search field: personal data **Resource Selection/Location**: by user determined relevance **Reflect**: Make Decision **Stop Process:** Task Completion
Q28. You need to find a song for a class project on music from the 1980s. How would you go about selecting a song and downloading it from the Internet?	"First I would probably ask my parents for the name of a semi-popular song form the 80's. **ST** I would type that song name in, **CSS/FQ** and look for information on it. **ER** I would then ask for my brothers help on how to download music off on Music Match for 10 cents. **DP** after that i would download it **EI** onto Wiindows [sic] media player, **ST** and then burn it onto a cd." **EI**	**Select Tool**: Research Tool: People: Parent **Create Search Strategy**/ **Formulate Query**: Analytical: Specific Names **Examine Results**: Resource examination **Define Problem:** Assistance Utilization: Sibling **Select Tool**: Networked Resource: Specific Web Site: Commercial **Extract Information**: Download **Select Tool**: Networked Application: Media Player **Extract Information**: Burn to CD

3.3.3.4 Analysis of Observation Data

Continuing to meet the objectives of the study and answer the research questions, the constant comparative method was also used to analyze the observation stage of data collection. I followed the process used by Walker and Moen (2001) which consisted of categorizing various seeking behaviors utilized by the participants while completing the scenarios. Walker and Moen (2001) created categories that describe networked generation youth's strategies, tactics, moves, patterns, and other cognitive and affective behaviors. Walker and Moen (2001) used Marchionini's (1995) processes (behaviors and their categories) of locating information as a basis for initial categorization of the participants' information seeking behaviors. Marchionini asserted that searchers possess substantial knowledge related to the factors of information seeking which causes them to develop distinct patterns of searching and to use a variety of strategies, tactics, and moves. Marchionini (1995) defined the processes as:

> Patterns: Behaviors that can be discerned over time and across different information problems and searches.
>
> Strategies: Sets of ordered tactics consciously selected, applied, and monitored to solve an information problem. Strategies can be general and flexible (browse strategies) or highly specialized and well-defined (analytical strategies). Strategies are the approach that an information seeker takes to a problem.
>
> Tactics: Discrete intellectual choices or prompts manifested as behavioral actions during an information-seeking session.
>
> Moves: Finely grained actions manifested as discrete behavioral actions. (pp. 72-74).

Walker and Moen (2001) categorized the transcribed data according to the various processes performed by the participants. Walker and Moen also examined the data for the emergence of categories not defined by Marchionini and found various cognitive and affective behaviors that did not fit into Marchionini's categories. These behaviors included cognitive behaviors, realization and thinking mode. The affective behaviors included affirmation, familiarity, frustration, and hesitation. Walker & Moen (2001) defined the behaviors as:

> Realization: Reaching a level of understanding to a specific action taken.
>
> Thinking Mode: Physical or verbal actions taken when deciding a route to take regarding a task.

Affirmation: Physical or verbal signs of elation in completing a task.
Familiarity: Choosing to perform a certain way based on previous behavior.
Frustration: Physical or verbal signs of difficulties in completing a task.
Hesitation: Physical action of pausing or verbal actions of uncertainty. (p. 24).

Figure 4 displays an excerpt from the transcript with coding of the beginning of a session. The transcribed data were categorized according to the processes performed by the participants. Among the types of categories, each action was coded with a letter and a number for the type of behavior it represented (i.e., S1, choosing resources was a strategy assigned for the action of selecting the resource [search tools, official homepages; Web pages] to use to begin the information seeking process). These codes were assigned as they were discovered among the data.

CODED DATA P7-1
Transcription-Information Seeking Process
Source: Audio Tape # 7-1 / Video #7-1 /Monitoring Software Files 7-1

Participant 7-1
Session 7-1-1
Instrumental Scenario: The need to find out what to do and/or how to do something.
Selected Scenario: # 2
Researcher explains type of scenario **R1** and asks student to select the scenario they would like to complete between the two choices given. The researcher then asks the student to read aloud the one they would like to complete. **R3**

P: Okay **A1** I am going to do number 2. **C6**
R: And, why did you choose number 2? **R2**
P: Um…**C2** because I know exactly what Web site to go to and the first one is a little bit easier **A2** and I can just go to Google but this one is a different Web site **C6** and I want to try something different. **A2**
R: Okay, please read the question a loud. **R3**
P7-1 reads through scenario aloud. **RS**
R: How are you going to go about… **R4**
P: I am going to go to Weather.com. **C6**
V: P7-1 has Internet Explorer opened to Google.com **S13/RA** [completed a practice search scenario prior to selecting the first scenario]. **RN**
M: 03/23/04 01:58:58 PM participant71 0:03:14 0:03:14 0:03:14 Web
http://www.google.com/

Google
V: P7-1 highlights the URL in the address bar **M12** by clicking the cursor on the URL **M5**
M: [Google - Microsoft Internet Explorer]
<01:59 PM><Backspace: 2 >**M6**
V: P7-1 types in weather.com. **S1**
M: weather.com **M4/P2** <Enter >**M6**
<02:02 PM>
V: The page loads to www.weather.com. **RA**
M: 03/23/04 02:02:12 PM participant71 0:00:00 0:00:00 0:00:00 Web
http://www.w2.weather.com/common/jump.html?/index.html
http://www.w2.weather.com/common/jump.html?/index.html
03/23/04 02:02:12 PM participant71 0:00:07 0:00:07 0:00:07 Web
http://www.w2.weather.com/common/jump3.html?/index.html
http://www.w2.weather.com/common/jump3.html?/index.html
03/23/04 02:02:19 PM participant71 0:00:14 0:00:14 0:00:14 Web
http://www.weather.com/index.html
weather.com
P: and okay … **A1**
V: P7-1 moves the cursor around the page **M5** and then scrolls over selections in a drop down menu box **M7**. P7-1 moves the cursor back up to the top of the page. **M13** P7-1 scans over navigation links on the top of the page. **T1**

Key:
A1 = Affirmation
A2 = Familiarity
C2= Thinking Mode
C6 = Decision Making
M4 = Typing
M5= Arrow
M6 = Keyboard
M7 = Drop Down Menu
M12 = Highlight
M13 = Direction
P2 = Knowledge Application
R1 = Researcher Clarify Question
R2 = Researcher Initial Question
R3 = Researcher Give Direction
R4 = Researcher Question Clarify (How)
RA = Resource Available
RN = Researcher Note
RS = Read Scenario
S1 = Resource Selection
S8 = Predetermined Resource Selection
S13 = Application Use
T1 = Review Material

Figure 4. Excerpt from Participant 7-1: Coded transcript.

Walker and Moen's (2001) categories were used as a starting point to create descriptions of the various seeking processes of the study participants. Categories were redefined as necessary and more were added and defined as they appeared in the seeking process of the participants. For example, Walker and Moen used M4 as the code for *type address*. This was assigned when a participant typed a specific address in the URL box. The code M4 was utilized but the category name was broadened to *type* and the definition altered as type information into search box, empty field box (i.e.

Address, search term, collected data, etc.). See Appendix H for the information seeking behavior categories code sheet and definitions. The categories are further discussed in chapter 4.

Once the transcript was coded the data was moved into a spreadsheet for further analysis. A file was created for each participant in the spreadsheet software. Four scenario worksheets were created; S1, S2, S3 and S4. The coded data from the first scenario was input into worksheet named S1. The first column contained the code number and the second column contained the action. As the data were transferred, coding was checked for accuracy. At times, data were re-evaluated and codes were re-assigned as needed. At the completion of data transfer, a new worksheet was created named S1-filter. The data were copied into the worksheet and the codes were sorted by type. Again, the codes were verified for accuracy and corrected as needed. The process was repeated for all scenarios. Check-coding assisted in providing a good reliability check (Miles and Hubman, 1994). Next, the data from the filter worksheets were copied into a worksheet named CODE that was created to show all categories the participant used during completion of information seeking scenarios. The categories were compared among participants, grade levels, and classes of information need.

Next, the problem solving techniques of participants were identified. Returning to the scenario worksheets, the problem solving techniques were coded using the previous list created in the analysis of the NEQ data as a starting point. Categories were created as needed using the constant comparative methods. Figure 5 displays an excerpt from a participant file with coding of problem solving techniques. Relationships were examined among problem solving techniques and information seeking behaviors. Based on the findings, I continued to develop the model that represents the information seeking process of the networked generation youth using the networked environment.

P7-1 Transcribed Data Coded for Problem Solving Techniques

Stage: Problem Solving Techniques	ISB Codes	Transcription Data: Scenario 1: Problem 2
	R1	Researcher explains type of scenario and asks student to select the scenario they would like to complete between the two choices given
	R3	The researcher then asks the student to read aloud the one they would like to complete
	A1	Okay
Recognize/Accept Problem: Make Selection	**C6**	I am going to do number 2.
	R2	And, why did you choose number 2?
	C2	Um…
	A2	because I know exactly what Web site to go to and the first one is a little bit easier
Reflect	**C6**	and I can just go to Google but this one is a different Web site
	A2	I want to try something different.
	R3	Okay, please read the question a loud.
	RS	reads through scenario aloud.
	R4	How are you going to go about…
	C6	I am going to go to Weather.com.
Select Tool: Network Application: Internet: IE	**S13/RA**	has Internet Explorer opened to Google.com
	RN	after completing a practice search scenario prior to selecting the first scenario
	M12	highlights the URL in the address bar
	M5	by clicking the cursor on the URL
	M6	Backspace: 2
Select Tool: Research Tool: Specific Web Site	**S1**	types in weather.com
	M4/P2	weather.com
	M6	Enter
	RA	The page loads to www.weather.com.
	A1	And okay…
	M5	moves the cursor around the page
	M7	scrolls over selections in a drop down menu box
	M13	moves the cursor back up to the top of the page
Examine Results: Resource Examination	**T1**	scans over navigation links on the top of the page

Figure 5. Excerpt from Participant 7-1: Transcribed data coded for problem solving techniques.

3.3.3.5 Analysis of Exit Interview

Data analysis was completed using the constant comparison method. Exit Interview questions were broken down into five themes: information seeking behaviors, problem solving techniques, networked environment use, networked environment/information seeking instruction, and scenarios evaluation. See Appendix I for the Code Sheet for Interview Questions.

The themes were developed based on the semi-structured interview questions. Each question was placed under the appropriate theme. Categories arose from researcher questions and participant comments. I defined subcategories or descriptors based on participant responses. Information seeking behaviors and problem solving techniques were coded using the previous list created in the analysis of the NEQ data and observation data. For example, the interview question, “What type of strategies do you use to locate specific information?” was placed under the theme *information seeking behaviors*. This question was assigned the category strategies. Participant 9-2 answered, “I start out general uh looking for like…like if I wanted to find Chicago fire I’d use “Chicago fire” and then I can narrow it down to theory and stuff like that.” The subcategories assigned to the participant’s statement were *keyword search: broad* and *modify search: keyword search: narrow*. Subcategories that arose from the other participant responses included *select resource: search tool*; *select resource: specific Web site*; *keyword search: broad*; *keyword search: narrow*; *Boolean search*; and *browse search*. The categories that described information seeking behaviors and problem solving techniques are discussed in the findings and integrated into the preliminary networked generation youth information seeking process model.

For the categories under the themes networked environment use, networked environment/information seeking instruction and scenarios, I used descriptors to represent the participant responses that described their attitudes, feelings, or answers given. For example, under the theme, *scenario evaluation*, the category *alternative completion* represented the questions, “What might you have differently?” and “Would there have been anything you would do differently?” Descriptions of student responses included *locate more information*, *tried different resources*, *verify information found*, *target search*, and *be more observant*. Descriptors were used when discussing the participants’ profile and how the participants learn in the results section. Participant responses provided examples when describing the themes, networked environment use and networked environment/information seeking instruction during the results discussion. Participant responses also provided examples when discussing the benefit of scenarios use when developing information seeking instruction.

3.4 Limitations

There are several limitations to this study. Although students in multiple grades levels were studied, all participants were from one school. Sample sizes for each grade were large enough for robust statistical analysis of the final score variable set; however, they were not large enough for analysis of the individual variables that compose the set. The information seeking process of only 12 students were studied in depth. Students’ observations were conducted over a two-week period. The research met with each student twice. Any attempt to generalize findings to other situations should be tempered by the fact that students performed scenarios under controlled settings. The scenarios were imposed and only simulated possible classroom or everyday information seeking environments. Students in this study were limited to networked resources provided by or allowed by the school. Desired networked tools students use in everyday information seeking (e.g., instant messaging, cell phones, specific Web pages) may not have been accessible due to school policy. This research was conducted in 2004 prior to the proliferation of social networking services, wikis, video sharing services, RSS podcasting and news feeds used by this networked generation youth set. Discussion of these services only occurs if students knew about the services or used the services during information seeking.

3.5 Summary

Chapter 3 describes the general research approach, the research design, and the data collection techniques and analysis procedures that were used in this research to investigate networked generation youth information seeking process in the networked environment. This chapter also explained the techniques that were used to establish the trustworthiness of the study. A mixed model research approach was chosen for its appropriate use in answering the study's research questions. The mixed model research approach allowed for the use of multiple approaches to address the research problem. The data collection activities include a questionnaire, observations, and semi-structured interviews. Chapter 4 discusses the results of the study.

CHAPTER 4

RESULTS

The goal of the research was to explore the information seeking process of networked generation youth to arrive at an understanding of how junior and senior high school adolescents access, acquire, interpret, and disseminate information using the networked environment. This was accomplished by examining the cognitive, affective, and physical information seeking behaviors and problem solving techniques networked generation youth use in the networked environment. First, a profile of the students who participated in the study is provided. The profile summarizes the students' knowledge and use of the networked environment in relationship to their information seeking process. Second, the cognitive, affective, and physical information seeking behaviors the participants used in the networked environment are identified. Third, problem solving techniques the participants utilized during information seeking are identified. The profile, behaviors, and techniques are reported using data analyzed from the questionnaire, observations, and interviews.

4.1 Profile of Study Participants

One goal of this research was the examination of adolescent students' specific seeking knowledge, perceptions, and interests in using networked environments. The networked environment questionnaire (NEQ) provided an opportunity to solicit this information. One hundred twenty-five students across six grade levels completed the 29 question, self-administered online questionnaire. The school's administration chose two classes from each grade level to participate. Average class sizes were 18 students.

Twenty students (16%) were from Grade 7. Eighteen students (14.4%) were in Grade 8. Another 18 students (14.4%) were in Grade 9. Twenty-four students (19.2%) were in Grade 10. The largest group, 31 students (24.8%), was from Grade 11. In addition, 14 students (11.2%) were in Grade 12. Age of students ranged from 12 years to 18 years. Participants included 67 females (53.6%) and 58 males (46.4%). Students reported attending the school as little as one year to over 12 years, with a mean score of 7.3 years in attendance. All participants have an opportunity to be effective users of information using a networked environment. The school provides networked computers with Internet access and integrates technology and information literacy into the curriculum. In addition, all participants have a computer with Internet access at home, a requirement of the school.

The student's knowledge and use of networked environments was scored. Abilities varied among participants. The highest possible score was 117. The minimum score received was a 44 and the maximum was 98 points. The mean score across grade levels was 71.57. Table 7 displays the demographic data by grade level showing frequencies and percentiles for number of students, gender, and age. The mean score is reported for years at school and the final score. This research examined the differences in knowledge and use of the networked environment. ANOVAs were used to compare final score means across grade levels, years at school, and number of days using the Internet. A *t* test compared final score and gender.

Although females (*M* = 67, *SD* = 9.07) had a higher final score average than males (*M* = 58, *SD* 10.82), there was not a significant difference for gender, $t\ (123) = .73$, $p < 0.05$. A One-way ANOVA was used to compare final score mean across the six grade levels. Results of the ANOVA analysis F (5,119) = .85, $p < .05$ indicates that there is no significant difference when comparing final score average across grade levels. A One-way ANOVA was used to compare final score mean across years enrolled at school. Years enrolled ranged from one to 12 with the smallest groups (4, 5 and 8 years) having seven individuals and the largest (12 plus years) having 23. Results of the ANOVA analysis F (11, 113) = .88, $p < .05$ indicates that there is no significant difference when comparing final score across years enrolled at the school. A Post Hoc did show that there was a difference for those students who attended the school two years versus four years. There appears to be a saturation of knowledge and use after attending the school for four years. This saturation may occur due to the technology credit hour requirements, the types of technology courses offered, and the level of technology and information literacy integration into the curriculum at each grade level.

Table 7

Frequencies and Percentile Reported for Number of Students, Gender and Age. Mean Reported for Years at School and Final Score on NEQ

Participant Demographics by Grade (N = 125)

GRADE	# OF STUDENTS		GENDER				AGE														Years at School	Final Score
			Male		Female		12		13		14		15		16		17		18			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	M	M
7^{th}	20	16.0	7	5.6	13	10.4	5	4.0	15	12.0	-	-	-	-	-	-	-	-	-	-	7.4	70.45
8^{th}	18	14.4	8	6.4	10	8.0	-	-	3	2.4	15	12.0	-	-	-	-	-	-	-	-	7.2	74.56
9^{th}	18	14.4	10	8.0	8	6.4	-	-	-	-	7	5.6	10	8.0	1	.8	-	-	-	-	6.4	73.06
10^{th}	24	19.2	10	8.0	14	11.2	-	-	-	-	-	-	6	4.8	17	13.6	1	.8	-	-	7.7	70.83
11^{th}	31	24.8	12	9.6	19	15.2	-	-	-	-	-	-	-	-	11	8.8	19	15.2	1	.8	7.0	71.87
12^{th}	14	11.2	11	8.8	3	2.4	-	-	-	-	-	-	-	-	-	-	4	3.2	10	8.0	8.6	68.00
Total	125	100.0	58	46.4	67	53.6	5	4.0	18	14.4	22	17.6	16	12.8	29	23.2	24	19.2	11	8.8	7.3	71.57

Note. Mean scores rounded

Results show that experience, (the number of hours a week a student uses the internet) plays a significant role in students' knowledge and use of the networked environment. Those students who reported using the Internet more often during the week had a higher final score than those who only used it a few days a week. To investigate further this phenomenon, the variable weekly use was compressed into three categories low (1-3 days a week), moderate (4-5 days a week), and high (6-7 days a week). A One-way ANOVA was used to compare final score mean across the three groups. Results show there is a significant difference F (2, 122) = 5.52, p<.05 between groups. A follow up Post Hoc test examined the individual differences between groups. The Tukey's LSD indicates that there is a significant difference between the low users (M = 63.2) and the high users (M = 72.6) when comparing average final score. Students who use the networked environment six to seven days a week were more knowledgeable about networked environments and able to utilize the networked environment more effectively than those who only spent a few days using the networked environment. The research continued to investigate students' knowledge and use of the networked environment in Phase 2 of the study.

Two students from each grade level were selected to participate in Phase 2, the observation and interview sessions, based on receiving the highest scores in their grade and responses given to the open-ended questions. Table 8 shows the distribution of scores and demographic information among the 12 students selected. By happenstance, an equal distribution of males to females occurred among Phase 2 participants.

Table 8

Phase 2 Participants Final and Verbal Scores

GRADE	GENDER	AGE	FINAL SCORE	VERBAL SCORE
7	Female	12	93	19
7	Female	13	87	17
8	Male	14	92	19
8	Female	14	88	17
9	Male	14	85	17
9	Female	14	81	16
10	Female	16	93	19
10	Male	16	89	18
11	Male	17	98	20
11	Female	17	90	18
12	Male	18	85	17
12	Male	17	80	15
Note. High Final Score = 117 points; High Verbal Score = 21 points				

These 12 students articulated a well-developed understanding of what it means to be an effective information seeker in the networked environment, as indicated by high verbal scores. The students' final scores and observation sessions showed they possess knowledge of networked resources and abilities to retrieve specific types of information using the networked environment. During the observation sessions, they often combined networked resources to locate and synthesize information. Moreover, they demonstrated abilities in utilizing networked resources in problem solving both in their verbal problem solving responses on the NEQ and in the observation and interview sessions.

The following subsections discuss students' knowledge and use of networked environments in relationship to their information seeking process. Specifically, the results describe students' perceptions of effective information seekers, knowledge of networked environment concepts, use of networked environments, knowledge and use of networked resources, and use of problem solving. Examples from the observation sessions and articulations from the interview session are integrated into the NEQ results to broaden the profile of study participants.

4.1.1 Perceptions of Effective Information Seekers Using the Networked Environment

Collectively the participants provided a well-developed understanding of what it means to be an effective information seeker using the networked environment. Students described effective information seekers as experienced computer and Internet users. They described them as practiced researchers who are familiar with available networked resources and can select reliable search tools depending on the information need. Effective information seekers create efficient search strategies that yield relevant resources. The individuals can evaluate resources for credibility, can assess information for its reliability, and use the information based on its relevancy to the information need. As several students explained,

> [The effective information seeker is] someone who can go to Google or local databases and use the resources to quickly and effectively find pertinent information on a certain subject. Usually [the person is] someone with a proficiency in typing and a good knowledge of [I]nternet databases.

> They probably have a feel for which search terms will return the types of pages or information sources they are looking for. Additionally, this person is probably well versed in which search engines are most comprehensive or tailored to what they want to find, and this person would probably do more than one search on more than one search engine. Finally, they would probably use the "advanced search" selection offered by most search engines in order to do more targeted research.

> [The effective information seeker is] someone who can quickly gather information that is both pertinent and factual to what the query is.

Intuition plays a role in being an effective information seeker, according to the students. The individual has the ability to “make intelligent guesses” in selecting tools, locating resources, and evaluating information. One student explained that an effective information seeker is,

> Someone who knows how to find information on the [I]nternet very well is very intelligent and has good instincts. This person can use the knowledge they have of the computer and build conceptually off of it just by ‘tinkering’ and by the process of elimination.

Students classified effective information seekers as professionals, “computer specialists”, “computer technicians”, and “researchers”. These individuals are considered “savvy,” “techies,” “gurus,” whizzes,” or “nerdy, in a good way”. Students described someone who knows how to find information on the Internet really well as “a computer expert, “computer smart,” “computer/Internet literate,” and “a great surfer”. They are “intelligent,” “well-informed,” “smart,” “resourceful,” “competent,” and “clever” individuals. The individuals know the “tricks of the trade” which include knowing various Web sites, “techniques” to use on a particular search tool, and how to use advanced search capabilities to create the most efficient search. Other students felt that knowing how to find information on the Internet really well was “normal”. According to one student, “Most people who have computer access have spent quality time using it, and are very familiar with the Internet.” And, another student commented, “Most people I know in this day and age do know how to work the [I]nternet well.” One student believed being an effective information seeker was inherent for younger users. The student stated that “normally teens are better at the [I]nternet stuff because they have grown up around it, so now a day people know more about computers due to their kids.”

Twenty-six students (20.8%) believed they are effective information seekers. They classified their abilities to locate information using the Internet as expert. An expert was defined for the students as, “I know all the tricks and kind find what I am looking for in a matter of minutes.” Three fourths of the students (77.6%) rated their abilities at the intermediate level. They believed they are good at locating information but admit they could always use assistance. Only two students (1.6%) believed they were at a beginner level, “comfortable logging on to a system and can enter a URL in the address box.” When locating information using the networked environment, 24 students (19.2%) reported that they find the information they are looking for all of the time. However, the majority of students (65.6%) believed they find what they are looking for most of the time. A few students (4%) maintained that they only sometimes find the information they are looking for when using the networked environment.

Seven out of 12 Phase 2 students classified themselves as experts in their abilities to locate information using the Internet (as reported on the NEQ). When asked during the interview session what they thought about their abilities to find information using the networked environment the students were more modest. They felt self-assured when locating information but admitted that their skills were not as proficient as they would like. Specifically, students mentioned a desire to gain stronger skills in building effective search strategies, learn more about their available resources, and be able to locate information at a faster rate. They felt this could be accomplished through practice and learning from others who were more knowledgeable. The students did believe they were more experienced than others were, including their peers, friends, parents, and coworkers who were typically adults. Students felt their persistence helps them acquire desired information.

Phase 2 participants feel comfortable using the networked environment. They reported consistently using the networked environment in their daily lives and stated that they like to use the networked environment because it is “quick and easy”. The feel they can find “anything and everything” using the Internet. “You got all this information. You don’t have to go to all these different places to find what you need; it is all there.” And, students like that they have access to the schools shared networked resources at school and home. When faced with an information need networked generation youth want to know they can find credible information in a timely manner. They like that they can multitask in their networked environment; utilizing multiple applications or resources simultaneously. Speed in locating information is important to this group. Students get frustrated when systems run slowly or shutdown, Web sites do not appear and objects do not properly download, irrelevant resources load, or when potential sites are blocked because it hinders their seeking process. These students strive to be effective information seekers.

The next three subsections continue to explore the participants’ information seeking abilities using the networked environment by analyzing the data from NEQ that examined students’ knowledge and use of networked environments related to their information seeking process. Examples from the observation sessions are integrated into the NEQ results.

4.1.2 Networked Environment Content Knowledge

Three questions on the NEQ sought to determine networked generation youth's network environment content knowledge through participants' understanding of basic network terminology. In Question 6, participants described what a network is and gave an example. As one student wrote,

> A network is a group of computers that are linked together. My family is on a network at our home. My computer is upstairs but yet I am linked to the downstairs computer, so that I can print my work off.

Over half the participants, 77 students (60.8%) explained the concept well. Of those participants, 32 students (25.2%) explained the concept well and provided examples. Examples of networks include home networks, school networks, business networks, and the Internet. However, 27 students (21.6%) just gave an example or only expressed the basic concept. In addition, 22 students (17.6%) either gave an inaccurate definition (seven students), said they "don't know" (three students), or did not answer the question (12 students).

Students selected multiple responses to describe two network concepts, Internet addresses and file extensions. All the students selected a correct response for Question 7, which asked what a URL is. Sixty-eight students (54.4%) selected the option Uniform Resource Locators as its definition. Eighty-four students (67.2%) selected the definition Web address unique only to one Web site; and 87 students (69.6%) selected the example http://www.dogpile.com. Not one student selected the inaccurate response. However, while the majority of the students understand the concept, only 40 students (32%) selected all three correct choices and received a perfect score for the question. The same results occurred with Question 8. All the students selected a correct response for the question, what do gif, exe, zip, doc, html, voc, mov and jpeg have in common? The majority of the students (87.2%) selected the response they are all common types of files. Yet, only 36 students (28.8%) selected the response they are used in Web addresses. Overall, only 24 students (19.2%) selected both accurate responses and received a perfect score for this question.

4.1.3 Networked Environment Use

Networked generation youth are consistent networked environment users. Most students (75.2%) reported on the NEQ using the Internet 6-7 days a week. The majority of students (91. 2%) reported using the Internet an average 1-3 hours per day for school work. And, over half the students (65.6%) reported using the Internet an average 1-3 hours for personal use; 27.2% reported 4-6 hours of personal use.

When surveying participants on the networked services used, students reported using networked services for communication and Web access. Email and instant messenger are the communication tools used most frequently. One hundred twenty-one students (96.8%) use email. Many students list using several different types of email services, which usually include having a fee-based, a free, and a school email account. Several students host their own mail service on personal mail servers. Many different instant messenger services are also used. Instant messenger services such as AIM®, Yahoo! ®, MSN®, ICQ®, and Hotmail® are used by 84.8% of the students. While not as widely used, 46.4% of the students use Chat services. Students use chat services to communicate with friends, discuss personal interests (music, politics, sports, television shows), and gather support on teen and lifestyle choice issues.

When asked how often students use the Web for activities such as auctions, shopping, games, searching, or business, 112 students (89.6%) reported that they sometimes or always use the Web in this manner. Ten students (8.0%) reported never using the Web in this manner. Students gain access to the Web through browsers including AOL®, Internet Explorer®, Netscape Navigator®, or Mozilla Firefox®. Students shop, play online video and fantasy sports games, research, use reference resources, complete homework, and access news, weather, and entertainment information. Students ranked their top ten Internet search interests from a predetermined list of 16 categories. Entertainment, music, research for school, news, and sports were ranked the highest. Table 9 shows the Internet search interest categories selected by rank. Search activity examples are reported with each category.

Table 9

Internet Search Interests Categories and Examples by Rank

Rank	n[a]	Internet Search Interests	Search Activity Examples
1	102	Entertainment	Television, Movies, Video games, News
2	100	Music	Concert Info., Genres, Artist/Band Sites, Radio,
3	95	Research for School	Projects, Papers, Study Guides, Homework help
4	89	News	Headlines, Weather, Sports, Science, History, Politics
5	73	Sports	Fantasy, Major League Teams, News, Reference
6	69	Shopping	Clothing, Books, Movies, Auctions, Concerts, Events, Music, Games, Electronics,
7	66	College and Universities	General Info., Application Process, Financial Aid, Testing, Summer Programs
8	53	Hobbies	Trading Cards, Digital Art, Woodworking, Collectables, Photography, Painting
8	53	Reference Resources	Dictionaries, Yellow Pages, People Search, Maps,

			Thesaurus, Encyclopedias
10	46	Fashion & Beauty	Clothing Stores, Designers, Beauty Tips, Fashion Tips, Magazines
11	39	Travel	Vacation & Trip Planning, Cruises, Airfare, Flight Info., Travel Weather Reports
12	33	Computers & Technology	Purchasing, Products, Upgrades, News, Troubleshooting
13	30	Food	Recipes, Food Web sites, Restaurant Reviews
13	30	Transportation	Cars, Car Shopping, Directions
15	28	Health and Fitness	Resources, Teen Issues, Diseases/Illness, News, Exercise, Magazines
16	23	Finance	Stock Market, Banking, News, Financial Assistance
[a]n = number of students selecting interest as a top 10 choice			

News groups and message boards are also services students use to gain access to information. Twenty-seven percent of the students subscribe to news groups. One student reports being in charge of a youth group sponsored newsgroup. And, 33.6% of the students use message board services. Message board topics student sign into include homework help, personal interest (music, science, art, games, sports, books), and support services (computer programming, teen issues, writing). One student reported accessing a personal soccer team's message board that was created to update team members on practice information.

A small percentage of students develop Web pages. Thirty-three percent of the students report using Web-hosting services. Services used included GeoCities®, AOL, Angelfire®, Tripod®, Freewebs®, SBC®, and MSN. Several students also host their own Web server. However, only 11.2% of the students use FTP services. Those students who FTP files use standard programs including Windows Server System™ 2000 FTP Server, SmartFTP®, WS_FTP®, and CuteFTP®.

While students reported using a variety of networked services, expressed use does not always mean explicit knowledge. For example, although students report using newsgroup services, they provide examples of gaining access to news on resources like CNN™, ESPN®, Fox News™, The New York Times®, and The Washington Post® as examples of newsgroup services. Some students were not sure if they understood the concept. For instance, one student wrote,

> I'm not exactly sure what you mean, but I receive the New York Times headlines and stories on a daily basis. I also receive different [announcements] in my mail from different groups to whom I've subscribed.

Moreover, for other students, complete knowledge of networked services has not been achieved. Several students reported not knowing about different types of services. When describing the networked services used, students wrote, “What is Web-hosting service?”, “What is ftp service?”, or “I don’t know what it is” in the example response field. Knowledge of networked environment technical terms may be a key as to why students express lack of knowledge regarding networked services. When providing an example of an instant messaging service used one student wrote, “Oh, so THIS is where AIM goes...” The student had placed AIM as an example in the chat services example field writing, “AIM--so not really a chat room, more of a chat service”. This was also evident from the 10 students who stated that they never used the Web for activities such as searching but they reported that they use search engines to search for locating information and the school integrates Web use into classroom activities.

4.1.4 Networked Resource Knowledge and Use

A person should possess knowledge of the range, organization, and uses of networked resources to be network literate (McClure, 1994). This understanding was articulated by a small percentage of the students when asked to describe the types of resources they use to find information using their school's network. One student explained,

> I often use LexisNexis Academic Universe to do research for debate. This includes finding law journals and recent newspaper or magazine articles on specific topics. Lexis has also helped me gather data for my Statistics course because it lists so many of the federal government's Bureau of Statistics' findings. Sometimes I use other electronic databases for research, especially if I am doing research in Spanish, because I can look to Informe Spanish to find articles in that language. For most generic school research, I turn to [I]nternet websites such as Google or Ask Jeeves. For bigger research assignments, databases such as Ebscohost come in handy. Having many different databases to search from ensures I get all the relevant articles I need.

In addition, a small percentage of students articulated knowledge of the range, organization, and use of the networked resources when describing what school networked resources are available to students at home. For example, two students wrote,

> You can search the actual site [referring to the school's Web site] then you have webmail in which you have your own e-mail account and that is connected to [discussion] groups that only other members of the [school's] network can log-in to.

> All of the online databases on the library website are [available] such as Lexis/dictionary/English links/language links/etc...only resource not available is the access to the network hard-drives from home.

Most students provided a brief description of generic resource offerings on the school network or just gave the name of some of the networked resources used. These students mentioned using the Internet, particularly search tools, the library catalog, the library databases, and teacher provided Web sites. A student explained, "For history and debate I use the electronic databases provided by the library. But mainly for other [subjects] I use the web resources like Google." In addition, another student stated,

> I use the [library's] online [catalog] (ATHENA) to find specific books. I also use the school's [I]nternet access to do research. Finally, I have (although rarely) used online databases our school has a subscription to, such as LEXUS NEXUS [sic].

The same occurred when students discussed the school's networked resources available to them at home. Fifty-three students (42.4%) gave only a brief description of generic resources available from home. Students mention the school Web site, library catalog, project sites, or databases as examples of available resources. Forty-seven students (37.6%) provided descriptive details of the networked resources available. They reported that all students have access to email, the homework system, message boards, discussion groups, and teacher pages with syllabi and linked resources. Many students listed project pages that are available on the library site which provide links to Web pages and database resources. Students described specific web-bases research databases, providing names (Junior Reference Collection, LexisNexis®, Bigchalk™, Ebscohost®) and how the databases are utilized in the information seeking process. Students also reported that many of the resources are secure (e.g., students need id and passwords to gain entry).

While students report knowing what networked resources are available at school and home, use does not always occur. Several students admitted using school networked resources only when they were required. One student remarked,

> When [I] am searching for an article or a reputable source of information, I use the tools on the library webpage. I do not remember their names, but only for specific cases do I use the ones available on the school website. Generally a teacher specifies if they want us to use the tools on the library page, but the rest of the time google.com works the best.

Others admit to not using the networked resources at all. One student declared, "If I'm using school resources, I usually just go to the library instead of using electronic resources." In addition, another student wrote, "If there are any [resources available from home], I do not know of them or use them." Reasons for non-use are personal preference,

> I don't usually use [the school's] network to find information. I am not a big fan of their databases. However, this is most likely because I like to find things on my own because I have a better understanding then.

Or, competency,

> I don't use the school's resources, mainly because [I] don't know how to get to them. When [I] want to find databases it always makes me have a password and a user id, and [I] don't know what they are.

Frustration can also cause lack of use. Like the student above, password frustration was also a problem for students electing to use the networked resources from home. Several students mentioned needing access codes for subscription databases that they did not have or were not given; so, they chose not to use the resources. During the observation session, one participant attempted to use a subscription database linked from the library Web page. Even though the participant possessed a code sheet provided by the library, when access code entry failed, the student became frustrated and returned to using a search engine. Some students even choose to use other school's resources. For example, one student reported that she did not know how to use her school's networked library resources at home so she used her brother's, who attends another school.

4.1.4.1 Networked Resource Selection

Although the school provides a variety of networked resources, generally, the students prefer using "Web sources" when locating information using the school's networked environment. One student stated, "Mostly I use web sources like I do at home. I can find just as much information.” Another student said, “[I] usually use the web sources because it is the easiest way to find useful information…” In Question 18, students selected all the resources they choose to use when locating information using the Internet. The list included five networked resources: search engines, pathfinders, library catalog, subscription databases, and own style. All students (100%) selected search engines use. Furthermore, 60% of those students reported using only search engines as a means of locating information. However, 40% of the students use multiple networked resources to locate information. Along with search engines, 42 students (33.6%) selected online databases use. Twenty-five students (20%) selected library catalog use. Seven students (5.6%) selected pathfinders use. And, six students (4.8%) selected using their own style. Examples of students own style of locating information included using specific Web sites (www.____.com), using Web category systems (i.e., DMOZ), asking people, and following hyperlinks to gather more in depth information on a topic. Only one student reported use of all five networked resources. Three students reported use of a combination of four resources. Twenty-one students reported use of a combination of three resources and 25 students reported use of a combination of two resource, typically search engines and subscription databases.

When selecting resources to complete the information scenarios, participants actually chose various networked applications and search tools. While the Internet was used to access information, students also selected word processing applications to collect, store, and synthesis information and calculator applications to process data. Students selected a variety of tools to locate information. Tool selection typically depended on the information need. Tools chosen were search engines (i.e., Google™, Yahoo!, Ask Jeeves®), search directories (i.e., DMOZ), subscription research databases (i.e., Ebscohost, LexisNexis), encyclopedias (i.e., Encarta®), and many commercial, educational, governmental, and organizational Web sites. However, a primary starting place for most students was a search engine, usually Google.

On the NEQ, students were asked to list three favorite search tools used for locating information, it is no surprise to find students frequently list search engines as their favorite tools. Table 10 displays the list of favorite search tools used by students in order of preference.

Table 10

Student Favorite Search Tools List by Order of Preference

Favorite Search Tools
Google
Yahoo!
Ask™; Ask Jeeves
Dogpile®
Reference (Encyclopedias, Dictionaries, ect.)
Browser Search box or Address bar (AOL, Netscape, IE)
Altavista™
MSN
Subscription Databases (LexisNexis, Ebscohost, etc)
Specific Web Sites (howto.com, about.com. www___.com)
Infoplease®
Lycos®
Forums; People
Yahooligans! ®
Ask Jeeves for Kids
DMOZ
Hotbot®
Sherlock®

4.1.4.2 Information Location Knowledge

The NEQ surveyed students' knowledge regarding information location. Question 20 asked students to select the most efficient way to locate information about NASA from a choice of six responses. Table 11 displays which resources students chose.

Table 11

Search Efficiency Reported By Percentiles

Know Homepage	52.8 %
Search Tool	39.2%
Online Catalog	2.4%
Online Dictionary	1.6%
Ask Friend	1.6%
Not Certain	1.6%
No Response	0.8%

Half the students (52.8%) recognized that it would be most efficient to go directly to NASA's Web site so they selected the known address of homepage response. However, 39.2% selected a search tool as the most efficient way. A small percentage of students thought online dictionaries, the online catalog, or asking a friend would be the most efficient way to locate the information. A few students were not certain which to choose as the most efficient resource.

Students used various Web pages, search engines, subscription databases, and online encyclopedias to complete the information scenarios in Phase 2. However, most of the students selected a search engine to begin locating information. Out of the 48 instances of scenario completion, there were 37 instances where students chose to use a search engine, usually Google, to begin locating information. There were 11 instances where students chose to begin scenario completion by selecting alternative methods. For example, the first instrumental scenario asked participants to find out what types of snacks a diabetic can eat then print or download two recipes to make with friends. One student selected a medical information site (WebMD® Health Search) to begin locating background information on the types of food diabetics were allowed to eat before using a search engine, Google, to locate recipes. For the second instrumental scenario, a student selected a specific site, weather.com, to begin to locate information on tornado safety. The second confirmational scenario asked students to compare their weekly school lunch menu to the recommended amounts of daily nutrition on the Food Guide Pyramid. Students who chose to complete this scenario began with selecting the Menu link located on the school's Web page to find the school's weekly menu items then switched to search engines to find information on nutritional policy or the food guide pyramid.

For the first factual scenario students were asked to locate a recent news article on the Great Chicago Fire that provided an alternate theory to a previously well-known theory. Again, the majority of the students used a search engine to begin their search; however, three students chose alternate paths. One student started with locating articles from one of the school's library subscription databases services. Another student chose Encarta.com, an online encyclopedia, to locate background information. The third student tried a specific science news site (sciencenews.com) since the words science news were mentioned in the scenario description and the participant knew of an online magazine with that title.

Students chose topical Web sites in the motivational scenarios. While planning a family trip to complete one of the motivational scenarios, two students chose a trip planning site, expedia.com, to begin selecting a destination and locating information.

For the fantasy sports game scenario two students began locating player information using ESPN.com, a topical sports site.

The observation data indicated that students recognize that selecting a source depends on the type of information needed and personal knowledge of resources. For the first confirmational scenario, students verified how much prize money they would have left for movie snacks after placing a portion into savings and purchasing desired video games and movie tickets. As the prize money was given in Canadian dollars, the first task was to convert the money to U.S. currency. All students used Google search to locate a currency converter to assist in converting the money because, as they revealed, a specific site was not known. However, once calculations were complete, students switched sources to locate video games and movie ticket information. Students used known commercial Web sites (e.g., BestBuy.com, eBay, Amazon.com, Cinemark.com, Fandango.com, etc.) to locate video game pricing and ticket pricing information because they were familiar with the sites and knew what information they would be able to locate off the sites. One student searching for information on the Great Chicago Fire theory used two sources simultaneously. Opening two browsers, the student multitasked using Google search to conduct “a general” search and the school’s library subscription databases to conduct searches on two different subscription databases (Bigchalk and Ebscohost) in order to locate background and scientific information.

Students also recognized that using one source may not always lead to finding desired information. This was evident by students’ plans to select multiple resources or actions of selecting alternate tools during scenario completion. When one tool was not producing the desired results, students switched to other sources. The student who began searching for tornado safety information using a specific Web site switched to Google search after reviewing the site and deciding that the site "doesn't have too much". A student searching for information on the Great Chicago Fire theory began by selecting Google search to locate background information but when no desired information was found the student switched to an online encyclopedia, Encarta. The student then decided that the newest information found was not as exhaustive as desired so the student placed a search query in the browser's address bar which returned results in the browser search tool (MSN).

4.1.4.3 Query Formulation Knowledge

According to the students, knowledge of how to formulate queries is important in being an effective information seeker. Another reason students switched source was because of the types of query they wanted to formulate. A student locating information for the Great Chicago Fire theory scenario started to locate information using Google search but switched to Ask.com because the student wanted to use a tool that searches using natural language. The student explained when asked about the switch:

> Because Ask.com…Google you search for keyword same as Yahoo and it will bring up sites that have stuff like that but when you go to Ask.com you can ask it specific questions so you can get more stuff answered…

When desired information was no longer found using a natural language search, the student switched back to Google search and conducted a more robust keyword search than the one used prior to switching to Ask.com. Source switching for the sake of query formulation also occurred with one of the student completing the tornado safety scenario. The student began looking for background information on Tornado Alley using

Google search but then switched to Ask Jeeves (also known as Ask.com) because as the student reported, “I feel like I have more of a question.” The student continued to use natural language queries when attempting to locate information using Ask Jeeves and when switching to use the browser search engine (MSN) to continue to attempt to complete the information scenario.

Whether students use search engines, subscription databases, or specific Web sites, the observation data indicated that students completing the scenarios understood that efficient search results depended on how well queries were formulated. Students formulated keyword, phrases, natural language, and subject queries. Queries were broad and narrow depending on the desired information. Students formulated broad queries when they wanted to “see what happens” in a search. As one student explained when searching for diabetic information, “I would probably type in diabetic um just as a generic search… Even though it is not specific so it will probably turn up a lot of stuff.” Students formulated narrow queries “to get more specific results.” A student completing the Great Chicago Fire theory scenario formulated the multiple keyword query “theory Great Chicago Fire” in the Google search box. After examining search results the student narrowed the query further by adding the date, 1871. The student modified the query “so it will narrow it down because it could be another fire in Chicago it could also be called the ‘great Chicago fire’ so I am just making sure it is the one in 1871.” When the new results loaded, the first result was a link to a recent article on an alternate theory.

Using keywords with Boolean search operators has been a key to developing robust search queries in electronic searching (Marchionini, 1995). When asked on the

NEQ if it was better to use more keywords in a search connected by *and*, 20% of the students agreed. When explaining their response one student said, “In a boolean (sp) search the more keywords you have the more the results will be narrowed down.” Another student replied, “It can narrow down a broad search and help find the specific information needed.” However, while some students agreed it was better to use more keywords in a search connected by *and*, from a system point of view students explained that the word *and* would be omitted. A student wrote, “Well, yes but its going to omit the "and" anyway...but the more keywords you have the narrower the search.” Other students gave examples of specific Boolean operators to use in search engines that could provide what they felt would return better results. As one student explains,

> As part of the search query--because most search engines don't search by words like "and" and "the"; As an alternative [use] a "+"--because the more detailed your search, the better results you'll get.

Students’ knowledge of search engine query execution algorithms may be one reason why 63.2% disagreed that it is better to use multiple keywords with *and.* Several students explained that some search engines “do not require Boolean operators for connections to be made.” The students stated that the search engine automatically uses *and* between words when multiple keywords are entered in a search field so the word *and* would be ignored. In contrast to those students’ opinions, several students feared that placing the *and* in the search would cause too many unrelated results. One student thought that using *and* would “break the words up and give you results that are irrelevant.” In addition, another student thought, “the search engine will locate all the Web sites that contain the individual words [separated] by ‘and,’ instead of locating the sites where the words are together.” Furthermore, students thought it best not to use multiple keywords with *and* because "'and' might throw the search engine off by making it search for 'and' as well as the important keywords." Many students felt a broad search was better; a narrow search "may limit the search too much." One student believed that a simple keyword search yields more sites that could then be narrowed down. While another student stated that, "Sometimes being too specific in a search can exclude valuable information from sites that may have been using slightly different wording."

Boolean logic was a confusing concept for some participants. Students at times inaccurately defined *and* use in Boolean logic. One student confused *and* with *or* stating that "if you use 'and' it could bring up information about both topics rather than them both together." Confusion of Boolean operator meaning may be why only 18.4% of the students knew that placing a "+" in front of keywords meant "all hits must have the word" when using Google search. Surprisingly, from the amount of times throughout the survey students reported using Google search, 37.6% said they did not know what the symbol meant and 40% of the students thought using the "+" was a replacement for the Boolean operator *and*. Students completing the information scenarios often used multiple keywords when creating search strategies. Many used quotations to keep words or phrases together. Students selected limiters in search tools and used advanced search features to narrow results.

4.1.4.4 Search Tool Knowledge

Knowledge of how to use Internet search tools is important in effective information seeking; especially the ones used most by an individual. Yahoo! had been one of the preferred search tools among children and adolescents in early Internet use (Bilal, 2002) and it was still a desired tool among this age group when the study was developed; therefore, Yahoo! was used as an example to determine student search tool knowledge. Question 21 sought to gather students' knowledge of Yahoo! as a categorical and keyword search tool. Students were asked to explain how they would begin a search to find information on the recent Mars exploration using Yahoo!. More than half the students (62.4%) provided responses that indicated knowledge in using Yahoo!'s keyword or categorical search features to locate information on a given topic. As several students explained:

> [I] would go to www.yahoo.com and locate the search box. Within the box, [I] would type in various phrases: "Mars", "Mars explorations", "Exploring Mars", etc and browse the results.

> [I would] go to yahoo.com find the search engine area, and type in, "recent Mars explorations.

> [I] would look for the links that lead to websites on mars such as space: planets: mars.

> Probably type "Marx exploration" [sic] into the search engine, and if I did not find what I was looking for under websites I would look at their specific, categorized choices of sites.

> Type in "mars explorations" under the main heading, then try looking under the science subcategory or the wider heading of recent space exploration.

Students' knowledge of Yahoo! was also surveyed in Question 25. Although Yahoo! began as a categorical search tool, its services expanded to include a full Internet service provider with services including email, Web hosting, and search capabilities. Almost half the students (49.6%) were able to select four or five of the services Yahoo! offers from the given list of five services: (a) subject search directory, (b) keyword search engine, (c) Web hosting service, (d) email provider, and (e) browser. Sixty students (48%) selected Yahoo is a subject search directory. One hundred four students (83.2%) selected Yahoo is a keyword search engine. Eighty-one students

(64.8%) selected Yahoo is Web hosting service. Seventy-eight students (62.4%) selected Yahoo is an email provider. In addition, fifty-three students (42.4%) selected Yahoo is a browser.

Students participating in Phase 2 demonstrated their knowledge of how to use search tools while completing the information scenarios. As stated earlier, students selected Ask.com as a search tool because they knew the tool uses natural language searching and the students desired to formulate their queries as questions. Students selected Yahoo! because they desired categorical searching. Students used the browser address bar as a search tool because they knew that if you place a search term in the box the default search engine will execute the search. Students used this option because it was “faster” than opening a search engine page. One student knew that Google search engine provides a built in calculator. This allowed the student to calculate quickly exchange rates, savings, and potential expenditures for the prize money after selecting video games or locating movie ticket pricing without switching to another application when completing a confirmational scenario. Students’ knowledge of a search tool was also instrumental when making decisions not to use particular tools. As one student reported, “The reason I prefer not to start with Google is because they started to use sponsored links and their results have deteriorated.”

Search tool knowledge includes knowing how tools return query results because it may affect identifying and accessing applicable information. The NEQ surveyed student knowledge of result return algorithms by asking the question, in what order do most search tools list their results? Table 12 shows the responses and their percentage selected among participants.

Table 12

Search Tool Result Order Reported By Percentiles

Relevant to the term	73.6%
Frequency	17.6%
Do Not Know	4.8%
Alphabetical	2.4%
Chronological	0.8%
No Response	0.8%

A majority of the students (73.6%) understand that most search tools return search results that are relevant to the terms typed. Most other students (17.6%) selected frequency of sites visited as the return algorithm. A participant in Phase 2 verified this thought when explaining the decision to use Google search engine as a source for locating information. The student stated,

> Google is the best search engine. I know it has most sites; and, I am pretty sure it ranks its sites in the order in [which] have been seen most often and what is visited most…What is visited most is what is going to be the best in Web sites.

While not incorrect, search engines typically rank results by relevancy to search term; some search engines, like Google, then add a frequency filter to the return. A small percentage of students thought search tools return results either alphabetical, chronologically, or did not know. Typically, students completing scenarios in Phase 2 selected the results that were either at the top or close to the top of the list returned by the search tool.

Phase 2 students also showed that titles and descriptions provided were important in their decision to identify and access applicable information. Students often scanned the titles and description and reported that selection or non-selection of particular links was based on the title or description. For example in the first factual scenario, after conducting general searches first using Google search and then using

LexisNexis to locate background information on the Great Chicago Fire theory, the student returned to Google search. The student formulated a query using multiple keywords added to the original search phrase to narrow the search. A link that had appeared in the previous Google search results list was now first on the list. The student reviewed the title and description for that result. The bolded portion of the transcript excerpt in Figure 6 shows that the student's earlier decision to ignore the result was based on the title provided. However, now that the link showed a higher relevancy with the new formulated query (i.e., the result is at the top of the list) the student gave the resource a second look. Something in the title caught the student's interest as the student declared, "Uh, discovery channel" and selects the link. After reviewing the page, the student found that the article provided the information needed to complete the scenario.

This students' experience shows that use of the networked environment for information problem solving affects students' information seeking process. In this instance, the position on the results page and the way the title was displayed by the search tool affected the student's initial decision not to select the resource even though, as later the student would find, it was the resource that would assist in locating the information needed to complete the scenario. Students' knowledge of search tool ordering and display of results also plays a role in information seeking. The student understood that Google search returns results based on relevancy to terms searched, which caused the student to reconsider looking at a resource earlier dismissed since now the resource was displayed at the top of the list.

Key: V= video capture P = Participant comments R= observer comments.
Participant 11-1 Session 11-1-2 Factual Scenario: The need for and consequent provision of precise data. … V: The search results page loads. P: um… uh discovery channel… V: P11-1 moves the cursor down into the page and scans the first link titled Discovery Channel: Did the Comet Trigger The Great Chica using the cursor. P: I saw that came up but it was lower on the first search that I did but I thought Chica because of that word and the title of the article I probably…it wasn't…that that wouldn't have been the article. I guess it just cut off after… um I guess I thought it would be different. V: P11-1 selects the link and the page loads. A pop up window appears on the screen with a security message. P11-1 selects the OK button. The window disappears. R: I was wondering why you didn't go down and select it. P: Yah, I thought… I just thought it would be something wrong. V: P11-1 moves the cursor down into the page. P: It looks like this gives most of the uh answers to the question. The first line indicates um or answers the questions of who started the fire.

Figure 6. Transcript excerpt: A student's decision to use title as link selection indicator.

4.1.5 Problem Solving in the Networked Environment

Three questions on the NEQ assessed how students approach information problems using the networked environment. Questions examined students' problem solving approach when locating information using networked resources, when locating specific types of information, and when using a specific function of the networked environment. Students articulated their problem solving process from beginning (i.e. log on to network) until end (i.e. process information, buy tickets, turn in assignment, log off network, etc.). Students' abilities to articulate their problem solving process varied. Table 13 provides the articulation ratings for each question. Student either provided full descriptions of each step they would take to address the problems, listed out some of the steps they would take, or provided a few words about the general process or first steps they would take. Some students chose not to complete the question or gave incomplete responses indicating they "did not know" or "would not use the networked environment."

Table 13

Frequencies and Percents of Student Articulation Ratings for the Problem Solving Questions

Questions	Articulation Ratings	n	%
Q26. Describe in the box what steps you would take to find information on the presidential candidates proposing to run in the 2004 election using your school's networked environment?	No response or incomplete response	11	8.8%
	Provide a few words about general process or first steps	13	10.4%
	List out some of the steps they take to address the problem	60	48.0%
	Provide a full description of each step taken to address the problem	41	32.8%
Q27. How would you look up information on what is playing at your local movie theater this weekend?	No response or incomplete response	2	1.6%
	Provide a few words about general process or first steps	23	18.4%
	List out some of the steps they take to address the problem	39	31.2%
	Provide a full description of each step taken to address the problem	61	48.8%
Q28. You need to find a song for a class project on music from	No response or incomplete response	15	12.0%

the 1980s. How would you go about selecting a song and downloading it from the Internet?	Provide a few words about general process or first steps	17	13.6%
	List out some of the steps they take to address the problem	60	48.0%
	Provide a full description of each step taken to address the problem	33	26.4%

Students' ability to articulate their problem solving process may increase or decrease depending on the type of problem or their familiarity with the problem.

For example, Question 26 asked students to describe the steps they would take to find information on the presidential candidates proposing to run in the 2004 election using their school's networked environment. This question examined students' problem solving approach when locating information using networked resources available form the school's network. Thirteen students (10.4%) indicated they would use a general process or by explaining the types of the tools and resources they would use and the search strategy they would create and implement. Examples included students stating, "I would get on a computer and either look up the presidential candidates name's or look up the 2004 election website" or "Go to our search engine and type in 2004 election." Sixty students (48%) described their approach by listing out some of the steps they take to address the problem. For example, one student explained,

> I would have to log on to my account, open up the [I]nternet, go to google.com, and search for "Vote 2004". From there I would access sites for the information on the candidates that I needed.

Forty-one students (32.8%) provided a full description of each step taken to address the problem. Most of these students described which resources they would select, provided examples of the search strategy they would use in a search tool, and explained how they would evaluate the information found in results of the search tool or in the resources selected from the tool.

> I would go to the computer lab. Then I would log on to my username. Then I would go to Google.com. Then I would type in presidential candidates proposing to run in the 2004 election. Then I would look at all the sites it gave me. And whatever information I thought was necessary I would copy and paste into word, creating a big file of info from different sites, and then I would print it out and highlight and read it.

Not all students knew how to locate presidential information, and therefore, were not able to articulate their problem solving process completely. However, several students indicated that locating current movie information was a regular occurrence and could easily be described. Question 27 asked how students would look up information on what is playing at their local movie theater. This question examined students' problem solving approach for locating resources to acquire personalized information. Previous experience may be why 61 students (48.8%) could provide detailed descriptions of the steps they would take to complete the problem and 39 students (31.2%) provided some steps. For example, the following three students explained their process using their previous experience:

> I look this information up often, so [I] know a good website. I would go straight to www.moviefone.com.

> [I] would sign onto my aol. At the top of the toolbar is a shortcut that [I] created called 'movies.' This shortcut takes me straight to, MoviePhone.com. Here in this website the movies playing around the metroplex are listed. Click on the movie u would like to go see. Then Times and theatres will show up and you click on the one that is most convenient!

> Login to the network. Go to "www.fandango.com". I would go there because I have used it before and it gives accurate show times etc... I would enter in my zip code and see what was playing.

Moreover, although 23 students (18.4%) only articulated their process with a few words, their responses usually indicated students knew a specific source they would select. Responses typically included a specific topical commercial Web site like a movie listing site (i.e., fandango.com or moviefone.com) or movie theater site (i.e. cinemark.com).

Articulating the problem solving process for Question 28 may have been more difficult or troublesome for some students because of students' perceptions of the legalities involved with downloading music from the Internet or because of inexperience with music downloading tools and procedures. Question 28 asked student to describe how they would select and download a song from the 1980s using the Internet for a class project. This question examined students' problem solving approach when locating information for the purpose of downloading, a process specific to the networked environment. Eleven students provided incomplete responses. Five of those students indicated they had not acquired music downloading skills; therefore, they did not respond to the question. Seven students thought downloading music was illegal, not allowed at school, or they just do not download and did not respond to the question. Although 60 students (48%) listed out some of the steps they would take, several of those students stopped their information seeking process after describing how they would locate a song because they did not know how to download music from the Internet or thought it was illegal. For example, two students explained their process:

> I don't know how to download a song. But, I would go to google.com, type 1980's "music", and then look at the results.

> I would go to a search engine and search for a list of 80's songs. I would then pick out a song and then I am not sure how to download it legally.

Although the questionnaire was designed to examine student knowledge and use of the networked environment, students articulated in their problem solving process that the networked environment is not their only option for locating information. For example, four students report that they do not use their school's networked environment so they did not complete Question 26. Moreover, source selection did not always include using the networked environment resources. In Question 26, one student reported that she would ask a teacher for assistance with source selection in locating presidential candidate information. Nine students articulated that they would not use the networked environment to complete Question 27, locate movie information; they would use a print (newspaper) source instead. In addition, in Question 28 twelve students decided they would ask a parent, friend, or use personal knowledge when locating a song for the class project. Overall, the majority of the students could articulate how they would solve an information problem using the networked environment.

Phase 2 students discussed in the interview sessions their problem solving processes used to complete the information scenarios and general problem solving used when locating information. However, when asked if they make a plan to deal with problems that need to be solved only three students indicated that they create a plan. One student reported that she sometimes makes an outline. Four students reported working out a process in their head. As one student explained,

> Um… I wouldn't consciously be like, okay, first I am going to do this, then I am going to do this. Not really in that sense. But, I usually have in the back of my mind a set formulated plan. I mean, like, when I was doing the scenarios, I would usually just try to answer the questions in the order that they came because that is usually what made sense. But, I wouldn't sit down and create a plan.

Four students say they just “search and go.” They “find a place to start and go from there.”

Most students agreed that it would be important to make some type of plan before beginning to locate information. According to several students, a plan would keep a person focused on the objectives. For two students creating a plan was conditional to time, whether or not there was a deadline involved, or with completing a specific task. One student felt creating a plan depended on personal preference. “If you need something right next to you written by yourself, telling you what to do, it might help you. But, if you know what you are doing and if you know exactly where to go, like it is an easy topic, then you don’t really need an outline.” In addition, one student felt planning is important, but that the plan does not need to be formalized. The student stated,

> I mean you need to have some sort of sense of where you are going ‘cause otherwise you are just going to be wondering aimlessly around the Internet. But, I don’t really think that is it is necessary to have a formulated step 1 step 2 step 3.

Students completing the NEQ described many techniques they would use in their problem solving process and Phase 2 students demonstrated various problem-solving techniques while completing the information scenarios. Techniques varied in defining the problem, selecting a source, formulating queries, executing queries, examining results or evaluating information, locating resources, selecting resources, extracting information from resources, and synthesizing information. The techniques students use in their problem solving process are reported in the problem solving process section of this chapter and discussed in the discussion section of chapter 5.

4.1.6 Summary

Network literacy is defined as the ability to identify, access, and use electronic information and includes one's knowledge of the range, organization, and uses of networked resources. Network literate individuals possess a specific set of skills, which include how to retrieve specific types of information from networks, how to combine networked sources, and how to utilize them in problem solving (McClure, 1994). Networked generation youth in this study used a broad range of networked services for communication, entertainment, commerce, and information gathering. They consider the networked environment to be an important resource for schoolwork often completing assignments using the school's networked information resources in the library, computer labs, and from home. However, knowledge and use of networked environment varied among students. Students who spent more time using the networked environment daily, for school and personal purposes, often knew more about networked environment concepts and resources and could utilize that knowledge during information seeking and problem solving. The more experienced users in this study write computer programs, create digital files, assemble computer networks, help fix or set up computers, and teach others how to use networked information resources.

In the context of information seeking, being network literate includes the ability to adapt effectively to the networked environment to solve information needs. A person should have awareness of networked information resources and their organization, be able to use information and communication tools effectively to access networked sources, and be able to judge the relevance of information located in networked resources (Savolainen, 2002). This is where participants in this study differ. About half of the 125 students completing the NEQ could only provide a brief description of the networked resources provided by their school that were available for use at school and home. Use of networked resources usually included general search tools (e.g., search engines) and commercial Web pages. Many students were able to provided descriptive details of the networked resources provided by the school. The majority of these students were members of the Grades 8, 11, and 12. These students reported that they knew about and used the networked resources because they were discussed in class or the students were assigned assignments and projects that required their use. These students used a combination of resources including search engines, online databases, library catalogs, pathfinders, and Web pages to locate information. Only a small percentage understood the full range, organization and use of networked resources using all types available networked resources depending on their knowledge of the resource and information need.

Again, there was a dichotomous nature to students' knowledge of information seeking. While some students only possessed a basic understanding of the networked resources they used to locate information, others knew how to customize the resources and use advanced features to meet their information needs. Many students understood the importance in selecting resources based on information need. These students formulated robust queries to locate specific information, evaluated resources for credibility, and evaluated information for accuracy prior to use. Other students took a search and go attitude. This dichotomous nature among students' ability may be due to how they have learned to use the networked resources for information seeking.

The participants in this study reported that they have learned how to locate information using the networked environment primarily on their own. Question 29 on the NEQ asked students to rank the top five ways they have learned how to locate information using the networked environment. Self-taught was ranked highest. Learning from friends ranked second, computer teachers ranked third, classroom teachers ranked fourth, and parents ranked fifth. Students also reported that they learn how to locate information using the networked environment from librarians, help menus, other sources (siblings). Phase 2 students were asked during the exit interview what type of classes they had taken to help them learn about the networked environment or finding information. Students reported taking computer application courses in middle school and Web design or computer science courses in upper school. Students stated that information literacy instruction using the networked environment was at times integrated into classes (e.g., debate, history, English) or class projects (e.g., research papers and projects). Students indicated that they possess what has been called a trial and error learning style (see Watson, 2001). This trial and error learning style may have affected their information seeking process.

Students reported effective information seekers must be able to understand their needs and apply their own knowledge and intuition when faced with problems. Effective information seekers know how to select and use search tools, developing advanced strategies when using search tools to locate information. Effective information seekers must be persistent, have positive attitudes, and have the ability to assess the information accurately for use. Student perceptions of effective information seekers, while at times described by many in simplistic terms, aligns with how professionals define expert information seekers. According to Marchionini (1995), an expert information seeker utilizes well-developed cognitive skills, domain knowledge, system knowledge, individual information seeking knowledge, and attitudes to solve information needs. He stated that expert information seekers possess substantial knowledge related to factors of information seeking, have developed distinct patterns of searching, and use a variety of strategies, tactics, and moves in their information seeking process. Figure 7 shows characteristics that embody an expert information seeker.

Expert Information Seeker =

Cognitive Skills +	Domain Knowledge +	System Knowledge +	Information Seeking Knowledge +	Attitudes
↓	↓	↓	↓	↓
Decision-making Making Inferences	Background Knowledge Hypothesis Formulation	Basic Functions Use Customization Feature use	Patterns Strategies Tactics Moves	Motivation Confidence Tolerance for ambiguity and uncertainty Curiosity Persistence

Figure 7. Marchionini's characteristics of expert information seekers.

While the majority of students classified their information seeking at an intermediate level, some classified themselves as expert. To examine characteristics of networked generation youths' information seeking and assess how networked generation youth's information seeking related to an expert information seeker, twelve students with the highest NEQ score were chosen for Phase 2. These 12 students articulated a well-developed understanding of what it means to be an effective information seeker in the networked environment. Their scores indicated they possessed knowledge of networked resources and abilities to retrieve specific types of information using the networked environment. Moreover, their verbal problem solving responses on the NEQ demonstrated their abilities in utilizing networked resources in problem solving. Students were individually observed as they completed four different information scenarios and interviewed. Students' cognitive behaviors were exhibited throughout the completion of information scenarios, as were affective and physical information seeking behaviors. The behaviors directly shaped the information seeking process. For example, students' cognitive effort of thinking about a potential resource was significant in understanding the student's information seeking process and the tactics in changing resources and strategies of switching from a broad search to a narrow search played a role in assisting the student's ability to locate desired information effectively. The next sections identify the information seeking behaviors and problem solving techniques students used while solving information needs in a networked environment.

4.2 Students' Information Seeking Behaviors

The research identified the cognitive, affective, and physical information seeking behaviors in the context of the networked environment. Data from the observation and interview sessions of 12 students selected from the six grade levels were examined. These students completed four information seeking scenarios. Based on the data, the information seeking behaviors were identified and categorized.

As described in chapter 3, I followed the process used by Walker and Moen (2001) which consisted of categorizing various seeking behaviors utilized by the participants while completing the scenarios. Walker and Moen (2001) created categories that describe networked generation youth's strategies, tactics, moves, patterns, and other cognitive and affective behaviors. Walker and Moen (2001) used Marchionini's (1995) processes (behaviors and their categories) of locating information as a basis for initial categorization of the participants' information seeking behaviors. As in Walker and Moen (2001), I categorized the transcribed data according to the various processes performed by the participants. I also examined the data for the emergence of various behaviors not previously defined. Categories were redefined as necessary and more were added and defined as they appeared in the seeking process of the participants. See Appendix H for the coding and definition scheme.

The following sections outline information seeking behaviors the participants in this study used while completing the information scenarios.

4.2.1 Cognitive Behaviors

Cognitive behaviors are acts related to cognition, knowledge comprehension, problem solving, and critical interpretation (Nahl, 1997). The cognitive effort of deciding which scenario to complete and formulating queries to describe it, as was well as keeping track mentally of resource options engaged the students on a number of cognitive levels. Making decisions about retrieved items and utilizing information in scenario completion was also a complex cognitive task. Based on an analysis of the data, the following student exhibited cognitive behaviors were identified and defined:

Realization: Students reach a level of understanding to a specific action taken.

Thinking mode: Physical or verbal actions students use when deciding a route to take regarding a task.

Error creation: The unconscious process of making an error that affects the outcome of an applied strategy.

Correction: The conscious process of correcting an error in order to redirect the seeking process or alter collected information

Relay findings: Students verbalize findings from information gathered or deduced.

Decision-making: Students make choices or judgments regarding the given information then select a direction to take to complete a task.

Confirmation: Students acknowledged researcher directive or question.

Process completion: Verbal acknowledgement or physical action students make when information seeking process is complete.

Background knowledge use: The students use background knowledge when making decisions about resources, information, or task completion.

The subsequent sections discuss each of the behaviors and provide evidence from the data to characterize each as a cognitive behavior and to describe it more completely.

4.2.1.1 Realizations

Realizations occurred when students reached a level of understanding to a specific action taken. Realizations typically included articulations about information found in the evaluation process or about missing steps in the search process. Realizations would start with an expletive, usually with words like, “oh,” “wait,” “actually,” or “oops”. For example, Participant 10-2 realized after modifying a search that a previously passed over link appearing on a new results list may actually be relevant to scenario completion:

> P: See what this one is because it has popped up on my search five times so I should look…

V: P10-2 quickly moves the cursor back up to the top and selects the top result link titled: Slashdot: Did A Comet Trigger The Great Chicago Fire? The page loads.

M: 03/30/04 01:21:11 PM Participant 10-2 0:01:17 0:01:15 0:01:15 Web http://science.slashdot.org/science/04/03/06/1831207.shtml

Slashdot | Did A Comet Trigger The Great Chicago Fire?

V: P10-2 reviews the posted information on the page using the cursor.

P: Oh… [REALIZATION]

P10-2 selects the linked information "New research lends credence to an alternative explanation". The page loads to a news article from discovery education titled "Did a Comet Trigger the Great Chicago Fire?" P10-2 scans the title using the cursor.

R: So if you saw this the whole time how come you haven't chosen it before?

P: Um… well it seemed like it might be a kid's site or something which I was wrong about.

V: P10-2 moves the cursor to the toolbar and selects the BACK button. The previous site reloads. P10-2 scrolls the page down then back up to the top. P10-2 hovers over the site title Slashdot using the cursor.

P: It's uh slash dot. Seemed like something else…but so, wow, I think I just found what I need…

After the student uttered "Oh," the student selected the resource and found, after reviewing the information, that the resource most likely did contain the desired information.

Realizations led students to re-evaluate current resources being used that were not providing desired information and redirect information seeking. Participant 7-1 came to a realization, "Okay, I don't think this Web site is exactly good," while trying to locate a book series in Amazon®. The student decided to apply the switch resources tactic, "so I am going to try something different… go back to Google…," to locate the information needed for scenario completion.

Realizations also came when students made mistakes or missed steps. Participant 11-2 calculated the Canadian to U.S. exchange rate by placing the rate found from an online bank conversion chart in the online calculator equation box and multiplying it to the amount given in the scenario. When a larger amount expected was return the student said, “Wait that is wrong…” The student realized the amount was incorrect and reconsidered the equation used, “should be divided by”. The student recalculated the figures using the readjusted equation and came up with the desired answer, “that’s right…”

4.2.1.2 Thinking Mode

Thinking mode is defined as the physical or verbal actions students use when deciding a rout to take regarding a task. Thinking mode allowed students time to plan out direction or reflect on information instead of taking immediate action. Walker and Moen (2001) found that cognitive behaviors can be explained by and typically included types of expletives or phrases participants used throughout scenario completion. When students in this study entered thinking mode, they would start out with an “um” or “well” then enter a period of silence prior to deciding what action to take, reflecting on information found, articulating direction of next steps in process, or applying previous knowledge to the problem. Students also used physical cues during thinking mode like tapping on the keyboard.

4.2.1.3 Error Creation and Correction

There are times in the information seeking process when unconscious processes of making an error affects the outcome of applied strategies. Error creation typically occurred when students misspelled or mistyped words when formulating queries in search tools. For example, at one point in the information seeking process Participant 10-1 modified the search by entering a new query in Google search:

> P: Um…and no this is not really what I want…I am going back…
>
> V: P10-1 scrolls back up to the top of the page into the Toolbar and selects the BACK button twice. The first Google results page loads.
>
> P: I am going to go [TYPING]…
>
> V: P10-1 highlights the search terms diabetic facts in the Google box. The terms are deleted. P10-1 types diabetic friendly recipies. [ERROR]
>
> P: diabetic…
>
> V: The Google results page loads with a "Did you mean diabetic friendly recipes" link on the top or the results list.
>
> P: If I can spell…diabetic recipes
>
> V: P10-1 selects the correction link. [CORRECTION] A new results page loads.
>
> P: And I am going follow the links to the sites …daily diet recipes…

The participant misspelled the word recipes. When the search results loaded, the participant recognized the misspelling, with the help of the auto spelling correction feature provided by Google search engine, and selected a link that executed the corrected spelling. A new results list appeared. The participant then continued the seeking process by examining the results and selecting a result from the new list. This conscious act of fixing the error is what puts the student back on track to locating information more efficiently. This was labeled correction.

Many search tools recognize error creation and offer alternative solutions to correct the problem thus putting students' information seeking back on track. Some students also recognized mistakes when irrelevant results or "no results" messages were returned by the system. When this occurred, those students typically corrected the error by redirecting the search, which usually included modifying the original query formulated.

4.2.1.4 Relay Findings

Students relay findings, orally communicate results, from information gathered or deduced. Students articulated their findings as they located resources or information to complete the scenarios. These verbalizations would typically be part of the inner thought process. Once students relayed findings, they would make a decision about the information or manipulate the information for further use. A participant completing the confirmational scenario relayed the amount of money left over after converting the money from Canadian dollars to U.S. dollars. The participant then organized the information for future use:

> P: So we have One hundred thirty-three and twenty-eight cents. [RELAY FINDINGS]
>
> V: P10-2 highlights the converted amount 133.279 USD.
>
> M: [XE.com - Universal Currency Converter Results - Microsoft Internet Explorer] <08:59 AM><Ctrl + c>
>
> P: Okay, I will open a Word Document to organize it.

4.2.1.5 Decision-Making

Decision-making is a process by which a person identifies a choice or judgment to be made, gathers and evaluates information about alternatives, and selects among the alternatives (Carroll and Johnson, 1990). Decision-making occurred when students made choices or judgments regarding the given information then selected a direction to take to complete a task. Students' decisions while completing the scenarios addressed the particular tools or resources to use, selection of information for the final product, and identification of completion of the seeking process.

Students' articulated decisions through their verbalized thoughts then acted out decisions on the networked environment. The verbalized thoughts usually included statements on the direction they planned to take to complete the scenario (e.g., "Well the first thing to do is to find out what a diabetic can or cannot eat so I am going to online. I am going to Google") or in reflections about the information found (e.g., "Okay, so that's one recipe that's good"). This articulation is typically part of a person's inner thought process; however, students were asked to talk aloud how they would go about completing the scenarios so their thoughts were verbalized. These verbalized thoughts showed where students were going to find information. Verbalized thoughts also told how they would use the information found. The decisions students made and actions taken directly affected the outcomes of scenario completion.

4.2.1.6 Confirmation

Confirmation occurred when students acknowledged directives (e.g., "Just put your participant number with a descriptive word") or answered questions (e.g., "And, you are picking it because you know of its reputation and you have seen it before?"). I asked questions during scenario completion to clarify participant actions (i.e., how they did or why they did an action) or prod the participant into talking about the seeking process. Research questions and prodding assisted students in beginning to verbalize their thoughts or during times when students failed to verbalize on their own. After confirmation (i.e., yes or no answer) was given then more descriptive information regarding the seeking process was offered:

> R: Okay so you wanted to use the online periodicals … Ebsco's online periodicals but you couldn't get into that so now you are going to try… Ebscohost is that what you said?

P10-2: Yes, [CONFIRMATION] I… that is Ebsco periodicals but I will just try Ebscohost. I have used the Ebsco periodicals one

R: So, familiarity helps you decide which resource to use?

P10-2: You use like the one's you know.

In the above example, Participant 10-2 confirms the actions he has taken after being prodded and supplies background information as to why the particular resource is being selected. This cognitive behavior is specific to the methodology of the study and may not reflect a normal information seeking behavior. However, the behavior may be indicative of a behavior the might occur if there is someone assisting or involved in the student's information seeking process (e.g., a librarian, teacher, friend).

4.2.1.7 Process Completion

At process completion students made decisions to end the scenario when they felt they had spent enough time on the problem or found the relevant information desired:

P7-1: I think its pretty much all he has written. [PROCESS COMPLETION]

R: Okay, you feel you have finished?

P7-1: Yes

R: Okay, let's stop for today.

Process completion typically ended with phrases like, "I have done all of it" or "So, that's it…," or with the physical act of closing applications and logging off the network. In some cases, I imposed process completion because the student stopped looking for information or stopped describing the information seeking process. I would ask if the student had finished completing the scenario and the student would confirm or continue completing the scenario. I also imposed process completion when the time limit had expired. For example, Participant 9-1 had located the series, the principal characters, and the author for the second factual scenario. The student was in the process of locating other types of work written by the author to complete the scenario. The student conducted a search on the author using Google search, but when reviewing the results page the student overlooked pertinent results that would have provided the information needed. The student returned to Google search to search for books by the author and time was called.

4.2.1.8 Background Knowledge Use

Student often dig into their mental processes and use long-term memories to direct their information seeking (Marchionini, 1995). These students used background knowledge when making decisions about resources, information, or task completion.

Background knowledge use occurred when students chose scenarios, selected resources, evaluated information, and completed tasks. Participant 10-2 chose to complete the fantasy sports motivational scenario because the student could utilize background knowledge about sports and experience with playing fantasy sports to complete the scenario. When explaining the decision to complete the scenario the student stated, “I know a lot about sports and so I think I will be able to, along the research abilities, use my already…my current knowledge.” The student continued to apply background knowledge while completing the scenario. The student’s knowledge of the sport and knowledge of how fantasy sports games operate played a role in selecting players for a fantasy team. The student explained player selections and use of evaluated information on two separate occasions:

> Now I am choosing him [referring to Kevin Garnett] because he is top rebounds and he is also the highest on points which combined means it is also up high on the blocks and he is a forward and he and really dominant this year. He is the leading candidate for MVP of this season…
>
> But, yeah, I took the list that had been made by the coaches themselves ‘cause they are the ones who make the list for the all-star games and then I compared stats. And, in terms… um of a fantasy sport game… in fantasy sports um you get points based on purely statistics and these guys all have the best statistics for there division so these guys are going to be the best players…in terms of points. And, that is the ideal.

Students’ used background knowledge to select the resources for locating information. Students selected Google search because they had prior experience using the search engine and felt comfortable using it to locate different types of information. Participant 7-1 stated that Google search is used “because [it] has a wide range of a lot of Web sites and it can usually bring you to a better search engine that can narrow down the topic.” Subscription databases were selected because students knew the school subscribed databases provided news articles and historical information. Participant 11-2 explained the choice to start with a subscription database to locate information for the first factual scenario:

> P: Um… This search I am going to use [the school’s] online database; probably either Ebscohost or LexisNexis depending on… or Searchasuaras… one of the online databases through our library network catalog.
>
> R: And why are you choosing to start with a database?
>
> P: Um because it deals with an historical…the issue deals with the Great Chicago Fire of 1871 and it’s historically based so it should have um online journals as well as published articles from professors since it’s theory… the question implies that it is theory and since you want to discuss it with your science class it might even be just as well to search online science databases.

Participant 8-1 used background knowledge to select a specific Web site, bestbuy.com, as a resource to locate video games to complete a task for the first confirmational scenario because the student had previously used the site. The student explained, “Um… I have been to the Web site before and I know it is convenient. There is a video game section where I can see average prices right there…” Participant 11-1 also chose to use a specific Web site, fandango.com, as a source to locate information on movie ticket prices to complete a task for the first confirmational scenario because the student frequently used the site. When moving through task completion the student stated, “Uh… purchase two games and then tickets to the movie…um that I would probably just go straight to fandango. I use that quite a bit…”

Background knowledge was also used to complete particular tasks within the information scenarios. For example, students applied background knowledge when calculating movie ticket price during confirmational scenario completion instead of using networked resources to locate information. Participant 7-2 began to locate the information using the networked resources but then stopped and stated, “What am I doing? I know how much a movie costs. It cost seven dollars for a kid…seven dollars for a kid and 12 dollars for adults. These are kids…so…” The student proceeded to subtract the amount on the scenario worksheet. Participant 12-1 subtracted 12 dollars “for the movie tickets” after calculating the amount taken for savings. When asked if the 12 dollars came from the students own knowledge the student stated, “Because…yah because that is just the price for students. I mean I could go to Cinemark.com and look at it but I already know what it is.” Students applied background knowledge to complete tasks in the instrumental, factual, and motivational scenarios as well.

Students also used their background knowledge with search tools during initial query formulation when locating specific information. Participant 9-1 started locating information on Tornado Alley by formulating a query using quotation marks. The student entered “tornado alley” in the Google search box because the student knew adding quotations meant the keywords would contain only the exact phrase in the results returned so results would be more relevant to the topic. Networked generation students also applied their knowledge of how search tool features assist in formulating queries in other situations of information need. Participant 11-1 illustrated in the interview session knowledge of how a specific subscription database used for a debate class assists with query formulation:

> LexisNexis has a lot of terms and connectors that you can use such as you know if you want at least five of this term in the document or um with it one word within twenty words of another word so it helps you come up with more specific searches.

The student applied this knowledge when completing the first factual scenario. Specifically, the student utilized features in LexisNexis to limit a search on the Great Chicago Fire of 1871 to recent articles by selecting “previous two years” on the date option. The student also reported that the advanced features provided by Google search engine and subscription databases help make searches more specific; a strategy Participant 8-1 applied when looking for information when vacation planning. The student initially searched using the words vacation US using Google search to “see what I get here”. After reviewing the results, the student selected the Advance Search link on the Google search page and typed movie in the box after the option *without the words*. The query was then modified to *vacation US –movie* in the Google search box and executed. The student decided to apply Google’s advance search feature to reduce the amount of irrelevant sites that were included in the results list.

As a note, these students’ background knowledge use for resource selection and task completion did not always produce desired results. Participant 7-1 chose the tornado safety instrumental scenario, “because I know exactly what Web site to go to.” The student selected the weather.com site to locate information but decided after reviewing resources in the site that, “It looks like this doesn’t have too much”. The student switched to a different resource, Google search engine, when the information the student thought would be available on the site was not found.

4.2.2 Affective Behaviors

Affective behaviors are acts related to feelings (Nahl, 1997) and attitudes (Marchionini, 1995). They are integral and natural to students’ information seeking processes (Yang, 1997). The students completing the scenarios were engaged on a positive emotional level when selecting scenarios and making decisions based on familiarity and when expressing affirmations prior to articulating direction, relaying findings, and completing scenarios. When students used familiarity and affirmations, they displayed self-confidence, persistence, patience, enjoyment, and comfort in their seeking process. Students were engaged on a negative emotional level when indecision or uncertainty arose or students encountered roadblocks when completing tasks. Indecision and uncertainty lead to feelings of frustrations and hesitations in the seeking process. There was also an intuitive attitude that guided information seeking. Based on an analysis of the data, the following affective behaviors were identified and defined:

> *Affirmation*: Students gain a sense of clarity. Physical or verbal signs of elation made when students move forward in the search process or complete a task.
>
> *Familiarity*: Students choose to perform a certain way based on previous behavior, personal likes or dislikes, comfort level or ease.
>
> *Frustration*: Students’ feelings of difficulties in completing a task expressed in physical or verbal signs.

Hesitation: Students show physical or verbal acts of pausing, uncertainty, or indecision.

Intuition: Students' believe that a particular act would or may happen if a strategy, tactic, or move is applied (i.e., a guess, hope, etc.). A cognitive process underlined with affective feeling, uncertainty.

4.2.2.1 Affirmation

Walker and Moen (2001) defined affirmation as the physical or verbal signs of elation in completing the task. Students in Walker and Moen's study often displayed elations in the form of hand signs (i.e., thumbs up) and exclamations (i.e. "I did it!") (2001, p. 24). The students in this study verbalized affirmations with phrases like "yes, this is what I want" or "there we go" after locating specific information or completing a particular task. Affirmations were also verbalized when students moved on in the seeking process. Student used words like, "okay", "alright," or "so," prior to making decisions, articulating directions, moving into thinking mode, or locating information. Due the experiences of the students in this study, I expanded the definition to physical or verbal signs of elation made when students move forward in the search process or complete a task.

4.2.2.2 Familiarity

Familiarity is used to direct decisions on scenario selection, resource selection, and task completion based on personal feelings (Walker & Moen, 2001). The students in this study chose to perform a certain way based on previous experiences that had resulted in personal preferences, comfort level or ease.

Most students selected scenarios based on how familiar they were with the problem. As Participant 11-1 reports, "I guess I am a tad bit not much though more familiar with sort of like health Web sites or food Web sites than I would be with weather Web sites.” Students chose to complete particular scenarios because they felt comfortable with the topic. They felt they would be able to locate information easily due to their knowledge of the topic or resources. As Participant 8-1 explained when the student chose the second instrumental scenario, “Um…well, it seems a little more interesting because it is more realistic and we actually do live in Tornado Alley. Plus, I am not a big fan of cooking.”

At times, students chose a particular scenario because they thought the Internet would provide more information on one topic than another thus making scenario completion easier. For example, Participant 9-2 chose the second instrumental scenario because, “…normally like you have Web sites like the weatherchannel.com and stuff cause lots of people like to study tornadoes and um school Web sites… also tornadoes… it would be harder to find like um nutritional facts on things than there would be…” The potential challenge a particular topic presented motivated students to select or disregard a particular topic. Participant 12-1 chose not to complete the second confirmational scenario because the potential difficulty with locating information to complete the scenario as well as to the cognitive challenge it presented. The student explained,

> Um… well, because the second one says something about the lunch menu and our schools lunch menu is not…like I don’t even know how may types of food there is so I don’t know what would be excluded and what wouldn’t be and I don’t [know] the nutritional value of any of it so it would be a lot more difficult.

Two students selected particular scenarios because they positively challenged the students’ information seeking abilities.

Students selected resources based on familiarity. Many students selected Google search engine as a source to begin locating information and continued to use it throughout scenario completion because as Participant 12-2 explains, “It is a wonderful search engine…Google has served me well in the past.” A student selected Amazon.com because, “It is uh easy to find video games.” And, another student chose Best Buy’s Web site because, “I have been to the Web site before and I know it is convenient.”

Tasks were also completed based on familiarity. Students chose recipes for the first instrumental scenario because they liked particular ingredients, the recipe “sounds delicious,” or ease in making the dish with friends. Students select video games and movies based on personal appeal, “I think this is one that I actually like I want to get.” And, students chose travel destinations because of personal or family interest. One student felt he could convince his father to take a vacation to Hawaii because, “There is stuff to do. There is a beach. Obviously, everyone knows Hawaii has good weather. I mean it is not… it’s a big beach…there is surfing…Pearle Harbor… There are things my mom would enjoy doing, there are things that I would enjoy doing, there are things my dad would enjoy doing… Everything but the price I could convince him on…” The student had spent several minutes on searching golf activities and course listings “because I know like me and my dad are probably going to go golfing.”

4.2.2.3 Frustration

Frustrations are feeling of difficulties in completing a task expressed in physical or verbal signs. Students in this study reported that what frustrates them when using the networked environment for locating information is when systems run slowly or shutdown, Web sites do not appear and objects do not properly download, irrelevant resources load, or when potential sites are blocked. Students became frustrated during scenario completion when the desired information was not located, passwords were required or did not work, data manipulations malfunctioned (i.e., “where did it go?”), the seeking process took too long (i.e., “this is taking too long”), or students made typographical or mathematic mistakes.

The challenge of a task also created frustration for students. A student felt uncomfortable during the completion of the factual scenario because he would have to verify unknown information on the theories of the Great Chicago Fire:

> V: P12-2 moves the cursor over the lower paragraphs scanning the text
>
> P: Um…I am going to assume that this is the first theory… I don’t like this science class [FRUSTRATION].
>
> R: Why don’t you like…is it kind of frustrating?
>
> P: Well normally when you go into class you discuss this before so you know like what the real thing is and you find you know the anomaly or whatever. Here I have to verify the original without knowing what it is.

Being caught in a loop (locating the same resources over again) can also cause frustration as Participant 7-2 found when searching for information on the Great Chicago Fire. Looping refers to the re-activation of previously executed searches (Bilal 2000, 2001, 2002). Looping was not common with these students; however, it did occur on occasion. A student formulated a search, executed the query, evaluated the results, and examined some of the Web resources. After extracting some data, the student returned to the search results:

> V: The MSN Search results list page reloads.
>
> P7-2 selects the fifth result on the list titled Chicago: Historical Information About Chicago. The page loads.

P7-2 scrolls down the page and scans the links using the cursor. P7-2 selects a link titled Chicago: 1871 The Great Fire. The page loads [to a previously viewed page sponsored by the Chicago Public library]. [LOOPING]

P7-2 selects a link on the page titled The Great Chicago Fire and the Web of Memory. The page loads. [This again is a link P7-2 had gone to previously.] [LOOPING]

P7-2 scrolls the page down and selects a continue button. P7-2 selects an Introduction button link. The page loads.

P7-2 scans through the page using the cursor.

P: [BIG SIGH]… [FRUSTRATION]

V: P7-2 moves the cursor to the toolbar and selects the BACK button five times. The MSN Search results page reloads.

P7-2 scrolls the page down.

P7-2 scrolls the page back up and places the cursor in the search box.

P7-2 highlights the previous search query and types the question how was the chicago fire started?

R: Okay, you are changing your search terminology…why are you…

P: To get more Web sites and links.

The student selected a previously viewed resource from result list. The student moved through the site by selecting various links. The student became frustrated. The student then backtracked to the search engine results page and altered the search strategies. Most of the students exhibited frustrations during scenario completion. Students typically dealt with frustrations by applying different strategies, tactics, or moves.

4.2.2.4 Hesitations

Hesitations are when students show physical or verbal acts of pausing, uncertainty, or indecision. Walker and Moen (2001) reported that hesitation occurred among adolescents using the Web when they would “stop and look at the screen, start to say something then stop, or begin typing then deleting and start over” (p. 24). Similar to these actions, Students in this study displayed hesitations when they held the cursor for a prolonged period over navigational toolbar buttons (i.e., Back, Forward, and Stop), the address bar, or the minimized application icons on the bottom taskbar. Hesitation also occurred when students would stop screen activities (i.e., scrolling, scanning, mouse movements) prior to beginning next steps, making decisions, verifying information, processing information found, or switching resources. Hesitations were typically verbalizations of uncertainties about topic knowledge (“I don’t know what they are talking about in number 2”), use of resources (“I am not sure if this is the right science…”), steps taken (“I don’t know why I chose that site”), or making final decision regarding information found (“I just can’t say which I believe”).

Uncertainty occurred at all stages of the information seeking process. Participant 9-1 experienced uncertainty at several stages of information seeking when completing the first confirmation scenario. At the initial stage of locating information to complete the scenario, the student was uncertain as to where to begin. The student stated, “I guess first I have to find out how much US dollars I actually received… So I will go to Google ‘cause I have no idea where I find the information.” When formulating a query the student showed signs of uncertainty. The student entered the word Canadian into the Google search box and then stated, “I have no idea where I am going” prior to adding the words US exchange money to complete the multiple keyword query. During resource examination, the student experiences uncertainty. The student located a conversion table that contained rates for various countries as well as the option to select countries to calculate exchange rates. The student stated after the examining the table, “This is definitely beyond me…” The student made selections and a page with a graph loaded that showed an exchange rate graph for US to CAD dollars but the student was unsure on how to interpret the information. The student replied, “Okay, the one American is about 75 cents or converts and I don’t know which way it is going so I should probably try to figure that out…” At this point, the student’s activity paused. The student decided to return to the Google search results page to select another resource that may be easier to use. The student located a Web site that automatically converts the exchange rate and calculated the amount from Canadian to U.S. dollars, Later, the student experienced uncertainty when selecting video games. The student again used Google search engine because, “well I haven’t got a clue what kind of video games I would get…” The student executed a general search on video games to locate a resource that assisted in completing the task.

Students also experience uncertainty with decision-making. Students completing the factual scenario dealing with Great Chicago Fire had to locate a new theory and previous theories regarding how the fire started then decide which theory they believed. Participant 12-2 located information on two separate theories, but was uncertain as which theory he believed. During information seeking the student executed a query and moved the cursor into the results page. The student paused activity. Next, the student scrolled the page down and stopped to examine a link toward the bottom of the results list. Again, the student paused activity. The student declared,

> P: I really can’t say which one I believe because I mean there is not really a way of knowing what happened. It could probably be both for all we know.
>
> R: Okay.
>
> P: I really couldn’t say if I could decide on which one.

The student continued to evaluate the information on the two theories. The student made a final decision on which to believe, but it was mixed with a level of uncertainty. As the student stated,

> So…I guess I probably actually believe the comet now… just because the cow always seemed like a nursery rhyme to me not really something…but I couldn't really say which one I believe….so…

Participant 11-2 also displayed this level of uncertainty when deciding which theory to believe. The student stated while evaluating the information found,

> This on a discover channel which I find to be a probably a much better source of information rather than the publications of 1871 in the newspapers. And, even the authors themselves disputed the information published at the time. So that is why I lean more towards… even though this discover.com is proposing a question and implies that there is not really a certainty of knowledge by the title "did a comet trigger the great Chicago fire?" imply there is no certainty to any of this um… therefore you cannot really conclude or side with either side… or… however, you can lean toward the newer theory cause this basically… this proves in a way much older 130 year old theory…

4.2.2.5 Intuition

While intuition is often defined as instinctive knowledge (Marchionini, 1995), students displayed and described their intuitive acts more as feelings so placed this category was placed under affective behavior. Intuition is defined as a student's belief that a particular act may happen if a strategy, tactic, or move is applied (i.e., a guess, hope, etc.). Intuition is a cognitive process underlined with affective feeling. For example, Participant 9-1 applied intuition to locate the book series in the second factual scenario. The student searched for a series previously read that dealt with the same story line described in the scenario because the student believed they were the same. However, there was a level of uncertainty in this hunch. The student stated after searching the series title in Google search, “I really hope that this is it ‘cause otherwise [I am] wasting time…”

Students made decisions based on hunches, guesses, or feelings. Intuition usually included verbal keywords such as *I guess* or *I hope*. All students when completing information scenarios utilized intuition. Participant 7-1 selected a resource from a Google search results list and stated prior to reviewing the site, “Now I am at Tornadochaser.net and it says um… tornado facts and tornado safety. So, hopefully this will have some stuff.” Participant 9-1 made a guess while looking for travel information that Fodor’s, a travel book series the student’s mother uses, would have a Web site. The student searched Google search engine for the Web site. The student’s intuition paid off. Fodor’s did have a site and the student used the site to locate various activities while trip planning.

Students also synthesized evaluated information and made conclusions based on intuition. For example, Participant 7-2 said when locating information to find out why tornadoes are common to the area known as tornado alley:

> It says it is when the moist air and the dry air and the hot and cold they like circulate together and it forms an echo…echo… which is I read on a site before. And, they like to come in ditches and not a lot of water and they usually come repeatedly in the same spot when they do. So, I am just guessing that that climate like in the southern and middle United States is the best climate for it and it just rapidly hits there. [INTUITION]

The student applied intuition to make conclusions regarding information found to complete a task in the second instrumental scenario.

4.2.3 Physical Behaviors

Physical behaviors are acts related to physiological movements (Nahl, 1997). Physical Behaviors were categorized as what Marchionini (1995) termed "physical actions" (i.e., moves students made during scenario completion). The specific moves are reported as a type of information seeking behavioral action and are described below. As I analyzed these moves, it appeared that the moves could be grouped into larger physical behaviors as described by previous research (see Agosto, 2002; Bilal, 2000, 2001, 2002; Thomas, 2004). Based on an analysis of the data and previous research, the following physical behaviors were identified and defined:

> *Exploratory Moves*: Use of embedded features in networked applications or resources.
>
> *Navigational Moves*: Use of moves to navigate through the networked applications and resources.
>
> *Operational Moves*: Use of networked environment peripherals (e.g., keyboard, mouse, drives, printers) to locate and manipulate information.
>
> *Constraints*: Operation of networked environment to locate information under constraints. Constraints may be negative (i.e., physical discomfort with screen) or positive (i.e. use of Web to relieve physical exertion of going to multiple places to locate information).

4.2.3.1 Exploratory Moves

The term exploratory move was used by Bilal (2000, 2001, 2002) to describe use of the embedded features located on Web browsers during information seeking. The definition was expanded to include the students in this study and their use of embedded features in networked applications and networked resources. Embedded features placed in this category included History, Favorites/Bookmarks, Find, Stop, Home, and Refresh.

4.2.3.2 Navigational Moves

The term navigational move was used by Bilal (2000, 2001, 2002) to describe use of physical moves to navigate through the Web. The definition was expanded based on this study's data to include use of physical moves to navigate through the networked environment (i.e., networked applications and resources). The students used a variety of navigational moves when completing information scenarios including scroll, backtrack, select/highlight, and direction.

4.2.3.3 Operational Moves

The term operational move was used when students located and manipulated information using networked environment peripherals. Operational moves included students' use of mouse (e.g., arrow, drop-down menus, right-click), keyboard (e.g., type, shortcuts, task switcher), main toolbar, buttons/icons, delete, close, drives, and printers. For example, the monitoring software displayed students' knowledge and use of keyboard shortcuts. Keyboard shortcuts included use of the CTRL key with copying, pasting, saving, alternating between open applications, finding information, manipulating information. Right-click mouse functions were also used to assist student in quickly manipulating the network or information found and collected.

4.2.3.4 Constraints

While analyzing the observation and interview data I noted students' operation to locate information was under what Agosto (2002) labeled as physical constraints. For example, when students were asked in the interview sessions if they would have done anything differently when completing the scenarios students replied:

P9-2: If I had more time, money and resources I think I probably would have maybe gone to a store and checked out maps that…I would have gone to Booksamillion and looked for maps on Moscow or something um…with the Chicago fire I could have gone to the local library resource and try to find things there. Um things that would take me to different places but since I had to be here…

R: So you would have gone outside of using the network.

P9-2: Yah, I would use the network to find other resources outside.

P10-1: Um…I probably would have gone to more sites and gone to paper resources or books. Um… like I know the Internet can be shaky at times… probably would have tried something like old newspapers or articles to see if that had anything.

Constraints in using the networked environment were often associated with time and resources limits. These students recognized that time constraints were a reason that they did not complete scenarios fully or effectively, as three students reported in the interview sessions:

R: Do you feel you completed the scenarios in a satisfactory manner?

P7-1: Well, I completed them but I don't with the time limit… so I don't know if I completed them that well.

P9-1: Some of them I didn't have time to finish but I mean like I got to the point it was obvious that you know…I got quite a bit or whatever so...

P10-1: Um…Without taking like three and a half to do it I probably would have worked more on the origin of the cow theory but….

Students also reported in the interview sessions that the decisions made regarding how the scenarios were completed might have been different if they were given more time.

R: Would there have been anything you would have done differently [to complete the scenarios]?

P8-1: Um…yah…Maybe just on the California one I did maybe gone to another site and get a little bit more information or pictures on it for those that didn't have pictures…find more places…but for about 15 minutes I think it was adequate.

> P9-1: Um assuming I had more time I wouldn't have had to rush or whatever…um some of them I may have gone back and verified some of the information that I wasn't 100 percent sure on.

Constraints appeared to have positive or negative affects on students' information seeking. For example, the time limit imposed on students' scenario completion posed a negative constraint. Decision-making based on the constraint time often caused students to select resources quickly without verifying the credibility of the resource or the reliability of the information found. However, students found use of the networked environment for information seeking to be a positive constraint because it alleviated physical exertion. As one student reported,

> It is a lot easier than, let's say, going through the library and having to pick actually 5 different books and open the books find what page the information is on and look through pages. Instead you can… like and that and also I can open 10 different place and go back and forth and try to extrapolate the information instead of I mean you would have to have a pretty big desk and a lot of time to go through a whole bunch of books that are open to the page that you are trying to find and then like kind of looking around.

4.2.4 Information Seeking Behavioral Actions

Students applied information seeking behavioral actions when completing the information scenarios. Marchionini (1995) defined information seeking behavioral actions as the specific patterns, strategies, tactics, and moves used during information seeking when solving a problem using a specific environment. According to Marchionini, information seeking behavioral actions are not mutually exclusive. Moves with a specific system can be chunked together as a tactic, and sets of tactics or strategies may be chunked as patterns by searchers using the same system. The moves, tactics, strategies, and patterns are discussed in the subsequent sections.

4.2.4.1 Moves

Moves are “finely grained actions manifested as discrete behavioral actions” (Marchionini, 1995, p. 74). Marchionini stated that moves are manifestations of tactics and mainly system specific. Based on an analysis of the data, the following moves were identified and defined:

> *Arrow*: Students use the arrow (i.e., mouse) to scan over information or check for hyperlinks.
>
> *Backtrack*: Students go back to or go forward to a previously viewed page (i.e., Back button, Forward button).
>
> *Buttons/Icon*: Students select buttons or icons to activate commands.
>
> *Close*: Students close a resource or application when no longer needed.
>
> *Delete material*: Students Delete material typed or collected. Un-highlight information selected.
>
> *Direction*: Students place the cursor at a particular location to continue information seeking process.
>
> *Drop-down menus*: Students use drop-down boxes to make selections for seeking information, creating search queries, or selecting resources.
>
> *Favorites/Bookmarks*: Students add a Web site to the favorites or obtain Web site from favorites.
>
> *Find*: Students use find function to locate desired information on a page.
>
> *History*: Students locate previously viewed Web sites.
>
> *Home*: Students return to the browser set home page.
>
> *Keyboard*: Students use the keyboard to make selections, manipulate pages, or activate shortcuts.
>
> *Main toolbar*: Students use functions on Main Toolbar
>
> *Print*: Students print information.
>
> *Refresh*: Students use refresh to reload a Web page

Right-click: Students use the right click functions to manipulate context menus (e.g., copy and paste information).

Scroll: Students use the scroll bar to look over the page.

Select information/Highlight: Students select or mark important information.

Stop: Students stop a process on Internet browser.

Task switcher: Students use the task switcher box to move from one resource/application to another resource/application.

Type: Students type information into search box, empty field box. (e.g., URL, search term, collected data).

Students applied moves to execute strategies or apply tactics. To assist with locating resources and collecting information students *typed* URLs into the address bars, formulated queries into search boxes, and calculations into equations boxes and information into Word documents. Students also used *drop down menu* boxes to select options when seeking information, formulating search queries, or selecting resources. Students used *direction* by placing the cursor at a particular location to continue information seeking. For example, students placed the cursor into the address bar to type a URL or moved the cursor over to navigation links to select a predetermined resource. Students reviewed information by using *scroll* bars or *arrow* (i.e., mouse). Students also used the arrow to check Web pages and documents for hyperlinks.

Students used the *keyboard* to select actions (e.g., enter button), manipulate page (e.g., move page up and down with arrow keys), or activate shortcuts (e.g., Ctrl + c, Ctrl v, etc.). Students *selected information/highlighted* when they wanted to mark important information or copy information to another resource or application. Students used the mouse *right-click* menu options or keyboard shortcuts to copy and paste information. To extract information several students elected to *print*. When student no longer needed information, they would *delete material* or *close* resources or applications.

Students selected the *main toolbar* options (e.g., File, Edit, Format, Tools, etc.) and used *button and icons* to activate browser and word document functions (e.g., Open, Save, Close, Enter, Select, etc.). Students selected the icons that appear on the bottom task bar when applications are open to switch applications or resources. Two students switched applications and resources using *task switcher*, which appeared after the student, used the Ctrl + Alt tabs on the keyboard. Students would *backtrack* using the Back button or the Forward button on the Web browser to view previously used resources.

Students applied moves to maneuver through networked applications and resources. Three students used *Find* to look for specific information either on a Web page or on Word document. This typically occurred when there was a significant amount of text on a page.

> P: Okay… [SILENCE]
>
> V: P8-2 scans over the first paragraphs of the article using the cursor. P8-2 scrolls the page down. P8-2 scans over the information using the cursor. P8-2 scrolls the page down and back up.
>
> P: [TYPING]…
>
> M: [Discovery Channel :: Did a Comet Trigger The Great Chica - Microsoft Internet Explorer]
>
> <09:34 AM><Ctrl + f> <09:34 AM>
>
> [FIND FUNCTION]
>
> V: The Find function box pops on the screen.
>
> P8-2 types the word theory in the black search box next to the words “Find what”.
>
> M: [Find]
>
> <09:34 AM>theory <09:34 AM>

V: P8-2 selects the Find Next button. A message box appears stating “Finished searching the document”. P8-2 switches the direction to Up then selects the Find Next button. The page is reloaded with the word theory highlighted. P8-2 closes the Find Function box.

P: [SILENCE]

V: P8-2 continues to scan next three paragraphs using the cursor under where the word theory occurs.

Participant 8-2 used the Find function to locate the word theory on a Web page that contained the article on a comet theory and the Great Chicago Fire. Two students used *Home* to return to the preset Web page. One student used *Refresh* to reload a Web page that was not loading. Two students used *Stop* to halt the activation of a chosen link. Six students used *History* to select previously viewed Web sites from the history list. In addition, one student used *Favorites* to save Web pages for further use.

4.2.4.2 Tactics

Tactics are “discrete intellectual choices or prompts manifested as behavioral actions during an information-seeking session” (Marchionini, 1995, p. 74). Marchionini stated that tactics are more focused and often apply inferences. Bates (1979) defined tactics as moves made to further a search. The students used various tactics to assist them in locating resources and gathering information to complete scenarios. Based on an analysis of the data, the following tactics were identified and defined:

Copy information: Students copy information from one resource and uses it in another to locate information or complete information need.

Maximize: Students bring an application to full view.

Minimize: Students remove an application from screen.

Modify collected information/Format: Students modify collected information or format page/text of information to be collected

Modify query: Students modify queries by changing or adding terminology in the search box.

Multitask: Students use multiple applications or resources to complete information needs.

Review material: Students reviews material on screen to see if it is information needed.

Save documents/Information collection: Students save documents or gathering information using an application (e.g. word processor, spreadsheet).

Switch application: Students move from one application on network to another (e.g., Word to an IE Browser).

Switch resource: Students move from one resource to another (e.g., search engine to subscription database).

Participant 8-1 applied multiple tactics to complete a first factual scenario dealing with the Great Chicago Fire of 1871 theory, including modify query, switch resource, review material, multitask, and maximize:

P: So now that I have a background I am going to try to find the new theory. So I will just say “Great Chicago Fire and new theory” [TYPING]… and see what I get from that.

V: P8-1 places the cursor in the search box and types the words new theory. The search query reads Great Chicago Fire new theory. [MODIFY QUERY]

P: And I think this is going to be a little too specific for the groups.

V: The results page loads with a no results message.

P: Yes, so I will try my search on Google.

V: P8-1 selects a suggested link to Google. The page loads to a Google Search results page based on the query previously searched in DMOZ. [SWITCH RESOURCE] P8-1 scans over the top of the list. [REVIEW MATERIAL] P8-1 moves the cursor to the first search result link titled *Discovery Channel :: Did a Comet Trigger The Great Chica* sponsored by discover.com. The right-click menu box appears and P8-1 selects the open in a new window using option. [MULTITASK] The page loads along with several pop up windows. P8-1 closes all pop-up windows. P8-1 moves the cursor to the top of the IE browser window. The IE browser maximizes. [MAXIMIZE] P8-1 scrolls the page down [reading the article and making statements about the findings].

Participant 8-1 selected DMOZ, a categorical database, and searched using the keyword phrase Great Chicago Fire to locate general information on the topic. Once background information was found the student applied the tactic, *modify query* to find the new theory. Typically in scenario completion if the students initial search strategy did not provide the desired information or if more information on the topic was needed, a subsequent search followed with the student applying the modify query tactic. Broad keyword searches were narrowed, narrow keyword searches were broadened, or natural language questions were reworded.

Participant 8-1 added the terms *new theory* to the existing search phrase, Great Chicago Fire, to narrow the focus. The categorical database returned no results so the student applied the *switch resource* tactic by selecting the suggested Google search link on the database site to redirect the search. In the DMOZ database, when the suggested Google link was selected the Google search engine executed the formulated query. Students often switched resources when one resource did not contain the desired information. Students switched from one search engine to another (i.e., Google to Ask) or from search engine to subscription database or vice versa (i.e., Google to EBSCOhost). Students also switched between Web pages when examining multiple resources or between Word documents when collecting information on separate tasks.

After the Google search results page loaded, Participant 8-1 reviewed the results. The tactic *review material* was applied when students wanted to evaluate whether the information found was pertinent to completing the task. Students evaluated materials by skimming, scanning, or reading. P8-1 scanned the results and selected the first result link listed. The participant applied *multitask* tactic by opening the link in a new browser. Multitasking allowed students to have several resources open at the same time for easier accessibility. Students would have multiple Web browsers open to review several resources at the same time or to compare information in two separate resources.

Students also opened multiple Word documents when wanting to collect information on different scenario task elements separately. After opening the link in a new browser, Participant 8-1 maximized the browser and read the material. Students would *maximize* windows for easier viewing, a tactic used to reduce physical constraints.

All students using multiple applications used the tactic *switch application* during the seeking process. A typical scenario consisted of students using Internet Explorer to locate and gather information and then students switched to Word to collect information. Students switched alternately among applications until the application was no longer needed for scenario completion. Students would *minimize* applications to have easier access to the information collected if needed later.

Another tactic students applied was *copying information* from one resource or application to another. Student copied information to collect material or formulate queries for scenario completion. Participant 11-2 located a list of ten all-star hockey players when searching for players for a fantasy sports team. The student copied the list and pasted it into a Word document. The student then selected five hockey players from the compiled list as fantasy team members. The student copied the first player’s name from the list and pasted it in a Google search box to formulate a query that would return resources for the player’s biographical and statistical information and images:

P: I am going to use Google images actually.

V: P11-2 selects the Image link. The Google Image search page loads.

P: And the first one Gordy Howe [TYPING]…

V: P11-2 switches to the Word document by selecting the Word icon on the bottom taskbar. P11-2 highlights the name Gordy Howe. The right click menu box appears. P11-2 selects the copy option. [COPY INFORMATION] P11-2 switches to the IE browser by selecting the IE icon on the bottom taskbar.

P: Um… [TPYING]…

V: P11-2 moves the cursor into the search box. The right click menu box appears and P11-2 selects the paste option. RWGordy Howe's name appears in the box. [COPY INFORMATION] P11-2 deletes the W then R from the name.

V: The Google Image Search results loads.

P11-2 moves the cursor over the top row of images. P11-2 selects the third image.

P: Here is his picture…

The student continued this process of copying the player's names from the list to formulate a search query throughout scenario completion. Once the student found the desired information for each player, the student then *collected information* using the copy information tactic. Once students collected information, students would *modify information* (delete information not needed, alter information found from other resources, or reformat information for easy viewing). Students would then *save* the information collected to a network file.

4.2.4.3 Strategies

Strategies are "sets of ordered tactics consciously selected, applied, and monitored to solve an information problem. Thus, strategies are concerned with multiple subprocesses of the information seeking process and are applied to specific information seeking tasks" (Marchionini, 1995, p. 72-73). Strategies are the approach that an information seeker takes to a problem. Marchionini found that strategies are mainly search specific. Based on an analysis of the data, the following strategies were identified and defined:

Application use: Students selects applications to use to complete tasks.

Boolean search: Students use Boolean code operators within search tool's query box to formulate queries.

Keyword search-broad: Students use broad or simple keywords to formulate queries.

Keyword search-narrow: Students use multiple words to narrow focus to formulate queries.

Natural language search: Students use questions to formulate queries.

Predetermined resource selection: Students select search tool generated results or Web site menu, categorical, or textual links.

Previously acquired information: Students use acquired information to continue to solve information problems.

Resource selection: Students selects a source (search tools, official homepages, Web pages) to begin locating information. Students select resources to continue to solve information needs.

Subject search: Students use subject search features to formulate queries.
Verify information: Students check to make sure the information given is correct or that they understand the meaning of the task (i.e., questioning).

An initial strategy students applied to scenario completion was *application use*. The school provided a range of networked applications for student use. The networked applications used by the students were Internet Explorer, Word, and the Calculator. Students also used the computer's local networked drive as well as their personal network account to save document files.

Students used Internet Explorer to locate resources and gather information. Students used Word as a way to organize information found. For example, during the completion of the second factual scenario Participant 9-2 opened a Word document "to keep notes” on the information found about the book series in question and the characters and author of that series. Participant 8-2 used a Word document to collect information on tornado safety to complete the scenario requirements of saving the information found to create a Tornado Safety Procedure List. All but one student used the calculator to compute money saved and spent during completion of the first confirmation scenario

These students typically approached scenario completion by *resource selection*. Most students chose a search tool, usually Google. Other search tools chosen were Yahoo!, DMOZ, and one of the school’s library subscription databases. Students also chose commercial or organizational Web sites, usually relating to the topic (e.g., weather.com, bestbuy.com, espn.com, expedia.com, WebMD.com, etc.). An online encyclopedia was chosen by one student to locate background information for the scenario selected.

When commercial or organization Web sites were used students typically browsed the site scanning for relative information or links that could assist in locating information. Students scanned side or top navigational menus, tables with categorical links, or textual information with links. Menu options or links were chosen based on how relevant the item appeared in assisting with scenario completion. For example, Participant 7-1 and Participant 10-1 chose to use the school’s Web site to start locating information to complete the second confirmational scenario, evaluating the school’s lunch program against new state lunch policies. The students selected the lunch menu tab on the top navigational menu list. Selecting this predetermined resource link provided the students with the school’s weekly lunch menu, one of the resources needed to evaluate information to complete the scenario. Participant 8-2 executed a search query in Google search to locate information to complete the first motivational scenario. The student selected a commercial site from a Google search sponsored list on the results page “because it seemed to have the most effective information…well it had more information um than a lot of other sites.” When asked why the site was chosen the student replied, “Um…it said ‘things to do’ on the side and that was basically what I was looking for in my head.” *Predetermined resource selection*, as described above, is a strategy that all students utilized for locating information.

When locating information using search tools, students applied analytical strategies to formulate queries including creating *keyword searches-broad, keyword searches- narrow, Boolean searches, natural language searches,* or *subject searches.* Students applied various search strategies throughout the sessions. Participant 11-1 chose to start with a broad keyword search when completing the first instrumental scenario. Students were asked during the interview if starting with a broad keyword search was typical and if it helped in locating information. A student replied,

> It depends what you are looking for. Like for example, I really don’t know that much about diabetic eating, but I figured that it is a really popular thing and that uh the main effects of diabetes is that it affects your eating habits. So, I figured there would be sort of a lot of generic Web sites. But, if I were looking for something more specific…I don’t know; say I wanted something with vegetables, I could search more specific.

Students created search strategies based on knowledge of the topic (“I want to go broad to see what is out there”), type of search tool (“Ask Jeeves lets me ask a question”), or knowledge of search tool features (“I put the little plus [+] thing to try and find two different keywords together and stuff.”).

Students formulated queries by extracting keywords from scenario descriptions, background knowledge, or information gathered on the topic. Students often used *previously acquired information* from information located on resources to formulate or modify search queries. Participant 7-1 located the title of the series, Series of Unfortunate Events, on Google.com then copied the information and pasted it into a Google search adding the words book reviews to locate information on the series characters to complete the second factual scenario.

Students used previously acquired information located during an information seeking session as a strategy to gather information from one resource and utilize it to continue to try to solve the information problem. Participant 10-1 selected an event on the activities calendar located on the Official Denver, Colorado Visitors Guide page when planning a family vacation to Denver. While reviewing the event information, the student located the main Web site for the event. The student copied the URL and pasted it into the address bar. Once at the official event site the student gathered location and pricing information to include in the travel itinerary document being created to complete the scenario. Students also used previously acquired information to complete tasks associated with the information scenarios. All students who selected the first Confirmational scenario used acquired information to complete the scenario. Students used the given amounts, $175 to convert the Canadian currency to U.S. currency and the 30% to savings, to calculate a starting figure for spending. As the students' verified video games and movie ticket pricing, they used those amounts to calculate a final amount and determine if there would be money left over to spend on snacks.

Throughout the sessions, students *verified information* to confirm that they were on the correct path to locating the information. Students asked questions regarding the scenarios ("Does it specify new games as in new to him or…that is the way I interpret it…"), asked if actions were acceptable (e.g., "can I just pick Dallas") or necessary (e.g., "should I save the document"), and examined the scenarios to make sure all tasks were completed ("so we have done all this stuff…"). Students also verified information for accuracy, resources for credibility, and to make sure the information to be used met the requirements for scenario completion.

Participant 7-2 located a news article about a Chicago fire. The student first believed that the news article was an alternate theory to the earlier theory found. The student scanned the article and then returned to a previously viewed resource that contained the first theory to "make sure [the new article was] the same fire." After reviewing the information, the student decided that two articles were "way to different stories" and returned to the search results to continue to look for an alternate theory.

Participant 12-1 switched to using WebMD to locate background information on diabetes "because it is pretty well known for a health database…" When asked if the student thought the resource was more reliable the student replied, "Yah, it will be more reliable than just the random sites also you wouldn't get a summary that says oh come and buy this or come buy this cookbook or something like this." After locating a recipe, the student evaluated the recipe to make sure "it is actually good to eat. So I know they are not just putting a recipe and saying eat this." The student stated that he examined the recipe because he wanted to "verify that it would be acceptable" to eat by the friend who is diabetic. Participant 11-2 also verified that a recipe chosen met the criteria for scenario completion. The student stated after locating a recipe,

> Okay and this seems to work it's um… It came up from a Web site Bawarchi Soraj's Cookbook it has solid peanuts as an ingredient; and, that's good big time. It seems to be a delicious snack that doesn't seem to include ingredients that are dangerous to their health or bad for them and it doesn't have popcorn in it.

The student evaluated the ingredients and made a decision that the recipe was acceptable for the friend who is diabetic and for the friend who does not like popcorn.

4.2.4.4 Patterns

Marchionini (1995) defined patterns as behaviors that can be discerned over time and across different information problems. He stated that, patterns may be chunked strategies or tactics that people internalize through repetition and experience. Patterns are caused by personality traits, attitudes, or cognitive style. Marchionini found that patterns are mainly information-seeker specific but are also influenced by domains and search systems. In examining the moves, tactics, and strategies used by students, I noted patterns that emerged across sessions of individual students. The use of the behaviors created certain patterns across the particular scenarios completed by a particular student (Instrumental → Factual → Confirmational → Motivational). Patterns also developed among the students completing the same scenario (Participants 7-1 and 9-1 completing Factual Scenario Question 2). Based on an analysis of the data, the following patterns were identified and defined:

> *Assistance utilization*: Students use assistance from an outside source (e.g., teacher, librarian, friend, electronic resource) in the decision making process of seeking information.

> *Knowledge application*: Students apply previously known strategies, tactics or moves to a current information problem.

Ordered behaviors: Students performing, in an ordered fashion, specific strategies, tactics, or moves for different information problems and specific search queries.

Personal interest utilization: Students use personal interest to decide the continuation of a query or selection of information.

Students use of assistance from an outside source in the decision making process of information seeking was identified as *assistance utilization*. Students sought help with scenario comprehension, directions, and decision making during information seeking. Participant 7-2 asked for help when defining scenarios, confirming directions, making decisions, and completing the scenarios. For example, the student asked me to define a term in the second confirmational scenario when selecting a scenario to complete. After reading the scenarios the student asks,

P7-2: What does combat mean?
R: To go against something…fight it.
P7-2: Okay, go against. Okay, I am going to do number one.

The student processed the definition then selected the alternate scenario to complete. The student also sought assistance when completing the confirmational scenario chosen. The student again asked me to define a term when locating the rate of exchange of Canadian to U.S. dollars. Then after figuring the rate of exchange, the student asked,

P7-2: Are you allowed to give me a hint?
R: If you want to ask me a question, you may ask it.
P7-2: Will I be turned down?
R: No, you are fine…you can ask any questions.
P: How do I find 30% of 100?

The student asked me for help when completing the task of taking 30% from the converted amount to put into savings.

Students also sought help provided by networked resources. Participant 9-2 used a Web site help feature to understand the monetary conversion process while completed the second confirmational scenario. The student activated help links for two different terms the student was having trouble understanding that were provided on the Web site. The student read the definitions, provided through the pop-up windows once the help links were activated, then returned to the conversion table to complete the monetary conversion process. Students used assistance utilization when they did not have the background knowledge to continue with scenario completion.

While some students information seeking was hindered because of a lack of domain knowledge, other students used *knowledge application* to select and complete scenarios. Knowledge application occurred when students applied previously known strategies, tactics, or moves to a current information problem. Participant 11-2 applied a strategy learned in a debate class when selecting the scenarios to complete. For each scenario the student would mark up the scenario questions sheet by underlining objectives and circling keywords to help prioritize what information was needed and how difficult the problem would be to complete. The student then selected scenarios based on the number of tasks required and personal interest. Participant 7-2 also marked objectives on the scenario question sheet for the confirmational and motivational scenarios. For this student this act was instinctive, a strategy not learned but initially applied by the student to help define a problem and continually applied to other problems because it consistently helped with process completion. Participant 7-1 and 9-

1 used knowledge application to complete the second factual scenario. Each participant attempted to locate the name of the series using a specific Web site, Amazon, because the students were aware of the Web site's affiliation with selling books. Both students also attempted to locate book reviews to find information about the characters in the series because the students knew that a book review would provide synopsis of the story.

Students typically used *ordered behaviors* (e.g., using the same strategies, tactics, or moves in an ordered fashion repeatedly) during scenario completion to navigate the networked environment, select resources, locate information, and extract information. In the first confirmational scenario, students confirmed that there would be enough prize money left over to purchase snacks at a movie after putting money into savings and purchasing video games and movie tickets. All students used the same strategies to locate a resource that would convert currency since the prize money is given in Canadian currency. All students started with Google as a source, formulated a query using keywords to execute a search, and reviewed the results list to select a resource. This was typical behavior of all students when locating information using search tools. Students would formulate a search, execute the query, evaluate the results on the list, and select a Web resource to examine. If the resource did not provide the information the students were looking for they would return to the results and examine more Web resources or alter the search using different strategies, tactics, or moves. When extracting information the students who used keyboard shortcuts to copy and paste information from resources to applications did so for each scenario while students who used the mouse right-click option repeated that process as well.

Personal interest utilization was used repeatedly to decide the continuation of a query or selection of information. During the observation sessions there were 27 instances where students reported selecting a particular scenario based on personal interest. Participant 10-2 chose to complete the first instrumental scenario, locating recipes because “Personally the first one is more interesting. More realistic…something I would actually look for.” Personal interest utilization also occurred during scenario completion. For example, in the prize money confirmational scenario students selected or revoked video games based on their personal interests. This pattern of selecting based on personal interest was also repeated in the motivational scenario. Students selected activities for a family vacation based on personal or family interests.

4.2.5 Interaction of Information Seeking Behaviors

Data from the observations revealed an interrelationship among students’ cognitive, affective, and physical behaviors and information seeking behavioral actions. For example, students’ background knowledge about the topic (cognitive), the information students’ extracted from evaluated resources (behavioral action tactic), students’ personal preferences (affective), or the time constraints (physical) placed on completing the task were factors affecting the cognitive behavior decision-making. A student selected the trip planning motivational scenario and began to think aloud different places to travel. The student said,

> Um…Florida, I could visit my cousins in Seattle. That would be really fun. In July, what would we be able to do in July…I guess July I would want to go to the beach. I could go seaside although it would be with my family… I am spending too much time doing this… um… I guess we could go to Florida go to Disneyworld… the beach…been to Disneyworld a lot but we have never been to the beach in Florida so that would be fun…

After voicing a few travel considerations based on personal preferences, the student placed the verbalized self-generated time constraint indicator, “I am spending too much time doing this,” on the amount of time it was taking to make a decision. Students often used personal preferences and created their own self-generated time constraints while making decisions during scenario completion.

Another example of the interrelationship among behaviors occurred with process completion. Time constraints (physical), decision-making (cognitive), knowledge application (behavioral action pattern), and verification (tactic) affected the cognitive behavior process completion. For example, Participant 9-1 had spent several minutes making decisions on the place to visit for the motivational travel scenario then spent most of the allotted time trying to locate a visible map of the area. The student had finished locating one activity and gathered the necessary information to complete the scenario when time expired. Participant 10-1 had spent the majority of the time locating information on the historical theory of who started the Great Chicago Fire of 1871 and had not begun to locate information on the new theory when time expired. When asked in the interview why the student did not select items in the results lists that pertained to the comet theory the student replied, “Um… I wasn’t interested in the theory any more, I was looking for the origin. And, like if I had a lot more time, I probably would have gone into the comet theory.” In these examples, decision-making and time constraints affected process completion.

The observation data also indicated that use of one behavior might give rise to or have an effect on another behavior in the same category. For example, students’ inability to recognize the cognitive behavior error creation affected use of the cognitive behavior correction. Participant 7-1 created several errors when locating information to complete the second factual scenario. The student began using Google, switched to Amazon, then returned to Google to try locating the title of a book series. The student formulated a query by stringing multiple keywords together, “I am typing in the summary of the books…and then I am going to type in orphan children running from a count and series.” The monitoring software captured the students many typographical errors and corrections made:

> M: [Google - Microsoft Internet Explorer]
> <02:15 PM>books <Backspace: 5 >su, <Backspace >mmary of book-<Backspace>/orpahned chio <Backspace >ldren running fromj <Backspace: 2 > ca o <Backspace: 4 >a count/series <Enter ><02:15 PM>

The student entered *summary of book/orpahned (sic) children running from a count/series* into the Google search box; however, even with the attempts to fix typing and spelling errors, the search query contained a spelling error when the student executed the search. Google returned an automated message containing the correct spelling that the student missed. The student decided to apply the modify query tactic, “And that didn’t match anything so I will take off all these extra words and I will just leave orphan children running from a count.” However, when the student modified the query, the misspelled word was not corrected. The search was executed and results were returned along with an automated message that would correct the spelling mistake. The student again missed the automated message result and decided to modify the query by adding the word *book*. However, this time when results were returned the student realized the mistake made and selected the automated link suggested:

> P: it’s not going to…I will just say it differently….

V: P7-1 moves the cursor to the search box

P: Okay …Okay, now I am going to try…I am going to put book in front of "orphan children running from a count"…

V: P7-1 types the word book in front of the search phrase [MODIFY QUERY].

M: [Google Search: orpahned children running from a count - Microsoft Internet Explorer]<02:16 PM>book <Enter> <02:16 PM>

V: The results page loads.

M: 03/23/04 02:16:35 PM 0:00:15   0:00:15   0:00:15 Web http://www.google.com/search?hl=en&lr=&ie=UTF-8&oe=UTF-8&q=book+orpahned+children+running+from+a+count

Google Search: book orpahned children running from a count

V: P7-1 moves the cursor to the search engine generated statement, "Did you mean: orphaned children running from a count". P7-1 moves the cursor to the bottom of the page [the "did you mean statement" is showing].

P: I just realized that I had a spelling mistake so that was really why… [REALIZATION]

V: P7-1 selects the search engine generated link that has the correct spelling. [CORRECTION] The new results page loads.

M: 03/23/04 02:16:50 PM participant7-1   0:00:39   0:00:39   0:00:39 Web http://www.google.com/search?hl=en&ie=UTF-8&oe=UTF-8&q=book+orphaned+children+running+from+a+count&spell=1

Google Search: book orphaned children running from a count

When looking at affective behaviors, uncertainty often caused students to feel frustrated with himself or herself, the problem, or the resource used. For example, students often missed helpful resources or information when uncertain about steps taken or resources being used to complete the scenarios. During completion of the confirmational scenario, Participant 9-1 missed the link to a currency converter, but because frustration had set in and the student was not open to looking at other options offered on the resource initially selected. The student dealt with the uncertainty by redirecting the process and locating another resource.

In other instances, students used intuition when indecision or uncertainty arose during information seeking. Hesitations, or uncertainties, often led students to perform intuitive acts in the information seeking process. To complete the first factual scenario Participant 11-1 conducted a search on the Great Chicago Fire of 1871:

> P: So I would type in "Great Chicago Fire of 1871" that is probably generic enough but um…
>
> V: P11-1 types in the Google search box Great Chicago Fire of 1871
>
> M: [Google - Microsoft Internet Explorer]
>
> <10:44 AM>Great Chicago Fire of 1871 <10:44 AM>
>
> V: The Google Search results page loads.
>
> M: 03/29/04 10:44:46 AM participant 11-1 0:00:14 0:00:14 0:00:14 Web http://www.google.com/search?hl=en&ie=UTF-8&oe=UTF-8&q=Great+Chicago+Fire+of+1871
>
> Google Search: Great Chicago Fire of 1871
>
> V: P11-1 moves the cursor down into the results.
>
> P: I guess I will just start with the first one.
>
> V: P11-1 moves the cursor over the first link titled The Great Chicago Fire and the Web of Memory. P11-1 hovers over the link then activates the link. The page loads.
>
> M: 03/29/04 10:45:00 AM participant 11-1 0:00:14 0:00:14 0:00:14 Web http://www.chicagohs.org/fire/
>
> The Great Chicago Fire and the Web of Memory: Welcome
>
> P: I don't know [HESITATION] it looks like uh from the name of the Web site and the URL it looks like that is probably uh pretty accurate…
>
> V: P11-1 moves the cursor up to the address bar and moves the cursor over the URL. P11-1 moves the cursor down into the page.
>
> P: Um I guess I will go through the historical site… [INTUITION]

During the seeking process, the student used Google to execute a query. The results loaded. The student activated the first result link. When examining the resource the student is uncertain of its usefulness; however, the student decided to review the information. The student described her hesitation to select the resource from the Google results list and use of instinct to review it as she stated,

> [At] first when I saw the Google results I was kind of hesitant to click on the first one because I didn't think it would be really not what I thought but I would try it anyway. Um…I usually just try to skim through and see if one of them works.

When students intuitions were correct they experienced positive affective feelings. Participant 11-1 applied a name replacement strategy in the NBA URL when looking for biographical information on the fantasy sports team players:

> P: It seems like the Web site looks pretty cleverly laid out I mean so I am just going to erase Alvin Iverson's name and put Steve Nash in and see if it comes up [INTUITION] but if doesn't come up I will just go back to the site but if it does that would be pretty easy.
>
> V: P11-1 moves the cursor into the URL and deletes Allen Iverson's name
>
> M: <Backspace: 5>
>
> V: P11-1 types Steve Nash's name.
>
> M: steve<Right: 2><Left><Delete: 7>nash <03:17 PM>
>
> V: The page loads to the NBA.com Steve Nash Bio page.
>
> M: 03/30/04 03:17:03 PM Participant 11-1 0:00:47 0:00:26 0:00:26 Web http://www.nba.com/playerfile/steve_nash/bio.html
>
> NBA.com: Steve Nash Bio
>
> P: Yep! [AFFIRMATION]

The student replaced one player name for another. When the change was executed the biographical Web page for the new player loaded on screen. The student expressed excitement with an affirmative exclamation statement, "Yep!" The participant continued to use the technique to locate other NBA biographical pages for players on the fantasy team. Affirmation often followed when desired information was located or techniques implemented worked.

4.2.6 Summary

I identified students' cognitive, affective and physical information seeking behaviors and found them to be at the core of information seeking influencing every aspect of the process. Students' cognitive behaviors focused students on information needs, provided background knowledge to a problem, offered realizations about information, verbalized information found, offered choices or judgments about information, and completed the process of locating information to support the need. Students' affective behaviors, in forms of positive emotions, helped students gain a sense of clarity during the seeking process. However, affective behaviors, in forms of negative emotions, also caused the information seeking process to falter. Students were found to be intuitive information seekers applying intuition throughout the process including when selecting tools, locating resources, and evaluating information. Physical behaviors helped students maneuver through the information seeking process. Behavioral actions were also identified. These actions were the specific moves, tactics, and strategies used to work through the seeking process in the networked environment.

The observation and interview data show that students understood that knowledge of particular strategies, tactics, and moves helps them locate desired information more efficiently. Students applied various strategies, tactics, and moves during scenario completion. Students who were able to formulate queries that were more robust received results that were more relevant and useful. The students who had more experience navigating through resources were able to find relevant information to review more efficiently. Students who used the multitask tactic were able to work simultaneously on locating, evaluating, and extracting information. In addition, students were more likely to complete the scenarios efficiently when they verified that all tasks were completed. However, use of behavioral actions did not always supply positive results. For example, students who quickly reviewed material often missed potential resources or valuable information. Whether positive or negative results occurred with the application of behavioral actions, patterns emerged that students applied which moved them through the information seeking process. Similar patterns emerged among student information seeking, each student completed information scenarios exhibiting many of the same cognitive, affective, and physical information seeking behaviors and behavioral actions.

Information seeking was defined for this research as the process in which a person engages to search for, obtain, evaluate, and make use of information in order to solve an information need. It is an interactive process utilizing one's cognitive abilities, one's special knowledge and skills, and problem solving techniques. The next section continues to examine the information seeking process focusing on the identification the problem solving techniques students exhibited during information seeking.

4.3 Students' Problem Solving Process

I identified and categorized problem solving techniques from the actions students described while completing the three questions in Section V, Networked Environment Problem Solving, of the NEQ. I also identified and categorized problem solving techniques from the actions student exhibited during the completion of four information scenarios. As described in chapter 3, the constant comparison method was used to identify the types of problem solving techniques used and categorized the techniques. Once categorized, the techniques became subcategories of larger categories.

Techniques often were analogous to cognitive and physical behaviors and information seeking behavioral action strategies and tactics identified earlier; in these instances, the same terminology was used in the identification process. The problem solving processes identified in Marchionini's (1995) information process model were used as well as researcher-defined categories that did not fit into Marchionini's processes. See Appendix G for the list of codes.

The following sections outline the problem solving techniques students described on the NEQ and interview phases, and also utilized while completing the information scenarios.

4.3.1 Recognize/Accept Problem

Students completing the information scenarios were given two options for each type of scenario. For each session students read through the scenarios. This technique was labeled *understand problem*. While reading the scenarios, two students underlined objectives and circled keywords on the information scenario sheets prior to selecting which scenario to complete. This was labeled as the *underline and circle* technique and placed under the category understand problem. After reading through the scenarios, the students selected which scenario to complete; this action was labeled *make selection*.

By reading through the scenarios and selecting a scenario to complete the students were accepting a problem; therefore, these practices were placed under the process Marchionini labeled *recognize and accept an information problem*.

4.3.2 Plan Process

While examining the NEQ data, I noted that several students outlined the steps they would take to complete the problems and determined an order for tackling each task. Typically, the steps were numbered or students used the words first, second, third, etc., in the description. Students completing the information scenarios would explain how they would go about locating information prior to beginning and during scenario completion by articulating the direction they would take during talk-aloud. For example, Participant 12-2 explains when beginning the instrumental scenario, “Alright, I am going to go ahead and open up Internet Explorer and start with Google.” These techniques were labeled *list out in steps*.

Students also described various ways they would approach each problem in their responses on the NEQ. For example, one student described two separate steps he would use to find presidential candidate information; one included conducting a search on Google and the other included visiting CNN.com, a Web-based news site. For the first option, the student applied an analytical search strategy to locate a resource by formulating a multiple keyword query and executing a search. For the second option, the student would apply a browse strategy to examine the site. This technique was labeled *formulate multiple options*. Students formulated multiple options for selecting networked resources to use or search strategies to execute.

The techniques list out in steps and formulate multiple options were placed under a new category labeled *plan process*.

4.3.3 Define Problem

A student wrote when answering Question 26 on the NEQ, “First, I would gather the people that I want to research and make a list of them.” Participants 8-2, 9-1, 11-1, and 11-2 made lists of defined tasks during scenario completion. The technique described by these students was labeled *gather needed information/make list*.

Students asked questions about the problem to help understand the problems. A student wrote in the response box, “What would you consider ‘my school's networked environment’?” prior to describing steps taken to complete Question 26 on the NEQ. A student wrote in the response box, “Now that downloading music has become such a big controversy [sic], I probably would not be able to download any music because I do not have a place where I can download music free,” prior to deciding they could possibly purchase a song through a service if needed to complete Question 28 on the NEQ. Participant 10-1 asked questions to seek clarification from the observer during confirmational scenario completion:

> P10-1: I have a question about the second one.
>
> R: Okay
>
> P10-1: Are you going to give me a meal and a program or do I have to find a program?
>
> R: Well is it is talking about your school. So is there a way you can find out about the school’s lunch menu for this week?
>
> P10-1: Okay, so the lunch menu for this school…

Students questioning the problem or asking questions was labeled *questioning*.

Students used *verification* to make sure they understood scenario directions. Participant 12-2 asked himself during scenario completion, “Does it say I need two recipes?” After reviewing the scenario sheet, the student replied, “A couple,” then returned to locate another recipe. Students proposed directional questions during scenario completion. Students confirmed when they should begin a process, save a process, close a process, or if they gathered enough information to complete the scenario.

Gathering needed information/making lists, questioning, and verification were techniques students used to assist in understanding the problem. These techniques were placed under the process Marchionini labeled *define problem*.

4.3.4 Enter Networked Environment

Students described when discussing the problem solving process on the NEQ and while completing the scenarios the act of entering the networked environment at *school*. Question 26 on the NEQ asked students to describe how they would locate information on the presidential elections using their school's networked environment. Students wrote in their descriptions:

1. Log on

I would have to log on to my account…

Using my schools network environment I would get on to the computers…

First, I would log on to my personal account…

I would go to the computer lab. Then I would log on to my username…

I would log onto the network using my username and password….

Question 27 on the NEQ asked students to describe how they would look up information on what is playing at their local movie theater. One student described in the steps taken, "Login to the network." A student wrote for Question 28 on the NEQ, "I would go to the band's website (after login and all that).” All students completing the scenarios were required to enter *access codes* to gain entry to the school’s network, which included their *student account*. Many students described this process during scenario completion.

Students also described on the NEQ entering the networked environment at *home*. One student wrote for Question 28 on the NEQ, “I would use my iTunes on my home computer.” Another student described that the ability to locate the information to complete the question was dependent upon *parental permission*. The student wrote, “First, I would have to get permission to download without parental block on the website.” Students’ descriptions of gaining access to the networked environment from home or school were placed under the category *enter networked environment*.

4.3.5 Select Tool

Students describing the process of locating information typically included statements such as, “I would open up Internet Explorer and immediately type in the URL of a popular search engine such as www.google.com. Once there, I would type in various phrases dealing with my interest into the search box.” Describing use of Internet Explorer was labeled *networked application selection*. Describing selection of search engines as a tool to locate resources was labeled *networked resource selection*.

Students on the NEQ described a variety of networked applications and resources they would use to begin to solve the problems. For example, a student wrote as a response for Question 26,

> To find out information about the presidential candidates running in the 2004 election, I would first see if there were any online databases set up by the school through a club, class, or library project. If there weren't, I would contact a teacher

> through the webmail system that had experience and ask them if they had any resources. Next I would check the [I]nternet through Google to see if there were any relevant official sites.

The student reported that they would select a networked application, the *Internet* (i.e., the Web), for locating resources. The networked resources the student would then select to find information included online databases and search engines, labeled as *search tools*, and a teacher, labeled as *people*.

Students completing the information scenarios used a variety of networked applications and resources. For example, Participant 9-2 selected two applications and a resource to use when beginning scenario completion. He stated,

> Alright, first just to save the information I find I am going to open a Word Document so I can copy and paste things that uh I find useful onto the Word Document. I am just going to minimize that so it's down there and I can copy and paste stuff. Then I am going to open Internet Explorer and go to www.Google.com 'cause they generally have a lot of information.

The student first opened a *word processing* application, Word, to record information found and then opened a *Web browser* application, Internet Explorer. Next, the student selected a search tool, Google, to locate information.

Networked applications students described they would use when answering the NEQ and ones students used during scenario completion included and were labeled: Internet, (e.g., Internet Explorer, AOL, Email), email (e.g., Outlook®), calculator application (accessed through the Accessories folder), word processing (i.e., Word), file sharing applications, and media players.

Resources students described they would use when answering the NEQ and ones students used during scenario completion included and were labeled: browser, search tools (e.g., search directories, search engines, subscription databases, library catalogs), and specific Web sites (e.g., school Web page, government, news sources, personal/official, commercial, created shortcuts). Students also reported on the NEQ and in the interview that they would go outside the networked environment and use resources such as print (e.g., books, newspapers), telephones (e.g., directories/information services), commercial stores, and people (e.g., friends, parents, teachers, self) to locate information; these were also labeled.

Networked application selection and resource selection were placed under the category named *select tool* based on Marchionini's (1995) process select source.

4.3.6 Create Search Strategy/Formulate Query

Students completing the NEQ described techniques they used when utilizing resources to locate information. Students completing the information scenarios applied these same techniques. These were placed under the process labeled *create search strategy /formulate query* based on Marchionini's (1995) process labeled formulate a query and his description of creating search strategies. Students used two types of search strategies labeled *analytical* and *browse*.

Students typically used the browsing strategies when they wanted to explore specific Web sites, as a student described, "I would browse blogs [sic] made by political activists and others who are interested…"

Analytical searching strategies were typically applied when students used search tools to located information resources. Use of analytical search strategies required students to formulate a query for the search tool to execute. Marchionini (1995) stated that query formulation involves matching understanding of the task with the resource selected. Analytical queries students formulated included and were labeled, *keyword(s),* *specific names, phrase, subject, natural language,* and *Boolean logic*. Table 14 provides a listing of the labels along with the various query formulations examples described or used by students.

Table 14

Labels Assigned To Analytical Search Strategies When Formulating Queries

Labels	Examples
Create Search Strategy/Formulate Query: Analytical: Keyword(s)	P: So I am trying to find diabetes. V: P10-2 types in the word diabetes into the Google search box. M: [Google - Microsoft Internet Explorer] <12:57PM>diabetes<12:57 PM>
Create Search Strategy/Formulate Query: Analytical: Specific Names	I would go to Google.com … I might also type in "Howard Dean" or "John Kerry" and would get in depth information about those specific candidates.
Create Search Strategy/Formulate Query: Analytical: Phrase	1. I would go to www.yahoo.com 2. type in "Movies in Dallas, Texas at Cinemark 17"
Create Search Strategy/Formulate Query: Analytical: Natural Language	P: And…then it should… [TYPING…] what is my state rank for tornadoes?... V: P7-1 types the query where does Texas rate for tornadoes. P7-1 selects the GO button M: [FEMA: Backgrounder: Tornadoes - Microsoft Internet Explorer] where does tv <Backspace >ecas <Backspace: 3 >xas rate for tornadoes <Enter: 2 ><Backspace ><Enter >
Create Search Strategy/Formulate Query: Analytical: Boolean Logic	I would go to Lexis-Nexis and type in "presidential candidates 2004" and select the boxes narrowing the search to "within 7 days" then I would select "all regional newspapers and magazines" and hit enter

The techniques students use to formulated queries included and were labeled *extract concepts from problem, extract from background knowledge,* or *copied from another resource*.

4.3.7 Execute Query

Many students described, when completing Question 27 on the NEQ, that they would execute a search on a particular movie Web site to locate theaters and movies by placing the name of the theater or their zip code into a search box. Students completing the first confirmation scenario executed searches on movie Web sites to locate theaters, movies, and movie ticket pricing. Students placed into a search field or selected from drop down menus personal data (i.e., zip codes), geographical data (i.e., city and state), dates, or specific names and executed the search. This technique was labeled *modify search fields*.

For Question 28 on the NEQ a student wrote after describing the selection of a media application that would allow him to search for music and download it to be burned on a CD,

> I would type in an 80's song my dad previously gave me and multiple results would show up. The results would list of. Title, Artist, Downloading Program, mg's, etc.

During completion of the first confirmational scenario, a student used Google and typed currency exhange rates in the search box. After the search page loaded the student selected the link "Did you mean: currency exchange rates." A new results page loaded in the browser. Participant 11-2, completing a task in the motivational scenario that requires the student to locate picture of the athletes chosen for the fantasy sports team, copied a name off a Word document created and pasted it into the Google Image search box. The student selected the search button and a results page loaded with images. The technique executing the search to gather a list of results or selecting a link to gain access to a list of resources was labeled *results*.

The physical actions students described or exhibited when modifying search fields and executing the search to gather results was placed under the process Marchionini (1995) labeled *execute query*.

4.3.8 Examine Results

After students executed a query or selected a resource, they would examine the results. This was placed under the process Marchionini (1995) labeled *examine results*. A student describing how he would go about locating a song for a class for Question 28 on the NEQ stated,

> I would first go to yahoo.com and search for some songs from the 1980's, for example I would search for "80's music" I'll write down the list of songs and then download them from Kazaa. After listening to each song, I would pick the one that would most satisfy the needs.

"Listening to each song" was labeled *evaluate information*. Students evaluate information in resources by skimming, scanning, listening, or reading. Students used the mouse to scan and read the material. Many students would highlight (i.e., dragging the mouse across text or images) information or images that related to the problem. Students completing the information scenarios scanned result lists examining the summaries or descriptions looking for criteria that matched the information need. Students selected or rejected information based on user-defined criteria such as relevance or usefulness. Students rejected information because of redundancy or irrelevance.

During completion of the second instrumental scenario, Participant 8-1 modified a search to locate information on the average number of tornadoes the state of Texas experiences per year. After the results page loaded the student selected the first link in the result list titled *Tornado Safety>>Tornado Facts>>Per Year* sponsored by http://www.ocs.ou.edu. The page loaded and the participant scrolled over the menu link options. The student reviewed the menu option titled Tornadoes per Year [avg.] using the curser. The reviewing technique was labeled *resource examination*. As with evaluate information, students examined resources by skimming or scanning.

4.3.9 Resource Selection/ Location

After describing the selection of Google as a source and formulation of a query a student wrote for Question 26 on the NEQ, "Then I would find a link that looks like it might have information on all of the candidates of the election and click it." This process was placed under a new category labeled *resource selection/location.*

Student chose resources that were *links on page* (e.g., specific site, help link, images, auto-generated Web pages provided by host, Web pages pre-selected by school), *links on result list* (e.g., newspaper and magazine articles, Web page), and *site sub page links*. Table 15 provides a list of the types of resource selection/location labels created along with the various student examples.

Table 15

Labels Assigned To Techniques Used In Resource Selection/Location

Labels	Examples
Resource selection/location: link on result list: Web page	V: P9-2 activates the link title "Exchange Rates"
Resource selection/location: Link on page	V: P12-1 moves the curser over the list of links in the section Top Destinations and selects the Hawaii link.
Resource selection/location: Link on page: Help link	P: um…oh and this one has help button… I have know idea what this one means V: P9-1 selects the Help hyperlink for the Nominal rate option

Resource selection/location: Link on a page: Specific site	V: P11-1 selects the LexisNexis link under Library Resources
Resource selection/location: Site sub page link	V: The school Web site loads. P10-2 moves the curser down the left navigation bar over the various links and selects the link to the LS Library

Students selected or rejected resources from the results list or specific Web pages in terms of relevance and usefulness to the problem. Students selected resources based on how well the title or description on the results list matched the information need, if the position of the result on the list was toward the top, or when the search tool suggested the result.

4.3.10 Extract Information from Resource

Many students answering the problem solving questions on the NEQ described how they would collect information once located. For example on Question 26 students wrote,

> ...I would write down the information that I wanted to use.

> ...whatever information I thought was necessary I would copy and paste into word, creating a big file of info from different sites, and then I would pint it out and highlight and read it.

> ...think up as many keywords I can about the candidates, type them in to the engine to see what comes up. If these keywords don't work I'd go to the best site I could find and retrieve more keywords

> I would go to www.google.com and in the search box I would type in the words: 2004 presidential candidates. I would then go to a website that I thought would be a good place to look out of the options that they gave us and I would record whatever they said...

Students completing the NEQ described various techniques they would use to extract information. The techniques were labeled *record data, copy and paste, save, print,* *download, burn to CD*, place in a *shopping cart*, or *purchase* (i.e., conduct monetary transaction). Students completing the scenarios used many of these techniques as well and gathered information using verbal communication. After selecting an online magazine resource that contains recipes and practical information for managing diabetes, Participant 11-1 reviewed the site links describing the information found. The student stated, "um…snacks the healthiness of a being a diabetic diet… That looks like it would pretty accurate so I will look there." The technique for describing the information found was labeled the cognitive behavior *relay findings*.

Information gathering techniques were placed in the process Marchionini (1995) labeled *extract information*.

4.3.11 Reflect

Students monitored the progress of their information seeking by thinking about the information found. A student answering Question 27 on the NEQ stated after describing executing a query on moviefone.com,

> A list of movies that are currently playing at the movie theaters will appear under the theater name and I would choose one that I would be interested in seeing.

Students decided on information use, next direction to take, if they should continue the process, or if a task was completed after reflecting. These were labeled the cognitive behavior make decision.

Students also reflect on information to make sure resources were credible, information was reliable, and all tasks were completed. For example in describing how to locate information on presidential candidates for Question 26 on the NEQ a student wrote,

> I would go to www.google.com and in the search box I would type in the words: 2004 presidential candidates. I would then go to a website that I thought would be a good place to look out of the options that they gave us and I would record whatever they said and then I would check it through a couple of other websites to make sure that the initial web [site] I went to was not giving false information.

The act of checking the information against other resources and making sure all tasks were completed was labeled *verification*.

Make decision and verification techniques were placed in the process labeled *reflect* based on Marchionini's (1995) process reflect/iterate/stop.

4.3.12 Continue Process

Marchionini (1995) stated that an information search is seldom completed with a single query and retrieved set. Student answering questions on the NEQ described and students completing the scenarios showed how they would repeat or redirect a search when more information was needed or desired information was not found. For example, a student answering question 26 wrote,

> First go to www.google.com and type in "presidential candidates running 2004" You would get a list of topics to choose from. [C]lick on the first topic, if it has no [relevance] of not enough information click the back button on your [I]nternet toolbar. When you have gone back to the topic page click the second one down. If it does not have either enough or no [relevant] information, then you simply click back. Repeat this process until you have gone far enough down the first page that the web pages have less and less [relevance]. ([T]he other pages will probably have so little [relevance] that you need not click on them.) If the search fails, go back to www.google.com and type in "presidential runnings 2004." Again keep finding information on various web pages and if that fails keep typing in different key words into Google search engine.

The student's description of returning to the source, Google, and repeatedly selecting resources and examining information was labeled *repeat stage using ordered behaviors*. The student's description of returning to the source, Google, and altering the query was labeled *modify query*. Techniques used to modify queries included *altering* (e.g., changing terminology in existing query), *broadening* (e.g., removing keywords from existing query), and *narrowing* (e.g., adding keywords or adding Boolean operators or limiters to existing query) and *creating new search strategies*.

Students also redirected a search when another technique did not work or students chose to move the process in a new direction. Students redirected a search using *switch application*, *switch resource*, or *create new search strategies*. Applications and resources were either previously used in the search or new. For example, after locating information on diabetic diets for the first instrumental scenario, Participant 11-2 used switch application. The participant moved from the Internet Explorer browser to a word processing application, Word to organize the information found. Once the information was organized, the student used switch application again by moving back to the Internet explorer browser. In Question 26 on the NEQ students reported that if desired information on candidates was not found in one resource (e.g., from the result pages list on Google) then the students would use switch resource (e.g., try another search engine, subscription database, or news Web site) and continue their information seeking process until the desired information was found.

Students use of repeat stages using ordered behaviors, modify query, switch applications, switch resources, and create new search strategy were placed under the process labeled *continue process* based on Marchionini's (1995) process reflect/iterate/stop

4.3.13 Stop Process

On Question 28 on the NEQ, a student described how to go about locating a song from the networked environment for a class project. The student wrote, "go to a search engine and search for a list of 80s songs." However, the student stopped the process after stating, "I would then pick out a song and then I am not sure how to download it legally." This was labeled imposed stop. During scenario completion stops were self-imposed (e.g., students felt uncertain of the next steps to take or they felt they spent enough time on the task so they stopped the search) or imposed by the researcher (e.g. time allotted to complete scenario expired and I called time).

Other students moved the problem process through what was labeled as task completion. For example, a student wrote for Question 28 on the NEQ,

> First, I would go to a Web site that allows you to download songs. Then I would type in the 1980's songs that I wanted to find. Then, I would buy the song and then burn it on a CD and turn it in.

Students ended problem solving when they believed they had located enough information for task completion or self-imposed a stop. Ending the problem solving process by task completion or imposed stop was placed under *stop process* based on Marchionini's (1995) process reflect/iterate/stop.

4.3.14 Exit Networked Environment

At the end of the scenario sessions, the students would close out applications and log off the school's networked environment. Students' actions of *closing applications* and *logging off* the networked environment after scenario completion were placed under the category *exit networked environment*.

4.3.15 Summary

In identifying problem solving techniques, I found that students move through various stages when solving information needs in the networked environment. The stages represent these students problem solving approach. The stages identified included enter networked environment, recognize or accept problems, plan, define problems, select tools, formulate queries and create search strategies, execute searches, examine results and information, locate and select resources, extract and organize information, reflect, continue process, stop process, and exit networked environment. Students applied various problem solving techniques as they moved through a stage. I identified two types of techniques; the first type of technique was the steps taken. These techniques correlated with information seeking behavioral actions identified earlier as strategies and tactics. The second type of technique was the methods applied to carry out the steps. The stages identified along with the techniques students applied are incorporated into a preliminary networked generation youth information seeking process model that represents and describes the networked generation youth's information seeking process in a networked environment.

4.4 Summary

This research was grounded in information seeking in context, the theoretical lens that guided the research design. The research examined information seeking process in context of networked generation youth. A goal of the research was to document how networked generation youth utilize the networked environment to solve information needs through their information seeking process. Chapter 4 presented a profile of the study participants, which described the students' specific seeking knowledge, perceptions, and interests in using networked environments. Data from the questionnaire, observations, and semi-structured interviews showed that knowledge and experience influence networked generation youth's information seeking process in the networked environment. This finding holds implications for teaching, learning about, and developing networked generation youth's information seeking process. Implications related to this finding are discussed in chapter 5.

Another goal of the research was to identify, describe, and categorize information seeking behaviors and problem solving techniques of adolescents as they use a networked environment. The research extended the user-centered approach to modeling the information seeking patterns of networked generation youth. Observation and interview data provided details of students' cognitive, affective, and physical behaviors and behavioral action patterns. These behaviors were found to be at the core of information seeking influencing every aspect of the process. Questionnaire, observation, and interview data also provided details of students' problem solving process. The research found that students move through various information seeking process stages when solving information needs in the networked environment, employing different problem solving actions and techniques to move through the stages. From the data, a model that represents and describes the networked generation youth's information seeking process in a networked environment was developed and is also discussed in chapter 5.

CHAPTER 5

DISCUSSION

This study was designed to examine information seeking process of networked generation youth. Specifically, this study examined the cognitive, affective, and physical information seeking behaviors and problem solving techniques adolescent student users of the networked environment utilize to solve information needs. Five research questions guided the study. Using a mixed model research design, I collected both quantitative and qualitative data in two phases to learn about students' information seeking process in the networked environment. A networked environment questionnaire (NEQ) was administered during Phase 1 to 125 students enrolled in Grades 7-12. Additionally, two students from each grade level were selected to participant in Phase 2. The twelve students were individually observed as they completed four information seeking scenarios and then subsequently interviewed. This final chapter provides answers the research questions, discussing implications to the findings, presents a preliminary model that represents and describes the networked generation youth's information seeking process in a networked environment, and presents additional research needed. The conclusion presents a summary of the study's significance.

5.1 Answers to the Research Questions

Based on analysis of the data presented in chapter 4, this section discusses the answers to research questions posed by the study.

5.1.1 Research Question 1

What cognitive, affective, and physical information seeking behaviors do networked generation youth exhibit while solving information needs in a networked environment?

The objective of the first research question was to identify the information seeking behaviors networked generation youth use in their information seeking process in the context of the networked environment. To answer this question, data from the observation and interview stages were examined. This study identified and characterized information seeking behaviors that generally fell into the categories of cognitive, affective, and physical behaviors and information seeking behavioral actions (i.e., patterns, strategies, tactics and moves).

As discussed in chapter 2, previous studies examined cognitive behaviors in terms of search strategies (e.g., analytical, browse). A previous exploratory study identified the types of information seeking behaviors exhibited by young adults using a networked environment (see Walker & Moen, 2001). Walker and Moen (2001) categorized information seeking behaviors as patterns, strategies, tactics and moves (i.e. behavioral actions). In identifying the patterns, strategies, tactics and moves, Walker and Moen found that there were behaviors that did not fit into the categories but were higher level cognitive behaviors that directed adolescents' information seeking process. For example, Walker and Moen (2001) identified realizations and thinking mode as cognitive behaviors. Students in this study exhibited *realizations* and *thinking mode*, these behaviors were witnessed through physical or verbal signs or articulations made during scenario completion. Additional cognitive behaviors identified in this study included *error creation*, *correction*, *relay findings*, *confirmation*, *decision-making*, *process completion*, and *background knowledge use*. Cognitive behaviors typically occur as inner thought processes; however, students were asked to talk-aloud during scenario completion so the thoughts were available to analyze. The cognitive effort of deciding which scenario to complete and formulating queries to describe it, as well as keeping track mentally of resource options engaged the students on a number of cognitive levels. Making decisions about retrieved items and utilizing information in scenario completion was also a complex cognitive task. Table 16 lists the observed cognitive behaviors, the definition of these behaviors developed through this study, and examples of types of each behavior.

Table 16

Observed Cognitive Information Seeking Behaviors

Behavior	**Description or definition or characterization**	**Example types of each behavior**
Realization	Students reach a level of understanding to a specific action taken.	Expletives stated within verbal thoughts such as “wait”, actually”, “oh”, or “oops”.
Thinking Mode	Physical or verbal actions students use when deciding a route to take regarding a task.	Statements such as “um” or “well” verbalized or actions such as tapping on the keyboard prior to entering a period of silence or pause in activity.
Error Creation	The unconscious process of making an error that affects the outcome of an applied strategy.	Misspellings, typographical errors, misuse of operator /mathematical symbols in query formulation
Correction	The conscious process of correcting an error in order to redirect the seeking process or alter collected information.	Fixing misspellings or typographical errors. Redirecting search
Relay Findings	Students verbalize findings from information gathered or deduced.	“So, the final amount would be $8.25 remaining for snacks”
Decision-Making	Students make choices or judgments regarding the given information then select a direction to take to complete a task.	“Well the first thing I am going to do is go to Google”
Confirmation	Students acknowledged researcher directive or question.	“Okay, save document as P7-1-1”
Process	Verbal acknowledgement or	“So that is it”

Completion	physical action students make when information seeking process is complete.	
Background Knowledge Use	The students use background knowledge when making decisions about resources, information, or task completion.	"What am I doing? I know how much a movie costs. It cost seven dollars for a kid…seven dollars for a kid and 12 dollars for adults. These are kids…so…"

As previous studies found, adolescents in this study experienced positive and negative feelings during information seeking. Previous research found students experienced a variety of affective behaviors during information seeking including motivation, persistence, self-confidence, satisfaction, joy, and patience, frustration, uncertainty, and confusion (Agosto, 2002, Bilal, 2000, 2001, 2002, 2005; Branch, 2001, Enochsson, 2005, Fidel et al., 1999; Hirsh, 1999; Large & Beheshti, 2000; Shenton & Dixon, 2003a; Watson, 1998). Bilal (2005) also included preference (e.g., search engine preference, task preference) as an affective behaviors when students used the Web for information seeking. Watson (1998) extracted common themes about students' feelings and perceptions. Students in Watson's study reported feelings of self-confidence and authority in using the Web from having experience with using the technology and learning by trial and error. Joy and challenge in finding information and the need for patience and persistence surfaced as motivational factors. This research used Walker and Moen's (2001) categories *affirmation*, *frustration*, *hesitation*, and *familiarity* to describe the students' affective behaviors they experienced while solving an information need in the networked environment. An additional affective behavior labeled *intuition* was also identified. Table 17 lists the observed affective behaviors, the definition of these behaviors developed through this study, and example of types of each behavior.

Table 17

Observed Affective Information Seeking Behaviors

Behavior	Description or definition or characterization	Example types of each behavior
Affirmation	Students gain a sense of clarity. Physical or verbal signs of elation made when students move forward in the search process or complete a task.	Use of words like “okay”, “alright” or “so” prior to making decisions.
Familiarity	Students choose to perform a certain way based on previous behavior, personal likes or dislikes, comfort level or ease.	“I am not a big fan of sports and I like to travel so I think it would be easier to find a place.”
Frustration	Students’ feelings of difficulties in completing a task expressed in physical or verbal signs.	“This is taking too long…”
Hesitation	Students show physical or verbal acts of pausing, uncertainty, or indecision.	“I just can’t say which I believe”
Intuition	Students’ believe that a particular act would or may happen if a strategy, tactic, or move is applied (i.e., a guess, hope, etc.). A cognitive process underlined with affective feeling, uncertainty.	“I really hope that this is it ‘cause otherwise [I am] wasting time…”

Physical Behaviors are described as the moves students make as they navigate through the networked environment. The moves were initially identified as a type of behavioral action; however, they were then grouped into larger physical behavior categories labeled operational, navigational, and exploratory moves as described by previous research (Bilal, 2000, 2001, 2002; Thomas, 2004). Constraints were also identified as a physical behavior.

Thomas (2004) related physical behaviors when utilizing a networked environment to eye-hand coordination, keyboarding and typing, mouse management, and operating peripherals (e.g., printers, network drives). These types of physical behaviors were classified as *operational moves*. Keyboard and mouse skills mastery is integrated into computer education curriculum usually taught at the elementary level.

Students in this study displayed experience with keyboard (e.g. typing, shortcuts) and mouse (e.g., arrow, right-click) use for information location, extraction, and gathering.

Bilal (2000, 2001, 2002) classified the physical behaviors of seventh grade students as they navigated through the Web-based search engine, Yahooligans! ®, as navigational and exploratory moves. *Navigational moves* included hyperlink activation, scrolling, backtracking, and looping. Hyperlink activation and scrolling were features students in this study relied on to navigate through the networked environment. These students often backtracked to previously retrieved sites. Backtracking allows the viewing of previously retrieved Web pages in a linear mode and is typical of user behaviors on the Web (Bilal, 2002). Most students in this study backtracked utilizing the browser's Back and Forward buttons; however, the more efficient users activated shortcuts, history lists and bookmarks. These *exploratory moves* are those that are embedded in using the browser's features (e.g., Find, Help, History, Bookmarks). The students who were more familiar with Web-based and application features used exploratory moves including Find, Home, History, Stop, Favorites, and Refresh.

Physical behaviors also include the *constraints* associated with using the environment. Agosto (2002) noted the physical constraints information seekers operate under during information seeking on the Web when studying adolescent girls' use of the Internet. Agosto found constraints to be negative (i.e., physical discomfort with screen) or positive (i.e. use of Web to relieve physical exertion of going to multiple places to locate information). Students in this study also operated under positive and negative constraints while using the networked environment. Students liked the multitasking capabilities of the networked environment because information could be found simultaneously using several resources by opening numerous Web browsers at one time, which according to the students, allowed for more efficient searching. Students also recognized that networked environment use created negative constraint when locating information, specifically with time and resource limits. Table 18 lists the observed physical behaviors, the definition of these behaviors developed through this study based on previous research, and example of types of each behavior.

Table 18

Observed Physical Information Seeking Behaviors

Behavior	**Description or definition or characterization**	**Example types of each behavior**
Operational Moves	Use of networked environment peripherals (e.g., keyboard, mouse, drives, printers) to locate and manipulate information.	Arrow, Buttons/Icon, Close, Delete Material, Drop-Down Menus, Keyboard, Main Toolbar, Print, Right-Click, Task Switcher, Type
Navigational Moves	Use of moves to navigate through the networked applications and resources.	Backtrack, Direction, Select/Highlight, Scroll,
Exploratory Moves	Use of embedded features in networked applications or resources.	Favorites/bookmarks, Find, History, Home, Refresh, Stop
Constraints	Operation of networked environment to locate information under constraints. Constraints may be negative (i.e., physical discomfort with screen) or positive (i.e. use of Web to relieve physical exertion of going to multiple places to locate information).	Time limit imposed for scenario completion, Multitasking capabilities of system (multiple browser use), Synchronized collaboration (group work through discussions, shared network space)

The specific moves, tactics, and strategies students used to work through the seeking process in the networked environment were categorized as behavioral actions. Students applied various moves, tactics, and strategies during scenario completion. Patterns developed based on the applied tactics and strategies. Table 19 lists the observed information seeking behavioral actions, the definition of these actions developed through this study, and example of types of each action.

Table 19

Observed Information Seeking Behavioral Actions

Behavioral Actions	**Description or definition or characterization**	**Example types of behavioral actions**
Moves	The operational, navigational, and exploratory moves students used during information seeking	Scroll, backtrack, type, arrow, keyboard, drop-down menus, right-click, print, home, highlight, direction, buttons, delete material, close, main toolbar, history, find, task switcher, stop, favorites, refresh
Tactics	The choices taken to locate resources and gather information during a search.	Review material, modify query, switch resource, copy information, multitask, minimize, maximize, switch application, save documents/information collected, modify collected information/format
Strategies	The approach students take to a problem.	Application use, resource selection, predetermined resource selection, keyword search-broad, keyword search-narrow, natural language search, Boolean search, subject search, previously acquired information, verify information
Patterns	Chunked strategies or tactics that students internalize through repetition and experience.	Assistance utilization, knowledge application, ordered behaviors, personal interest utilization

Student's *moves* coincided with those found in previous studies on adolescents (Bilal, 2000, 2001, 2002; Fidel, 1999; Walker & Moen, 2001). The operational, navigational, and exploratory moves assist students in maneuvering networked applications and resources during information seeking. Students also used moves to apply tactics or execute strategies.

Students in this study applied *tactics* to locate resources and gather information in efficient and effective manners. Walker and Moen's (2001) previously identified tactics of review materials, modify query, switch resources, and copy information were utilized by students in this study. These students also applied the tactics multitask, minimize, maximize, switch application, save documents/information collected, and modify collected information/format using the networked environment. Tactics directed the flow of students' scenario sessions, affecting the speed of the session and the ability to locate the desired information. For example, students reviewed materials using scanning methods. When students quickly scanned the page, at times important data were missed that would have provided useful information to complete the task. Students who thoroughly reviewed materials located information more effectively.

Strategies are the approach students take to a problem (Marcionini, 1995). Previous research reported that children and adolescent's search strategies are heuristic in that they are highly reactive rather than planned when approaching a problem (Fidel et al, 1999; Marchionini, 1989, Shenton & Dixon, 2003a; Valenza, 2006). Researchers found that students preferred browsing to the more complex analytical strategy approach (Bilal, 2000, 2001, 2002; Bilal & Bachir, 2007; Large & Beheshti, 2000, Marchionini, 1989; Small & Ferreira, 1994). In contrast, the majority of students in this study applied analytical strategies as an initial search strategy. Browse strategies were typically applied after selecting a specific Web site as a source or after choosing a resource to find specific information in relation to the task. Students often planned out the search strategies formulating queries by extracting keywords from scenario descriptions, background knowledge, or information gathered on the topic. Students created keyword searches-broad, keyword searches-narrow, Boolean searches, natural language searches, or subject searches. Students applied various search strategies throughout the sessions based on need or type of search tool used. Students also applied the strategies, application use, resource selection, predetermined resource selection, previously acquired information use, and verify information. The study found that the students who consistently verified information completed the scenarios more efficiently than those students who did not. These participants stayed with the task and kept a directive pattern in their seeking process.

Patterns are chunked strategies or tactics that students internalize through repetition and experience (Marchionini, 1995). Patterns emerged across scenario sessions of individual students and among the students completing the same scenario. Patterns of assistance utilization, knowledge application, ordered behaviors, and personal interest utilization were identified.

Patterns in behavioral actions have been noted in previous research. Fidel et al. (1999) found that students often followed the suggestions of peers, teachers, and librarians during information seeking. Similarly, while students in this study reported that they typically located information on their own, a pattern noted was their use of assistance utilization in the decision making process of seeking information during scenario completion. Students asked for assistance as well as sought assistance from networked resources (e.g., help links). Students also reported in the interview stage that they would seek help from friends, teachers, librarians, and parents when locating information using the networked environment.

Students' application of previously known strategies, tactics, or moves to a current problem, i.e., knowledge application, and students' use of personal interest to decide the continuation of a query or selection of information, i.e., personal interest utilization, is also consistent with previous research that found students often repeated previous past experiences and start with what they know when beginning a search or select information based on familiarity (Fidel et al., 1999; Guinee, Eagleton, & Hall, 2003; Madden, Ford, Miller, & Levy, 2006, Shenton & Dixon, 2003a, 2004).

Use of ordered behaviors has also been noted in previous research. Bilal (2000, 2001, 2002) noted that students began search strategy formulation with an initial keyword searching using multiple concepts while subsequent searches used concrete terms or concepts. Madden, Ford, Miller, and Levy (2006) found students used refining search techniques where by they entered a term, scanned the results, and then modified their search. Branch (2001) found that students developed a pattern when completing tasks that included entering a search term, reviewing results lists, skimming the list for a relevant topic, reviewing selected article by skimming or reading, and finding answers within the chosen article. This research found students used ordered behaviors often performing, in an ordered fashion, specific strategies, tactics, or moves for different information problems and specific search queries. Students would select tools, formulate query using keywords, review results, modify query, review new results, select resource, and review material when describing how they would locate information or while completing scenarios. The students would then repeat the process until desired information was located. Table 20 lists the information seeing behavioral action patterns, the definition of these behaviors developed through this study, and example of types of each pattern.

Table 20

Observed Information Seeking Behavioral Action Patterns

Pattern	Description or definition or characterization	Example types of each pattern
Assistance Utilization	Students use assistance from an outside source (e.g., teacher, librarian, friend, electronic resource) in the decision making process of seeking information.	P7-2: What does combat mean? R: To go against something…fight it P7-2: Okay, go against. Okay, I am going to do number one
Knowledge Application	Students apply previously known strategies, tactics or moves to a current information problem.	"I learned this technique from uh debate"
Ordered Behaviors	Students perform, in an ordered fashion, specific strategies, tactics, or moves for different information problems and specific search queries.	Select tools, formulate query using keywords, review results, modify query, review new results, select resource, and review material. Repeat
Personal Interest Utilization	Students use personal interest to decide the continuation of a query or selection of information.	"Personally, the first one is more interesting. More realistic…something I would actually look for."

In examining the behaviors, I found that students' cognitive, affective, and physical behaviors and information seeking behavioral actions are interrelated. As discussed in chapter 2, Nahl (1997), in developing the ASC model, followed the assumption that affective variables always accompany cognitive and physical behavior and provide a filter for making cognitive decisions. In this study, observation data revealed that cognitive behaviors initiated affective and/or physical behaviors and information seeking behavioral actions. Affective behaviors bring out cognitive behaviors and/or physical behaviors and information seeking behavioral actions. Physical behaviors prompted cognitive and/or affective behaviors and information seeking behavioral actions. This interrelationship influenced how student addressed information needs while using the networked environment.

Answering the first research question helped meet the objective to document how networked generation youth utilize the networked environment to solve information needs through their information seeking process. Answering this research question also helped meet the objective to identify, describe, and categorize information seeking behaviors and problem solving techniques of adolescents as they use a networked environment. I found that students exhibit a range of cognitive, affective, and physical behaviors that are at the core of information seeking influencing every aspect of the process. As discussed in chapter 2, cognitive, affective and physical behaviors are a driving force in any information seeking process. The cognitive, affective, and physical behaviors and information seeking behavioral action patterns were placed at the center of the preliminary networked generation youth's information seeking process model presented in this chapter (See section 5.2).

5.1.2 Research Question 2

How do the cognitive, affective, and physical information seeking behaviors exhibited by networked generation youth for solving information needs in a networked environment differ among grade levels?

Results from the NEQ and data from observations and interview indicated that cognitive, affective, and physical information seeking behaviors exhibited by networked generation youth for solving information needs in a networked environment differ more on individual knowledge and experience than on grade level although differences among age and grade level did occur. For example, results from the NEQ and observation data showed that particular grade level students (i.e. students in Grades 8, 11, and 12) knew more about and used a variety of networked environment resources for solving information needs than the students in other grade levels. This phenomenon was attributed to the fact that the students at these grade levels were provided more training on knowledge and use of resources because, as those grade level students reported, resources were integrated into particular class assignments and projects.

During observations, scenario completion began with entering the networked environment and choosing a networked application. All students used an Internet Explorer® browser to locate and extract information and Microsoft® Word software to collect information. Source selection depended on the type of information needed, knowledge of resources, and comfort in using particular resources. Older students appeared to have more experience with query formulation and using subscription databases. They were more likely to select a subscription database as a source because, as the students reported, they have been utilizing the networked resources in classes. However, the younger students who were aware of the resources attempted their use.

All students used search engines; however, knowledge of the engine typically depended on student's level of experience with the tool. Similar findings occurred in Madden, Ford, Miller, and Levy's (2006) study on children's use of the Internet for information seeking. The authors found that the older students (14-15 years old) carried out more sophisticated searches than the younger students (11-12 years old). This phenomenon was attributed to the idea that the older students cognitive abilities, vocabularies, and problem solving skills were more developed and that the older students would have had more information skills training. Younger students, the authors noted, were more likely to be innovative thinkers (e.g., inventing URLs as a means to find information). Innovative thinking often came in the use of intuition among the more experienced students in this study. All students completing information scenarios exhibited use of intuition.

Students who were able to apply background knowledge or who were more comfortable with a topic were more confident in applying strategies, tactics, or moves and less likely to experience frustration during information seeking when completing scenarios. Hesitation in making decisions also occurred less often during information seeking when students were more comfortable with a topic or the strategy, tactics, and moves applied. This was consistent with previous research that found students with prior experience using the Internet for information seeking knew more about the features available to locate information and felt more confident and comfortable with their abilities (Kafia & Bates, 1997; Hirsh, 1999; Lazonder, Biermas, & Woperies, 2000; Madden, Ford, Miller & Levy, 2006, Watson, 1998). Students moved through the networked environment using operational moves. All students used navigational moves to execute strategies or apply tactics. Students used exploratory moves to navigate through Web pages when familiar to the student.

Multitasking allowed all students to work simultaneously on locating, evaluating, and extracting information. *Copying information* was a common practice among the students. When copying information, eighth grade students were most concerned with synthesizing information on their own for retention. Ninth and tenth grade students were concerned with citing the resources to avoid plagiarism. All but one student expressed the importance of using credible resources and locating reliable information for scenario completion. Many students selected resources based on what they believed was an indicator of a credible site, authority. Students often stopped looking for information when desired information was found from what they determined a credible resource. For example, Participant 8-1 only used the one resource found on the comet theory because a reputable science news outlet, Discovery.com, produced the article. Participant 7-1 only gathered weather and health information from reputable government sites. In addition, both Participant 10-1 and 12-1 used only official city or state tourism sites to plan vacations.

When students did not have experience with the topics or resources, breakdowns in the seeking process surfaced. The seventh grade student who attempted to complete the confirmational scenario on prize money had trouble with the mathematical concepts of converting the prize money from Canadian to U.S. dollars and calculating the amount that would be put into savings. The student converted the dollar amount inaccurately so the initial amount used to complete the scenario after conversion was incorrect. The older students also experienced difficulty calculating the conversion amounts, typically because students entered the wrong equation into a calculator application. When frustration set in for the seventh grade student during calculating percentage, the student applied a verification strategy and asked for assistance. Older students were more likely to attempt to work out breakdowns on their own. The older students who experienced problems with the mathematical computations continued their process completion and recalculated the equations until they came up with the desired amounts.

How students approached the problem affected the outcome of scenario completion. The students who verified all tasks associated with the scenario typically completed the scenarios more efficiently. Younger students were more likely to seek assistance from the observer when frustrations or uncertainty with scenario completion occurred. Older students looked to help menus for assistance or applied alternate strategies, tactics, and moves. Most students admit that they prefer to locate information on their own. However, students did indicate in the exit interview that they would ask others for assistance if needed. Students said they typically ask friends, through AIM® instant messaging service, teachers, or librarians. Vansickle (2002) reported similar findings.

Answering the second research question helped meet the objective of investigating how the study's results can assist in the development of appropriate information literacy programs. Implications for teaching, learning about, and developing networked generation youth's information seeking process related to the findings are discussed in the implications section of this chapter.

5.1.3 Research Question 3

In what ways do networked generation youth's information seeking behaviors assist or deter solving information needs?

The observation and interview sessions showed that various cognitive, affective, and physical seeking behaviors and behavioral actions assist students' information seeking by helping them work toward solving information needs. *Realizations* led students to re-evaluate resources being used that were not providing desired information and redirected information seeking. Realizations also showed that students were cognizant of *errors* (misspellings or illogical actions). Realizations usually led students to *decision-making*. *Thinking mode* allowed students time to plan direction and reflect on information helping students stay focused to the task. Students were not misled or misdirected by quick decisions that may have produced or returned irrelevant information. Use of thinking for planning is reported to save time and energy during information seeking (Thomas, 2004). Realization and thinking mode expletives and articulations are often overlooked by researchers when examining cognitive behaviors because the expletives tend to be part of adolescent everyday speech (e.g. oh, um, well, wow, yeah, okay). The commonality of their use by all students and the actions taken by students after use showed that they were a significant aspect in helping students move through the information seeking process. Educators should not overlook these expletives or articulations when working with students, as expletives or articulations may be key indicators as to where students are, what they are planning, and where they are going in the information seeking process.

A cognitive behavior that had a significant impact on solving information needs in the networked environment was *background knowledge use*. Students who applied background knowledge use (domain knowledge or topic knowledge) to a problem completed information scenarios more efficiently (completing the scenario using the least amount of time) than those who did not or who were not able to apply background knowledge. This finding is in contrast to Bilal (2001) who found when examining novice seventh grade information seekers using Yahooligans! as an information resource that domain knowledge and topic knowledge did not have significant effect on students' success when completing research based or fact-based tasks. In the characterization of an expert information seeker, background knowledge use is shown to be an indicator that an information seeker is using mental processes and long-term memory to solve information needs more efficiently and effectively. Ennochson (2005) identified six different skills students perceived as fundamental to information seeking on the Web. Half of the skills identified were knowledge-based skills. The students in this study revealed during questionnaire completion, scenario completion, and in the interview session an understanding of the importance in applying background knowledge (e.g., domain, system, and topic) during information seeking.

Students applied background knowledge use when choosing scenarios, selecting and using resources, evaluating information, and completing tasks. Students often chose to use known sources (e.g., search tools, previously used specific Web sites) to complete a task. Agosto (2002) defined returning to previously used Web sites as a “reduction” method in the decision making process when locating resources because the student can decrease the number of resources they would have to choose from when using the Web (p. 23). This was typical behavior for the adolescent girls Agosto studied. Students in this study recognized that applying background knowledge to a problem assists in completing information needs more efficiently by helping reduce the amount of effort expended to complete problems including reducing the number of potential resources they may have to use to locate the desired information. As one student reported:

> Um…well, I guess…a lot of stuff… I just knew stuff based on prior knowledge and I guess it may have been a little bit difficult if it wasn’t something that I didn’t know that much about. I would have actually had to go do research for that. I don’t think it would have been that difficult, but I would have had to go look at something else to find something else out instead of just knowing what it is and going straight to it.

Background knowledge use with search tools also helped students reduce the amount of effort it took to gather information on a topic. Students found their knowledge about search tools helpful with initial query formulation when locating specific information.

Background knowledge use helped students reduce the amount of effort expended to complete problems.

Affective behaviors created positive performances in adolescents' information seeking process. Students were engaged on a positive emotional level when selecting scenarios and making decisions based on *familiarity* and when expressing *affirmations* prior to articulating direction, relaying findings, and completing scenarios. When students applied familiarity and affirmations, they displayed self-confidence, persistence, patience, enjoyment, and comfort in their seeking process. Affirmations appeared to help students gain a sense of clarity during the information seeking process. Familiarity (i.e., personal comfort, personal preference, previous behavior) influenced decision-making. Agosto (2002) stated that personal preferences are an aspect of the affective side of information seeking as these preferences are based on personal feelings (i.e., likes or dislikes). She found that personal preference played a role in Web site selection and evaluation, specifically design and content, among adolescent girls. Students in this study used personal preferences to select scenarios, select resources, and complete tasks during information seeking. Familiarity motivated students' information seeking and assisted in scenario completion. Students were more likely to apply seeking strategies and to complete the scenario effectively when they connected with the problem on a personal level.

Intuition played a key role in students' information seeking process. Students stated earlier that effective information seekers use intuition in the process of locating information. The individual makes intelligent guesses in selecting tools, locating resources, and evaluating information. Students made decisions, synthesized information, and made conclusions based on intuition (e.g., hunches, guesses, or feelings). When selecting resources students would say, “Let see …”, “hit the button, see what comes up”, “and see what I get here.” Previous research found experienced adolescent Web users apply intuitive approaches (i.e., trial and error) to information seeking (Agosto, 2002; Bilal, 2001; Madden, Ford, Miller & Levy, 2006; Watson, 1998). Madden, Ford, Miller and Levy (2006) called the trial and error approach “imaginative thinking” where students guess or try different tactics in hopes of locating information. They found students to be untutored explorers and experimenters. Madden, Ford, Miller and Levy stated that students who learn through exploring an environment rather than being guided through it are better able to recognize the affordances (actions it allows) of that environment. Participant 7-1 in this study demonstrated this when she executed a search using Google to locate the book series. The participant moved the cursor over the first result link. The participant made a guess that the information found is correct by stating “I am going to this series, Series of Unfortunate Events and it is called the carnivorous carnival and it’s about the orphan…the three orphan[ed] Baudelaire children… and I am guessing they are running from a count…” The participant continued to evaluate the information then used the information gathered to see if more information would be found. The student applied intuition, which was articulated when the student stated, “and then in Google.com I am going to type in book review for and then I am going to copy and paste “book of the ninth” or “carnivorous carnival book of the ninth” and then see if I find something.” These students often used intuition when completing information scenarios. Use of intuition often engaged students on a positive emotional level when the intuitive act led desired outcomes in the information seeking process.

Physical behaviors also assist students information seeking. Students' *operational*, *navigational*, and *exploratory* moves and *constraints* directed students through use of the networked environment during information seeking. Researchers have reported that adolescents prefer using networked resources (e.g., Web resources) over print resources because they provide ease of access to information (Agosto, 2002, Fidel 1999). Agosto's (2002) students valued the Web for reducing "physical exertion" (i.e., having to go to different places for information gathering, saving time, etc.). Students in this study reported this same experience and, in addition, valued the networked environment for its capabilities in assisting in reducing the time it took to complete class assignments and group work. Students used the networked environment to alleviate physical exertion by applying multitask tactics during information seeking.

While there were ways in which information seeking behaviors assisted solving information needs, conversely, various behaviors deter information seeking by causing breakdowns in the process. Breakdowns are considered failures in successful information seeking (Solomon, 1993). *Error creation* caused breakdowns in some of the student's information seeking process. While error creations were minimal, they did hinder students' ability to locate information. Error creation included misspelling or mistyping words when formulating queries in search tools or using search tool Boolean operators incorrectly. Typographical and spelling errors, errors in using the system, deficiencies in topic knowledge, errors in source selection and use, errors in generating search terms, errors in using information, and errors in recording the results are often reported by researchers as breakdowns affecting adolescent information seeking (Bilal, 2000, 2001, 2002; Chen, 1993; Edyburn, 1988; Hirsh, 1999; Large & Beheshti, 2000; Madden, Ford, Miller, & Levy, 2006; Kafia & Bates, 1997, Shenton, 2007; Solomon, 1993). Bilal (2001) found that regardless of age, users tend to make spellings errors either because of inability to spell correctly or because of lack of attention to the error made. Students in this study typically corrected errors by fixing the misspelled word, using supplementary tools (i.e., selecting an auto-generated correction link provided by a search tool). However, if missed, students typically redirected the search by modifying the original query formulated. Students used the cognitive behavior *correction* to assist in moving through the breakdown and working toward solving information needs.

Cognitive behavior use that led to breakdowns often caused affective behaviors such as *frustration*. Several students experienced frustration when the search tool returned irrelevant or no results because the students did not recognize their mistakes or ignored the auto correction feature after error creation. Students' abilities to apply correction eased frustration. Students believed applying their background knowledge in the use of shortcuts helped them quickly navigate through the networked environment. However, students report that frustration occurs when applied shortcuts do not work in a system. As one student stated, "It's just that sometimes it [using shortcuts] can be a problem because you know you will push a shortcut and nothing happens…a couple of times I have tried to use Alt + Tab to switch to Word and it hasn't done anything." The student also gave another example of when using shortcuts led to frustration. The student stated while attempting to copy a picture from Internet Explorer and paste it into Word using the right-click mouse tool, "[Here is] another example when it [use of shortcuts] can be a pain because it doesn't want to paste it now. I don't know why…" The student switched back to Internet Explorer and attempted the process again. A typical response for students in this study when shortcuts did not work was to apply the move again or attempt a different shortcut that would produce the same results.

The affective behavior *hesitation* (i.e, pauses, uncertainties, indecisions) hindered information seeking for students. Students were engaged on a negative emotional level when indecision or uncertainty arose or students encountered roadblocks when completing tasks. Uncertainty has been found to be a common experience for information seekers and occurs at all stages of the information seeking process (Kuhlthaua, 1993). Uncertainty occurred throughout students' information seeking process including prior to beginning scenario completion when students were unsure of how to proceed and during choosing next steps, making decisions, verifying information, processing information found, or switching resources. For some students, uncertainty led to breakdowns in decision-making and process completion, as well as caused feelings of frustration. Uncertainty often caused students to feel frustrated with himself or herself, the problem, or the resource used. Students reported in the interview session that they feel frustration when systems run slowly or shutdown, Web sites do not appear and objects do not properly download, irrelevant resources load, or when potential sites are blocked because it hinders their seeking process. This is consistent with previous research that found students experienced feelings of frustration due to slow systems, equipment failure, time loss, and lack of information found (Agosto, 2002; Bilal, 2000, Fidel et al., 1999; Hirsh, 1999; Large & Beheshti, 2000, Shenton & Dixon, 2003). Students in this study dealt with the uncertainty by redirecting the process, applying intuition, or seeking assistance.

Physical behaviors such as time *constraints* placed on information seeking while using the networked environment hindered students' information seeking. Agosto (2002) defined two types of time constraints, "imposed and self-generated" (p. 22). Imposed time constraints are placed upon people. Self-generated time constraints occur when students set personal time limits. Agosto reported that time constraints are often placed on adolescents during information seeking. Students were given fifteen minutes to complete each scenario. This physical time constraint caused a negative feeling of unease for younger students. Participant 7-2 continually worried about not having enough time to complete the scenarios. During the first session, the student asked while in the process of locating information for the Great Chicago Fire theory:

> P7-2: Am I out of time?
> R: You are okay.
> P7-2: I am just making sure….

During the second session, the student again verified the amount of time remaining. The student asked while completing the confirmational scenario:

> P7-2: How much time.
> R: Don't worry about time.
> P7-2: [TYPING] …I doubt I will make it through.

However, once students were reassured through *assistance utilization* that there was plenty of time in the session the students relaxed and continued completing the scenarios. Interestingly, students worried about time when having difficulties with locating information to complete the scenarios.

Students in this study recognized that constraints were a reason that scenarios were not effectively or fully completed. Students reported in the interview sessions that the decisions made regarding how the scenarios were completed may have been different if they were given more time. Decision-making based on the constraint time often caused students to select resources quickly without verifying the credibility of the resource or the reliability of the information found. This may have caused students to collect inaccurate data thus diminishing the integrity of the conclusions made during process completion.

Process completion was also hindered when students failed to apply specific behavioral actions in their information seeking process. Scenarios were not completed accurately or effectively when students overlooked completing particular tasks associated with scenarios, misread or misunderstood the scenario directions, selected inadequate resources, did not review materials thoroughly, or did not verify that the information used was correct. In contrast, the students who completed the scenarios most accurately and efficiently were those students who applied the strategy *verify information*. Madden, Ford, Miller and Levy (2006) and Shenton (2007) noted similar findings when examining factors that affect student success in solving information needs.

Answering the third research question informed the development of the preliminary networked generation youth's information seeking process model and helped meet the objective of investigating how the study's results can assist in the development of appropriate information literacy programs. Implications for teaching, learning about, and developing networked generation youth's information seeking process related to the findings are discussed implications section of this chapter.

5.1.4 Research Question 4

How do networked generation youth construct strategies for information problem solving in the network environment?

Student enter the networked environment, recognize or accept problems, plan, define problems, select tools, formulate queries and create search strategies, execute searches, examine results and information, locate and select resources, extract and organize information, reflect, continue process, stop process, and exit the networked environment.

Students recognized and accepted problems by understanding the problem and making selections. To assist in understanding the problem several students used an underline and circle technique that was either learned or intuitive. Students made selections (i.e., accepted or rejected problems) based on background knowledge, personal interest, or ease of information location. Several students chose not to complete Question 26 or Question 28 on the questionnaire after reading the question. These students stopped their problem solving process because, as indicated, they did not know how to use the networked environment at school (Question 26) or they thought downloading music was illegal (Question 28). Marchionini (1995) labeled rejecting a problem as suppression. He stated that rejection is "influenced by the setting and the information seeker's judgment about immediate costs of initiating the search" (p. 51).

Previous research has indicated that adolescent strategies for information problem solving in the networked environment are primarily highly reactive rather than planned (Fidel et al., 1999; Marchionini, 1989, Shenton & Dixon, 2003a; Valenza, 2006). In this study, students' information seeking process ranged from those who used this highly reactive search and go approach to those who applied a more experienced methodical planned approach. The students who planned during problem solving did so by listing out steps using note taking or talk-aloud techniques or formulating multiple options using brainstorming techniques.

Marchionini (1995) stated that while defining the problem, "the information seeker represents the problem internally as a task with properties that allow progress to be judged and then determines a general strategy to use for subsequent steps" (p. 52). Students defined problems by gathering the information needed and making lists using note-taking techniques. Students also defined problems using questioning and verification.

Planning and problem definition occurred at various times during problem solving; however, most students did not articulate these stages when beginning problem solving in the networked environment. Most students in the interview session agreed that it would be important to make some type of plan before beginning to locate information. In both phases of study, most students described problem solving at source selection or formulate queries and create search strategy after entering the networked environment.

Students selected two types of tools when solving problems using the networked environment. The first tool selected was the networked applications used to locate, collect, evaluate, interpret, and present information. The questionnaire showed students selected the Internet, word processing programs, email, and media players and sources. The observations showed students select the Internet, word processing programs, and calculators as sources. Students applied a multitask technique when using these applications, opening several applications at once and switching back and forth when needed. The second tool was the networked resources used to locate and retrieve information.

Previous research found that choice of resource was determined by ease of access (link to resource on school Web site made it readily available for students) speed, popularity, and relevance of hits (Madden, Ford, Miller, & Levy, 2006). While this occurred among some students in this study, data from the questionnaire and observations also indicated that students' tool selection depended on the information need. For example, a student completing Question 26 wrote when describing the steps she would take to located presidential candidate information,

> I would probably start with the [I]nternet and look at a generic newspaper such as washingtonpost.com or nytimes.com, because they both have sections for "Politics" or "Washington" and subsections about the 2004 election. Otherwise, I might use the school's electronic databases such as LexisNexis or Ebscohost to find specific journals or magazine articles.

Tool selection also depended on how students interpreted the question. For example, students reported that they would look for different types of information on presidential candidates including biographical information, news commentaries on the candidates' politics, articles written about the candidates, candidates' personal Web pages when answering Question 26 on the NEQ. Students selected search engines, library catalogs, library databases, government Web pages, news Web sites, blogs, and personal Web page to locate information. One student also reported emailing a teacher for information. Scenario tasks varied so students again selected tools based on the information need (i.e., instrumental, factual, confirmational, or motivational), as well as background knowledge and the familiarity with the tool. Students selected search engines (e.g., Google Search™, Google Image Search™, Yahoo! ®, browser's URL), specific Web pages (e.g., commercial, school), search directories, and subscription databases to search for and retrieve information.

When creating search strategies students applied analytical and browsing strategies. Previous research found that students preferred browsing to the more complex analytical strategy approach (Bilal, 2000, 2001, 2002; Bilal & Bachir, 2007; Large & Beheshti, 2000; Marchionini, 1989; Small & Ferreira, 1994) and applied skimming and scanning techniques to analyze information (Agosto, 2002; Fidel et al., 1999; Hirsh, 1999; Marchionini, 1989; Liebscher & Marchionini, 1988; Watson, 1998). The students in this study applied browsing strategies when examining specific Web sites. Students browsed using scanning or skimming techniques to examine the source for information or for locating resources to gather information (i.e., sub page links, or information links). Students, when formulating queries in a search tool, applied analytical strategies. Students used single keywords, multiple keywords, specific names, phrases, subjects, natural language, and Boolean operators when formulating queries. The level of specificity depended on students experience with the search tool and knowledge of the topic. Students formulated queries by extracting concepts from the questionnaire problems and scenarios, extracting concepts from background knowledge, and copying concepts from another resource.

Students executed the query to obtain results. Results were then examined using browsing techniques (e.g. skimming, or scanning). Students scanned results examining the summaries or descriptions looking for criteria that matched the information need. If criteria were not met, students would continue the process by modifying the query. Techniques used to modify queries included broadening (e.g., removing keywords) and narrowing (e.g., adding keywords, altering keywords, or adding Boolean operators or limiters). After executing the modified query, the student would then examine the new results, repeating the process of browsing, skimming, or scanning.

Students selected or rejected resources from the results list or specific Web pages in terms of relevance and usefulness to the problem. Students evaluated the resources and links to determine which would be the most relevant to task completion and which direction would be most productive to follow. Agosto (2002) found use of titles and descriptions as means for resource selection to be a typical process performed among adolescents using the Web. The students in this study selected resources based on how well the title or description on the results list matched the information need, if the position of the link on the result list was toward the top, or when the search tool suggested the link.

Students extracted information for evaluation, synthesis, and use. Information extraction was verbal, written, or electronic. Students relayed findings verbally to determine relevance and usefulness, make inferences, and to make decision of next steps to take in the problem solving process. Students printed information from resources for evaluation or use. Student recorded data for evaluation, synthesis, and use using written and electronic note taking techniques. Students recorded data on the scenario sheets or used word processing applications. Note taking in the networked environment allowed students to use the copy and paste tactic. Students copied and pasted extracted information (e.g., resources, citations, and facts) to organize. Students organized extracted information to synthesize it with prior knowledge and experiences, then make inferences, and report results.

Students extracted information to manipulate data for continued information location or information processing. For example, students extracted keywords from resources to modify or formulate new queries and execute alternate searching. Students extracted prices from resources to execute calculations and report on monies spent. Students placed items in a shopping cart to conduct monetary transactions, purchase movie tickets, or songs from music stores. Students also extracted information to use later or to complete a task by using downloading or saving options.

Students reflected on effectiveness of the information found and on the process used to complete the problem by making decisions and verification. Students made decisions on information use, next direction to take, if they should continue the process, or if a task was completed. Students answering questions on the NEQ and completing the scenarios revealed the importance of verifying that the resources they find are credible and information is relevant to their need. This finding is in contrast to Shenton and Dixon (2003a, 2004) who concluded that students pay little attention to the accuracy of the information retrieved from a selected resource. Students also used verification techniques to make sure the problem solution was complete or if students needed to locate additional resources for cross evaluation. Students completing the information scenarios verified that they completed all required tasks and that the solutions answered the problem.

Students articulated an understanding that even though they use multiple steps (i.e., source selection, query formulation, resource selection, etc.) in the problem solving process the techniques applied may not provide the information needed. Students used continued process when a technique did not work or students chose to move the process in a new direction. In the continue process stage students modified queries, switched sources, or repeated process. Students modified queries by adding terminology, narrowing the search, broadening the search, or creating a new search strategy. When switching sources students opened new or previously used applications and opened new or used previously visited search tools and Web sites. Students used a set of ordered behaviors to repeat the process for information location, evaluation, and use. Ordered behaviors typically included formulate query, execute query, evaluate results, resource selection, evaluate information, extract information, and reflect. Students repeated the process until they found desired information, completed a task, or decided to stop the problem solving process.

Marchionini (1995) stated that determination of a stopping function may depend on external functions like setting or search system or on internal functions like motivation, task-domain knowledge, and information seeking ability. Stop process occurred when students believed they had located enough information for task completion, reached the imposed time limit, or felt uncertain of the next steps to take.

As with the first research question, answering this research question helped meet the objective to document how networked generation youth utilize the networked environment to solve information needs through their information seeking process. Answering this research question also helped meet the objective to identify, describe, and categorize information seeking behaviors and problem solving techniques of adolescents as they use a networked environment. By answering this research question, I found that students move through various information seeking process stages when solving information needs in the networked environment, employing different problem solving actions and techniques to move through the stages. Students' strategies for information problem solving in the network environment, (i.e., stages, actions, and techniques) were placed in the preliminary networked generation youths' information seeking process model presented in this chapter (See section 5.2).

5.1.5 Research Question 5

How do networked generation youth's problem solving techniques relate to the cognitive and affective behaviors exhibited in their information seeking?

Yang (1997) declared information seeking to be an activity of problem solving. Observations and interview data indicated that students' cognitive and affective behaviors are integral to problem solving guiding each stage of the process.

Marchinioni (1995) stated that if a person judges a situation appropriate, the person would accept the problem and begin to define it for the search. He continued stating that acceptance is influenced by knowledge about the task, by the setting, by knowledge of search systems, and by a person's confidence or personal information infrastructure. Phase 2 students completing the scenarios selected scenarios based on background knowledge, personal interest, or ease of information location. Students used background knowledge to recognize or accept the problem, plan, define problems, formulate queries, examine results, select tools and resources, and reflect. Phase 2 students reported in the interview stage that when they make a plan, they develop it in their head prior to execution. Students typically used the cognitive behavior, thinking mode, when planning during scenario completion.

Students in this study applied cognitive behaviors and information seeking behavioral actions (i.e., strategies and tactics) as means for problem solving. Students thought out the problem and made decision that directed the processes toward completion. Students used decision-making in the reflection stage. Students applied analytical strategies when locating information and browsing strategies when examining resources to gather information. Use of multitasking tactics allowed students to review resources simultaneously, making the process of locating information more efficient.

Bilal (2005) stated that information seeking is a dynamic process that involves the whole individual. Bilal declared that affect imparts directionally to problem solving, which in turn influences action. Affective behaviors, positive and negative emotions, directed students in this study to apply techniques that effected moving effectively through a stage. Students accepted problems based on familiarity and ease of information location. Students also applied familiarity when selecting resources and applied personal interest while in the reflection stage. Feelings of uncertainty, realization, affirmation, and intuition also enter the reflection stage during decision-making.

Frustrations occurred when an applied process or the networked environment did provide a desired response. This often caused students to change direction, apply alternate techniques, or stop process. Students demonstrated persistence that helped push them through the problem solving process at times when uncertainty arose. For example, after explaining how the student would locate a song the student moves to the next task, downloading from the networked environment. The student experiences uncertainty in the process, “I don't know how I would download it, because using Kazza, Limewire, and Napster is illegal.” However, the student troubleshot and came up with an alternate way to obtain the song using tools available on the networked environment, “I would probably rip it from one of my dad's old CD's using Windows Media Player.” Students often troubleshoot alternate paths and implemented trial and error techniques during problem solving to move toward problem resolution. Students applied intuition when defining problems, selecting sources, formulating queries and creating search strategies, selecting resources, extracting information, reflecting, and stopping process.

Answering the fifth research question informed the development of the preliminary networked generation youth’s information seeking process model. The preliminary networked generation youths’ information seeking process model depicts the relationship among information seeking behaviors and problem solving. Answering the question also helped meet the objective of investigating how the study’s results can assist in the development of appropriate information literacy programs. Implications for teaching, learning about, and developing networked generation youth’s information seeking process related to the findings are discussed in the findings and implications section of this chapter.

5.2 Findings and Implications

Data collected through questionnaire, observations, and semi-structured interviews were analyzed to answer the research questions. This section discusses the findings and the implications for teaching, learning about, and developing networked generation youth's information seeking process.

5.2.1 Findings 1 and 2

Students exhibit a range of cognitive, affective, and physical behaviors that are at the core of information seeking influencing every aspect of the process.

Students move through various information seeking process stages when solving information needs in the networked environment, employing different problem solving actions and techniques to move through the stages.

As discussed in chapter 2, Bilal (2002, 2005) requested a new model of information seeking that integrated a user's feelings, thoughts, and actions with problem solving, to derive a holistic model on which to build effective information literacy skills programs for children. These findings listed above are significant in understanding the information seeking process of the networked generation. The findings were used in the development of the preliminary networked generation youth's information seeking process model. The model has potential for use as a diagnostic tool when analyzing and instructing on students' information seeking process. The model can inform information literacy instructors on students' information seeking process in the networked environment. Cognitive, affective, and physical behaviors and behavioral actions can be examined to assess the degree to which the behavior affects the process. Instructors can pinpoint strengths and weaknesses in the information seeking process as students move through a particular stage, implementing specific actions or techniques. Instructors can then assist students in enhancing their strengths and addressing the weakness, teaching alternative methods. The model can also be used to help students learn to assess their own process so self-evaluation can occur. The model is presented in the following section.

5.2.2 Finding 3

Knowledge and experience influence networked generation youth's information seeking process in the networked environment.

The results from the questionnaire reported a significant difference in knowledge and use of the networked environment for information seeking among those who had more experience (i.e. spent more time) using the networked environment. This is consistent with previous research that found level of experience affected information seeking (Madden, Ford, Miller, & Levy, 2006). Schools provide computers and access to networked environments at younger ages. Many students have been using the networked environment since their primary grades or even before entering formal education. As previous studies on networked generation adolescents reported (Geck, 2006; Goodman, 2007; Lenhart, Madden & Hilton, 2005; Plotnik, 2003), the more experienced students in this study used a broad range of networked services for communication, entertainment, commerce, and information gathering. They consider the networked environment to be an important resource for schoolwork often completing assignments using the school provided networked information resources in the library, computer labs, and from home.

It was expected that since the students have grown up using networked environments, have access to computers and Internet at home, and the school integrates information and technology literacy into the curriculum that all students would be knowledgeable about networked environment concepts and resources and use a variety of networked resources during information seeking. Surprisingly, results from the NEQ showed disconnect among some students' knowledge of the range, organization, and uses of networked environment resources and how they used that knowledge during information seeking. Whereas students report use of the networked environment during information seeking, NEQ results indicated that not all students take advantage of the networked resources provided by the school. Many students know the school provides specific networked information resources and services, but some students reported only using the networked resources and services when required, usually for a particular class projects or assignments. Students typically used general Web resources, search engines and Web pages, when solving information needs using the networked environment. Students selected these resources based on the comfort and familiarity with the resource. Students need to recognize that while search engines may output reliable resources, there are other sources that can help meet their information needs more efficiently. Students also need to learn how to use different types of networked resources at various stages of learning in multiple settings. The oldest students were more likely to transfer use of various networked resources to non-school related information needs because they had used the resources during different classes for various information needs. Integration of all types of networked resources across curricula can play a significant role in students' abilities to utilize multiple networked resources during information seeking.

Levin and Arafeh (2002) reported a substantial disconnect between how students used networked resources for schoolwork at home and how they used networked resources in the context of the school day. They found that students' educational use of networked resources occurred outside of the school day, outside of the school building, and outside the direction of their teachers. The students in Levin and Arafeh's study reported that attitudes about technology use in the classroom varied among educators, not all teachers make assignments that require use of networked resources and those teachers who require use assign work that is neither engaging nor relevant to the students' lives. Information seeking that is relevant to daily life is important to students. Students reported in the semi-structured interviews a desire for assignments and projects that can enhance their information and technology skills and that are relevant to their own lives. Integration of real world problems and creation of assignments that foster students' interest can motivate students learning process and teach students information seeking and problems solving skills that they can utilized in everyday life situations. Johnson (2002) suggests emphasizing daily mini-lessons taking a single aspect of the inquiry process to provide practice that more accurately resembles the kinds of problem solving adults actually do in their every day lives (e.g. jobs, weather, personal life). Scenarios offered students in this study an opportunity to address information needs in the networked environment that simulated school and life situations. Students reported that the use of scenarios provide experience for searching practical, realistic, everyday information needs.

Scenario use in information literacy instruction provides students with motivational exercises that simulate everyday life activities. Students can build information seeking and problems solving skills when completing scenarios by having to work through complex problems. Students can build networked literacy skills when completing scenarios by having to work through tasks that require use of specific networked environment tools and resources. Scenario use also provides an activity that will help students assess their own information seeking process. Scenario use provides a method to elicit the behaviors and techniques networked generation youth use in completing an information problem in the networked environment. Students can record their information seeking process while completing scenarios, and then examine their behaviors and techniques looking to see if their behaviors and techniques helped or hindered their information seeking process. Students then share their experiences on completing the scenarios, exploring ways that will assist in developing or enhancing skills.

Students in this study reported being self-taught when using the networked environment for information seeking and look primarily to their friends when seeking assistance during information seeking. This is consistent with Vansickle's (2000, 2002) findings. Vansickle concluded that seeking assistance from friends, along with being self-learners, has perpetuated misconceptions and novice understanding about information seeking. Vansickle is concerned that if students continue to work only with each other the cycle will continue. However, not all students in this study have perpetuated misconceptions and novice understanding about information seeking as self-learners. The observation and semi-structured interview data showed that the self-taught students in this study have developed their own ways of dealing with information seeking in the networked environment and are adopting and adapting to it with their own successful behaviors, sharing those behaviors with friends; therefore, self-instruction should not be entirely dismissed. Students need to be given opportunities to discuss their positive or negative experiences that occur during information seeking in a forum (e.g., classroom, discussion group, chat) with their peers and experienced information seekers (e.g., teachers, library media specialist, technology specialists, professional researchers). This would provide students with the opportunity work together with peers and professionals to address any faulty logic or present successful behaviors and effective techniques that occur thereby enhancing everyone's information seeking.

While the majority of students report being self-taught, many students in this study do look to professionals when seeking assistance. Those students reported they asked teachers, librarians and technology specialists for help. For the more reluctant student who may not seek out professionals for assistance, these students can benefit by learning to use the national online reference service available through their state public library that connects users with librarians at any time during the day when seeking assistance with information gathering. Librarians and teachers can also use school approved instant messaging services to chat with students when problems arise. The data from the NEQ showed that 84.8% of the students used instant messaging. Phase 2 students reported getting help from friends using instant messaging. If schools utilize the desired online communication tools students may be willing to work with professionals as well as friends during information seeking.

5.2.3 Finding 4

Students exhibited traits of expert information seekers; however, even the experienced students need assistance in developing their information seeking process.

Students believe an expert information seeker is knowledgeable about the networked environment, can utilize the resources effectively, and can locate and use information efficiently using credible resources and reliable information. An alternate finding that came out of the study was that the subset of students that participated in Phase 2 exhibited traits of effective information seekers as they utilized the networked environment to solve information scenarios. These students demonstrate many characteristics that have been used to describe expert seekers. The students use developed cognitive skills, domain knowledge, system knowledge, individual information seeking knowledge and positive affective attitudes to solve information needs. The students have developed distinct patterns of searching and used a variety of strategies, tactics, and moves in their information seeking process. Students implemented creative and evolving behaviors and techniques that assisted in completing information needs using the networked environment. Problem solving techniques such as circle and underline and electronic note taking, and strategies, tactics, and moves such as resource selection, multitasking, copy and paste, and keyboard shortcuts assisted the student through their information seeking process. Students need to have opportunities, in either a face-to-face class or online discussion, to share the behaviors and techniques with other students. Educators can reinforce the effective behaviors and techniques by bringing them into literacy instruction in order to assist all students in developing their information seeking process.

Although students revealed traits of effective information seekers, they also show that at times their cognitive, affective, and physical information seeking behaviors can hinder their information seeking process. Information seeking skills are not as developed as students believe. In examining students responses on the NEQ and observing students completing information scenarios it is evident that students need assistance with learning how to select, evaluate and use resources, formulate queries, and evaluate and use information efficiently, effectively, and ethically. Students also need assistance with planning, defining problems, and reflecting during information seeking. Students need to learn how to become aware of when behaviors and techniques hinder the process. Students need to learn how to recognize the stages in their own information seeking process and how the information seeking behaviors and problem solving techniques being used affect solving information needs. Teaching process models creates a systematic approach to and structures for information seeking (Thomas, 2004). Using a holistic model, as developed in this study, can inform student how cognitive, affective and physical behaviors are integral factors in a problem solving process.

Teaching students to talk-aloud during information seeking can also assist in self-awareness. Students in this study were more cognizant of their information seeking when voicing the steps they were taking to complete the information scenarios. In addition, use of monitoring software can aid in helping students locate the point when the information seeking process has gone astray. Schools can install programs used to record computer activity to record students' information seeking sessions. Students can review sessions to see where problems arose in their seeking process. Teachers, media specialists, and technology specialists can also act as intermediaries by monitoring student progress during an information seeking session and point out problems that occur. Many classroom management systems include monitoring software that has capture and playback features that can be utilized as a training tool.

Many students in this study recognize that they need assistance in becoming expert information seekers. They believed that professional information seekers could assist in helping students enhance their knowledge and skills. Students desired more instruction on advanced searching techniques and resource use, specifically with Web search engines and subscription databases offered through the school. Students prefer experiential learning; they want time to use the networked environment in a class setting with assignments that focused on helping students use networked resources more effectively during information seeking. Independent learning is important to networked generation youth. Vansickle (2002) recommends use of pathfinders and online tips sheets to promote independent learning. Students in this study appreciated the project pages that were developed through the library. The students said that tips to help get around frustrating moments when the system or keywords do not work would also assist in learning how to locate information using the networked environment. Students are willing to learn to become expert information seekers. Schools need to support continued expansion of the programs in place that facilitate information seeking skill development.

5.3 Preliminary Networked Generation Youth's Information Seeking Process Model

Networked generation youth's information seeking process is a multidimensional problem solving process. The preliminary model characterizes information seeking in the context of the networked environment. The model was established in light of previous information seeking models (Ellis, Cox & Hall 1993; Kuhlthau, 1993; Marchionini, 1995; Nahl, 1997, Wilson, 1999). The model depicts a holistic understanding of networked generation youth's information seeking, incorporating networked generation youths' information seeking behaviors and problem solving approach used to solve information needs, as identified from the data collected in the study.

The preliminary model is built on Marchionini's (1995) information seeking problem solving model. Marchionini (1995) theorized that information seeking is a goal-directed, interactive process guided by the methods developed to complete the process. The preliminary model includes stages defined in Marchionini's model along with stages defined in this study based on students' process of locating information using the networked environment. Kuhlthau (1993) emphasized that information seeking entails holistic learning, which encompasses three realms of experience: cognitive (thoughts), affective (feelings), and physical (actions). This research found cognitive, affective, and physical information seeking behaviors and behavioral actions to be at the core of information seeking influencing each stage in networked generation youth's information seeking process.

The preliminary networked generation youth's information seeking process model shown in Figure 8 indicates that information seeking is a process where networked generation youth move through various information seeking stages which are influenced by cognitive, affective, and physical information seeking behaviors and behavioral actions. Cognitive behaviors focus networked generation youth on the information need, provide background knowledge to a problem, offer realizations about information, verbalize information found, offer choices or judgments about information, and complete the process of locating information to support the need. Affective behaviors help networked generation youth gain a sense of clarity during the seeking process or cause students' information seeking to falter. Affirmation, familiarity, frustration, and hesitation or uncertainty, are affective behaviors elicited during the information seeking process. Networked generation youth are found to be intuitive information seekers applying intuition throughout the process including when selecting tools, locating resources, and evaluating information.

Physical behaviors maneuver networked generation youth through information seeking using operational, navigational, and exploratory moves. Constraints steer networked generation youth through information seeking in positive or negative directions. Behavioral actions are the specific patterns, strategies, tactics, and moves networked generation youth use during information seeking when solving a problem using the networked environment.

Cognitive, affective and physical behaviors and behavioral actions directed students toward solving information needs and are placed at the center of the model. Networked generation youth apply actions and techniques to move through each stage.

The term action is used to describe steps taken in each stage. The term technique is used to describe how students carry out the action. Actions and techniques were derived from specific cognitive behaviors, information behavioral actions (i.e., strategies, and tactics) and problem solving techniques students applied as a means for problem solving. The networked generation youth move through stages consecutively, repeat stages, or work through stages simultaneously until a task is completed, the information need is met, or a stop is imposed.

The preliminary networked generation youth's information seeking process model shows networked generation youth's information seeking process is nonlinear, evolving, and iterative as described in earlier findings (Marchionini, 1995; Yang, 1997). Vansickle (2000) found that not all students have a developed sense of problem solving; in comparison, the students in this study were able to articulate how they go about solving their information needs. While some students may apply the search and go approach, they also apply formulized plans, either consciously or subconsciously, utilizing strategies, tactics, and moves more consistent with expert information seekers. The process approach students take toward solving information needs is dependent on the information need (e.g., problem, task). Cognitive skills, background knowledge related to the need, system knowledge, information seeking skills, and affective behaviors all play a role in the networked generation youth's information seeking process.

STAGES

Enter Networked Environment
Action: Access school network
Techniques: Student account/ access codes
Action: Access home network
Techniques: Parental permission

Recognize/Accept Problem
Action: Understand problem
Technique: Underline & circle
Action: Make selection

Plan Process
Action: Formulate multiple options
Technique: Brainstorm
Action: List out in steps
Techniques: Note taking, Talk-aloud

Define Problem
Action: Gather needed information/make list
Technique: Note taking
Action: Verification
Action: Questioning
Techniques: People, Self

Exit Networked Environment
Action: Close applications, logoff

Stop Process
Action: Task completion
Action: Imposed stop
Techniques: Self, People, Time

Continue Process
Action: Modify query
Techniques: Alter, narrow, broaden concepts; copy from another resource
Action: Create new search strategy
Action: Repeat stages in ordered behavior
Action: Switch application
Techniques: Previously used, new
Action: Switch resource
Techniques: Select previously used, new
Action: Switch resource
Techniques: Previously used, new

Cognitive Behaviors
Background Knowledge
Correction
Confirmation
Decision-Making
Error
Process Completion
Realization
Relay Findings
Thinking Mode

Affective Behaviors
Affirmation
Familiarity
Frustration
Hesitation/Uncertainty
Intuition

Physical Behaviors
Constraints
Exploratory Moves
Navigational Moves
Operational Moves

Behavioral Actions
Patterns
Strategies
Tactics
Moves

Select Tool
Action: Networked application
Techniques: Multitask, Minimize
Action: Networked resource
Techniques: Multitask, Maximize

Create Search Strategy/ Formulate Query
Action: Analytical
Techniques: Extract concepts from problem; extract concepts from background knowledge; copied from another resource
Action: Browse
Techniques: Scanning, Skimming

Execute Query
Action: Modify search field
Techniques: Alter or select information
Action: Modify strategy
Action: Results

Reflect
Action: Make decision
Action: Verification
Techniques: Confirm resource credibility, Confirm task completion

Extract & Organize Information
Action: Extract keywords
Techniques: Copy & paste
Action: Record data
Techniques: Copy & paste; note taking; synthesis
Action: Relay findings
Techniques: Talk-aloud
Action: Print, Shopping Cart, Save, Download, Burn to CD

Resource Selection/Location
Action: Select by title & description; user-determined relevance, result link position; search tool sponsored link
Action: Multitask

Examine Results/Information
Action: Resource examination
Techniques: Browse (scanning and skimming)
Action: Evaluate information
Techniques: Browse (scanning and skimming), Read, Highlight

Figure 8. Preliminary networked generation youth's information seeking process model.

5.4 Future Research

The following section identifies general areas of future research.

5.4.1 Research on Cognitive, Affective, an Physical Behaviors in Other Contexts

This research found cognitive, affective, and physical information seeking behaviors and behavioral actions to be interrelated. Further research is needed to explore this interrelationship. A possible study could examine to what extent one behavior affects or is affected by others. Research in this area could provide more information on how information behaviors affect the information seeking process.

Networked generation youth's information seeking process was examined as students completed four different scenarios using the networked environment. The scenarios were developed using four of Taylor's classes of information need, informational, factual, confirmational, and motivational. These needs were similar to factual, research, and self-generated questions previously used in earlier research, which allowed for comparison. Further research is needed to examine networked generation youth's information process utilizing the additional classes of information need. The additional classes, enlightenment, problem understanding, projective, and personal or political, are more philosophical in nature and may require a greater depth of the networked generation youth's own personal understanding of their information needs. Further research can explore similarities and differences among the cognitive, affective and physical information seeking behaviors and problem solving techniques students exhibit across all of Taylor's classes of information needs. Research in this are may influence the fields understanding of networked generation youth's information seeking process.

Networked generation youth report that they ask friends for assistance when seeking information, often using social networks (e.g., instant messaging). Future research is needed to study networked generation youth working in this collaborative environment. Findings may show additional or variant behaviors that occur during information seeking related to collaboration using social networks.

5.4.2 Research on Information Seeking Process Models

The preliminary networked generation youth's information seeking process model was developed based on the cognitive, affective, and physical behaviors, information seeking behavioral actions, and problem solving techniques students exhibited while solving information needs. The behaviors and techniques played a guiding role in networked generation youth's information seeking process. Future research is needed that tests the model among other networked generation adolescents to confirm the behaviors, stages, activities and techniques. Testing the model would solidify the model's value as a way to describe networked generation youth's information seeking process. Another area of interest in relation to the model would be to explore ways in which the model could be used as a diagnostic tool for examining students' information seeking process in the networked environment. This could impact information literacy instruction by providing better ways to assess students' information seeking process.

5.4.3 Research on Using Methodology as Instructional Tools

Scenario use as an instructional tool for information seeking skills development is another area of study. Students said that scenarios would be helpful in teaching them how to be effective information seekers. A study on the instructional benefits of scenario use in information seeking skills instruction may provide data that shows that scenario use provides educators with an instructional tool that can help them work with students in becoming expert seekers.

Monitoring software was used as a devise in recording students' information seeking process. Recording student's process provided opportunity to examine students' information seeking process through log files and screen shots. Monitoring software is packaged in classroom management software (e.g., GenevaLogic® active teaching system, Dyknow™ software) and provides the abilities to teach, mentor, supervise, and chat with students. Research is needed to examine the effects of using monitoring software to teach information seeking skills development. Research in this area could also influence information literacy instruction.

5.5 Conclusion

I initiated the study as a comprehensive investigation of the information seeking process of the networked generation youth. Specifically, I examined the cognitive, affective, and physical information seeking behaviors and problem solving techniques adolescent student users of the networked environment utilize to solve information needs.

The relationship among information seeking behaviors used and information problem solving techniques of youth utilizing a networked environment is a desired area for investigation as behaviors and techniques utilized in information seeking directly affect the information seeking process. In addition, exploring cognitive, affective, and physical behaviors and problem solving techniques adolescents employ in the networked environment leads to a better understanding of individuals who have grown up using the networked environment as they solve information needs.

Grounded in the theoretical context of the information seeking process in the networked environment, the research extended the user-centered approach to modeling the information seeking patterns of networked generation youth. The methods chosen generated rich, descriptive data about networked generation youth's information seeking process using the networked environment. Cognitive, affective, and physical information seeking behaviors and problem solving techniques were identified and categorized using the constant comparative method.

Using a mixed model research design, I made use of questionnaire, observations, and semi-structured interviews to profile students' networked environment knowledge and use in relationship to their information seeking process. I found that knowledge and experience influence networked generation youth's information seeking process in the networked environment. A subset of students were found to be experienced information seekers who applied various cognitive, affective, and physical information seeking behaviors and behavioral actions that guide them through their information seeking process. I presented a preliminary model of the networked generation youth's information seeking process. The model provides a detailed map to networked generation youth's information seeking and problem solving.

I bring to light experienced users successful behaviors as well as areas where all students need assistance in understanding networked environments and their own information seeking. The study suggests ways in which educators can evaluate their students and integrate the successful behaviors as well as assist students with the behaviors that hinder their process. Students desire assistance in learning advanced information seeking skills to become expert information seekers. Students need opportunities to share effective information seeking skills with other students and work on developing their weaker skills with information professionals in classroom and networked environments. Methods used in this study, scenario use, verbal protocols use, and monitoring software use, may assist with teaching, learning about, and developing networked generation youth's information seeking process.

APPENDIX A

HUMAN SUBJECTS RESEARCH CONSENT FORM

UNIVERSITY OF NORTH TEXAS COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS RESEARCH CONSENT FORM

Participant Name: Date:

Title of Study: NetGen Youth's Information Seeking Process: An Examination of Cognitive, Affective and Physical Information Seeking Behaviors and Problem Solving Techniques

Principal Investigator: Janet Walker Peterson

Faculty Advisor: William E. Moen, PhD

Before agreeing to participate in this research study, it is important that you read and understand the following explanation of the proposed procedures. It describes the procedures, benefits, risks, and discomforts of the study. It is important for you to understand that no guarantees or assurances can be made as to the results of the study.

Purpose of the study and how long it will last:

The purpose of the study is to investigate how students look for and use information while using a networked environment. Specifically, the study looks at the types of behaviors students show and techniques students use while they solve problems using the Internet. This study will take place at [redacted] during January 2004-April 2004.

Your participation is fully voluntary and you may withdraw from the study at any time. There are no risks attached to your participation; neither will there be any effects if you choose not to participate at a later date. Your grade will not be affected whether you choose to participate or not participate in the study.

Description of the study including the procedures to be used:

The research takes place in two phases of study. In the first phase of study you will complete an online questionnaire that will show what you know about networked environments and how you use the Internet to find information. You will be given 40 minutes during a scheduled class period to complete the online questionnaire. Based on the knowledge and use of the networked environment, 12 students from your school will be chosen to participate in the second phase of the study. If you are selected for the second phase of study, you will complete two 45-minute observation sessions. During each session you will be given scenarios with information problems to solve using the networked environment. An example of a scenario is as follows:

> You are working as a summer intern for the local sports radio station, "The Ticket". Your assignment for today requires you to research player statistical information for tomorrow's game between the Texas Rangers and the New York Yankees. During inning changes, the announcers usually converse about various players and how they performed in seasons past. Your task is to find a listing of the opposing players' statistics.

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RESEARCH CONSENT FORM (continued)

As you use the networked environment to answer the scenarios, you will talk aloud the steps taken to perform the various tasks. Each observation session will be recorded on an audio cassette player. The researcher will videotape the task session to capture everything that is happening on the computer screen. Only the information on the screen will be captured on the video recorder, your identity will remain anonymous. Monitoring software will also be used to capture all movements not verbally described or captured by video (e.g., keyboard strokes, URL addresses visited). After the completion of the final scenario the researcher will ask you questions in a follow-up interview. You will also be given an opportunity to explain how you use the networked environment to locate information to complete information problems and ask any question or clarifications regarding the scenarios you completed during the study.

Benefits to the participants or others:

This research will help educators understand the behaviors exhibited and problem solving techniques used by students as they locate information using the networked environment. The research can assist educators in the development of information literacy programs that teach information skills required for lifelong learning. The research also may assist you in your own understanding of the process you use to solve information problems.

Confidentiality of research records:

Results from the questionnaire, observation sessions and interviews will be reported as group results only. Individually taped responses will be used as examples of information seeking behaviors and problem solving techniques; however, you will not be identified by your full name. To preserve confidentiality, a number will be used to identify participants on the video and audio formats. Your name will not be used on any formal writings or presentations of the research. The researcher will retain audiotapes, videotapes, and monitoring software transaction log files for 3 years after the study's conclusion.

If you have further questions regarding this study you may contact Janet Walker Peterson at [redacted]. You may also contact William E. Moen, Faculty Advisor, University of North Texas, School of Library & Information Sciences at (940) 565-3563.

Review for protection of participants:

This research study has been reviewed and approved by the UNT Committee for the Protection of Human Subjects, 940-565-3940.

Research Consent Form -Page 2 of 3 __________ Participant's initials

UNIVERSITY OF NORTH TEXAS
RESEARCH CONSENT FORM (continued)

RESEARCH PARTICIPANTS' RIGHTS: I have read or have had read to me all of the above.

Janet Walker Peterson has explained the study to me and answered all my questions. I have been told the risks or discomforts and possible benefits of the study.

I understand that I do not have to take part in this study, and my refusal to participate or to withdraw will involve no penalty or loss of rights or benefits or legal recourse to which I am entitled. The study personnel may choose to stop my participation at any time.

In case there are problems or questions, I have been told I can contact Janet Walker Peterson at [redacted].

I understand my rights as a research participant, and I voluntarily consent to participate in this study. I understand what the study is about and how and why it is being done. I have been told I will receive a signed copy of this consent form.

____________________________________ ________________
Signature of Subject Date

____________________________________ ________________
Signature of Witness Date

For the Investigator or Designee:

I certify that I have reviewed the contents of this form with the person signing above, who, in my opinion, understood the explanation. I have explained the known benefits and risks of the research.

____________________________________ ________________
Signature of Principal Investigator Date

APPROVED BY THE UNT IRB
FROM 11/19/03 TO 11/18/04

Research Consent Form -Page 3 of 3

APPENDIX B

PARENT LETTER

January 2004

Dear Parents:

I am currently conducting a dissertation research project designed to study adolescents' information seeking process in the networked environment. The purpose of this study is to identify and describe various information seeking behaviors and problem solving techniques adolescents employ while using the networked environment to solve an information problem. I request permission for your child to participate.

This study will be conducted at [redacted] during January 2004-April 2004. Permission has been obtained from Mr. Scott Griggs, Head of School and Mr. Mark Crotty, Director of Curricular Programs PK-12 at [redacted]. All documentation regarding this study is on file in the office of the Director of Curricular Programs PK-12 at [redacted].

The research takes place in two phases of study. The first phase of study consists of a networked environment questionnaire completed by all participants to assess their networked competencies and information seeking skills. During one class period, students will be given 40 minutes to complete the online questionnaire. Based on the knowledge and use of the networked environment, 12 students from your child's school will be chosen to participate in the second phase of the study. The second phase of study consists of two 45-minute observation sessions. During each session the participant will be given scenarios with information problems to solve using the networked environment. An example of a scenario is as follows:

> You are working as a summer intern for the local sports radio station, "The Ticket". Your assignment for today requires you to research player statistical information for tomorrow's game between the Texas Rangers and the New York Yankees. During inning changes, the announcers usually converse about various players and how they performed in seasons past. Your task is to find a listing of the opposing players' statistics.

As the participant uses the networked environment to answer the scenarios, he will talk aloud the steps taken to perform the various tasks. Each observation session will be recorded on an audio cassette player. The researcher will videotape the task session to capture everything that is happening on the computer screen. Only the information on the computer screen will be videotaped, your child's identity will remain anonymous. Monitoring software will also be used to capture all movements not verbally described or captured by video (e.g., keyboard strokes, URL addresses visited). After the completion of the final scenario the researcher will conduct a follow-up interview. Results from the questionnaire, observation sessions and interviews will be reported as group results only. Individually taped responses will be used as examples of information seeking behaviors and problem solving techniques; however, the participant will not be identified by name. The researcher will retain audiotapes, videotapes, and monitoring software transaction log files for 3 years after the study's conclusion. To preserve confidentiality, only first names will be used to identify participants. A summary of group results will be available at the conclusion of the study.

Should you have any questions or desire further information, please contact me at [redacted]. You may also contact William E. Moen, Faculty Advisor, University of North Texas, School of Library and Information Sciences at (940) 565-3563.

Thank you in advance for your cooperation and support.

Sincerely,

J W Peterson

Janet Walker Peterson
Doctoral Candidate
Interdisciplinary Ph.D. Program in
Information Sciences
University of North Texas
[redacted]

William E. Moen, PhD
Faculty Advisor
School of Library & Information Sciences
University of North Texas
wemoen@unt.edu
(940) 565-3563

APPROVED BY THE UNT IRB
FROM 11/19/03 TO 11/18/04

UNIVERSITY OF NORTH TEXAS COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS PARENTAL CONSENT FORM

Name of Child ________________________ Date_______

Title of Study: NetGen Youth's Information Seeking Process: An Examination of Cognitive, Affective and Physical Information Seeking Behaviors and Problem Solving Techniques
Principle Investigator: Janet Walker Peterson
Faculty Advisor: William E. Moen

You are making a decision about whether or not to have your child participate in this study. Your signature indicates that you have decided to allow your child to participate, that you have read or have had read to you the information provided in the Consent Form, and that you have received a copy of the Consent Form.

___________________________________ ______________

Signature of Parent or Guardian Date

Assent of Child (required if your child is less than 14 years old)

The Child named _________________________________ has agreed to participate in the study mentioned above.

___________________________________ ______________

Signature of Child Date

APPROVED BY THE UNT IRB
FROM 12/19/03 TO 12/18/04

APPENDIX C

NETWORKED ENVIRONMENT QUESTIONNAIRE

Networked Environment Questionnaire

This questionnaire is the first part of a study to be conducted on how adolescents (students in Grades 7-12) locate and use information while using networked environments. The following questions examine your knowledge of networked environments, abilities to find information, and interests in using networked resources. The questionnaire is divided into five parts. From the surveys completed, twelve participants will be chosen to continue with the study on networked generation youth's information seeking process in the networked environment.

Remember to read the questions carefully and answer to the best of your knowledge.

Please enter your User ID and Password to complete the study. This has been provided to you through your classroom teacher.

User ID

Password

Login

I. Demographics (Some information about yourself)

1. I am [11 ▾] years old.

2. I am in the [7th ▾] grade.

3. I have attended Greenhill School for [1 year ▾].

4. I have a computer with Internet access available for my use at home

- Yes
- No

5. My gender is

- Male
- Female

Please enter your contact information:
(This information will only be used if you are chosen for the next phase of the study).

Name:

Advisor:

Submit Responses

<Part 1 of 5>

II. Networked Environment Knowledge
(What you know about the networked environment)

6. Describe what a network is and give an example.

7. A URL is (Choose all that apply)

- ☐ Uniform Resource Locators
- ☐ Web Address unique only to one Web site
- ☐ Mickey@aol.com
- ☐ http://www.dogpile.com

8. What do gif, exe, zip, doc, html, voc, mov & jpeg have in common? (Choose all that apply)

- ☐ They help locate pictures
- ☐ They are all common types of files
- ☐ They are used in Web addresses
- ☐ Do not know

9. How would you describe someone who knows how to find information on the Internet really well?

10. How would you define your abilities to locate information using the Internet? (Choose one)

- ○ Expert (I know all the tricks and kind find what I am looking for in a matter of minutes)
- ○ Experienced (I am pretty good at finding what I need, but I can always use help)
- ○ Beginner (I know how to log on and can enter a URL into the address box)

Submit Responses

<Part 2 of 5>

III. Networked Environment Use (How you use the networked environment)

11. Internet Use

On average I use the Internet [ ] hour(s) a day for school work.
On average I use the Internet [ ] hour(s) a day for personal purposes.
On average I use the Internet [ ] day(s) a week.

12. How often do you use these networked services?

a. Chat services: always sometimes never
What types of chat rooms do you visit?

b. News group services: always sometimes never
What types of news groups have you joined?

c. Web Services (e.g. auctions, shopping, games, searching, business):
always sometimes never
What types of Web services do you use?

d. E-mail services: always sometimes never
Which e-mail provider(s) do you use?

e. Web hosting services: always sometimes never
Which Web hosting service(s) do you use?

f. ftp services: always sometimes never
What ftp software do you use?

g. Messenger services: always sometimes never
Which messenger services do you use?

h. Message boards: always sometimes never
What types of message boards do visit?

13. Which Browser do you use?

14. List three of your favorite search tools to find information.

1.

2.

3.

15. Describe the types of resources you use to find information using your school's network (i.e., library online catalog, electronic databases, and Web resources). Be Specific.

16. What type of information do you search for on the Internet either at home or school? Please provide the top 10 types of information you search for on the Internet either at home or school and provide a few examples of the sites you visit. Rank your selections from 1-10.

Rank	Choice Selection		Provide a Few Examples
#1.	No Choice Selected	and	
#2.	No Choice Selected	and	
#3.	No Choice Selected	and	
#4.	No Choice Selected	and	
#5.	No Choice Selected	and	
#6.	No Choice Selected	and	
#7.	No Choice Selected	and	
#8.	No Choice Selected	and	
#9.	No Choice Selected	and	
#10.	No Choice Selected	and	

17. How often do you find the information you are looking for? (Select the best that describes your answer)

- All the time
- Most of the time
- Sometimes
- Not very often

Submit Responses

<Part 3 of 5>

IV. Networked Resources Knowledge

(What you know about the different tools available on your networked environment)

18. How do you locate information using the Internet? (Choose all that apply)

- [ ] Use Search Engines
- [ ] Use Pathfinders
- [ ] Use Library Online Catalog
- [ ] Use Online Databases
- [ ] Use my own style of finding information (Explain)

19. Which of your schools networked resources are available for you to use at home? Be specific.

20. Is it more efficient to find information about NASA if you: (Choose one)

- ○ Know the address to the homepage
- ○ Use a search tool (Yahoo, Excite, Dogpile)
- ○ Use an online dictionary
- ○ Use an online library catalog
- ○ Ask a friend
- ○ Not certain

21. Have you used Yahoo?

- ○ No
- ○ Yes

If yes, how would you begin a search to find information about recent Mars explorations?

22. Is it always better to use more keywords in a search connected by "and"?

- Yes Why?
- No Why?
- Do not know

23. In Google, putting a "+" in front of a keyword means (Choose one)

- "And"
- "without the words"
- All hits must have the word
- Some hits may have this word
- Do not use Google
- Do not know

24. In what order do most search tools list their results (Choose one)

- Alphabetical
- Chronological
- Frequency
- Relevant to the terms you type
- Do not know

25. Yahoo is a (select all that apply)

- Subject search directory
- Web host
- E-mail host
- Keyword search engine
- Browser

Submit Responses

<Part 4 of 5>

V. Networked Environment Problem Solving
(How you would solve an information problem using the networked environment)

26. Describe in the box what steps you would take to find information on the presidential candidates proposing to run in the 2004 election using your school's networked environment. Be specific.

27. How would you look up information on what is playing at your local movie theater this weekend? Be specific.

28. You need to find a song for a class project on music from the 1980s. How would you go about selecting a song and downloading it from the Internet? Be specific.

29. How have you learned to find information using the networked environment?

Please provide the top 5 ways you have learned to find information using a networked environment. Rank your selections from 1-5.

Rank	Select Choice
#1	No choice selected
#2	No choice selected
#3	No choice selected
#4	No choice selected
#5	No choice selected

Submit Responses

<Part 5 of 5>

Thank you completing this networked environment questionnaire.

If selected, you will be notified to continue with the study.

In the second part of the study you will be required to perform tasks using the networked environment. During two 45- minute sessions, you will complete four scenarios to solve different information problems. As you use the networked environment to complete the scenarios, you will talk out loud the steps taken to perform the various tasks. Each scenario will be recorded on an audio cassette player. The researcher will video tape the task session to capture everything that is happening on the computer screen and will use monitoring software to capture the keyboard and mouse movements. A short follow-up interview is required to complete the study.

Phase 2 of the study will take place at Greenhill School. We will set up times to complete the scenarios. This part of the study will occur in March and April 2004. You will only be required to come on your two scheduled days.

If you have any questions or comments please e-mail me at walkerjr@swbell.net.

Janet Walker Peterson
Doctoral Candidate
Interdisciplinary Ph.D. Program in Information Sciences
School of Library and Information Sciences
University of North Texas
walkerjr@swbell.net

APPENDIX D

INFORMATION SEEKING SCENARIOS

Information Seeking Scenarios

• Instrumental: The need to find out what to do and/or how to do something.

1. You have invited a group of friends over to your house to watch movies. You are planning to provide some snacks but one of your friends is diabetic and another does not like popcorn so you want to find a couple of recipes that everyone can enjoy. First, find out what types of snacks a diabetic can eat then print or download two recipes that you all can make together.

2. Watching the weather report you learn you live in the part of the country know as "Tornado Alley". Concerned for your family's safety, you want to find out why tornadoes are common to this area and where your state ranks in number of tornadoes per year. You also want to learn what steps you should take in the event a tornado is sighted in your area. Save the information you find to create a Tornado Safety Procedure List for your family.

• Factual: The need for and consequent provision of precise data.

1. A recent story in science news claims a different theory on how the Great Chicago Fire of 1871 started. You want to discuss this theory with your science class. What is this theory? Who developed the theory? Historically who has been blamed for the fire? Based on the evidence you find, which theory do you believe?

2. For your literature class you are working on creating an online trivia game that students in various grades can play. You remember hearing about a popular series where the protagonists are a group of orphan children running from a count. For your trivia game you want to find out the name of the series, the names of the principal characters, the author, and what other types of works the author has written.

• Confirmational: The need to verify a piece of information.

1. Congratulations! You just won a $175 (CAD) dollar first prize in a Canadian essay contest on exploring the cultural differences between Canadian and US youth. Your parents are going to let you spend the money on two new games you have wanted for your video game system after you put 30% of your prize money into your savings account for college. However, you also promised your best friend you would treat him to a movie for helping you with the essay if you won. How much money will you start out with in US Dollars? Will you have prize money left over for a snack at the movies after you put the 30% in your savings, purchase your two new games, and pay for the tickets to the movies? If so, how much?

2. To combat the growing rates of obesity in children and young adults in the U.S. federal, state, and local government agencies are calling for reforms on the types of foods available to students during school hours. Does your school's lunch menu this week provide some of the recommended amounts of daily nutrition on the Food Guide

Pyramid? Would certain foods on the menu have to be excluded if the proposed nutritional policy for school lunch programs in your state goes into effect next school year?

• Motivational: The need to find additional information based on personal involvement with a task.

1. Your family has begun to talk about summer vacation plans for the month of July. To decide where you will vacation each family member will choose a city they would like to visit in the U.S. and then everyone will compare the places and vote on which would be the most fun for all. Select the city you would like to visit and compile a list of activities and places to see while in the city. Include pictures, descriptions, and maps of the places you want to visit along with any cost that is associated with the activities or events so you can convince your family to pick your selected destination.

2. You have recently joined a sports discussion group that creates online fantasy sports games. As a new member, you will need to put a team together. Select a sport and put together an all-star team that will play for the championship title or a tournament of champions if it is an individual playing sport (like tennis, golf, skiing, ice-skating, etc.). Compile a sheet of bios, pictures, and stats on your players for your team roster or tournament player list.

APPENDIX E

SEMI-STRUCTURED INTERVIEW QUESTIONS

Semi-structured Interview Questions
Scenario Evaluation

- What did you think about the types of scenarios you had to complete: level of difficulty?
- Did you feel you understood what information you needed to find to complete the scenarios?
- Do you feel you completed the scenarios in a satisfactory manner?
- What might you have done differently?
- Do you think these types of scenarios would be helpful in teaching you how to find information more proficiently?
- Was how you completed the scenarios typical of how you find information using the networked environment at home/school?

Information Seeking Behaviors

- How do you typically find information using the networked environment?
- What type of strategies do you use to locate specific information?
- What types of resources do you use and how do you decide which is best?
- Do you ask for assistance when locating information using the networked environment; and if so, whom do you ask?

Problem Solving Techniques

- When you have a problem to solve, do you make a plan to complete it? What steps do you take?
- Do you feel it is important to make a plan before you begin locating information?
- What do you do when you cannot find information that you need or want?
- How do you decide when to stop looking for information?

Networked Environment Use

- What is frustrating to you when you use the networked environment for locating information?
- What do you like about using the networked environment for locating information?
- What do you think about your ability to find information using the networked environment?
- What would make your abilities better?
- How much time do you spend on a network (at school, at home)?
- What types of activities do you do...research/homework for school, personal research, browsing, chat, email, and any other activities?

Network/Information Seeking Instruction

- How do you learn to find information using the network environment (self--play on Internet, friends, parents, teachers, others)
- What type of classes have you taken to help you understand the network better; finding information?
- How long have you attended the school?
- What classes would you recommend the school teach in learning how to find information better using the networked environment?

APPENDIX F

NETWORKED ENVIRONMENT QUESTIONNAIRE SCORED QUESTIONS VALUES AND VALUE DESCRIPTORS

Table Appendix F

Networked Environment Questionnaire Scored Values

Question	Value Point	Value Point	Value Point	Value Point	Value Point	Value Point	Value Point
q6netdefs:	3	2	1				
q7adefurl:	3						
q7bdefweb:	2						
q7cdefeadd:	0						
q7ddefwadd:	1						
q8adef:	0						
q8bdef:	2						
q8cdef:	3						
q8ddef:	0						
q9defsc:	3	2	1				
q10ablty:	3	2	1				
q11ciuse:	7	6	5	4	3	2	1
q12achat:	3	2	1				
q12s:	1						
q12bnguse:	3	2	1				
q12bs:	1						
q12cwebs:	3	2	1				
q12cs:	1						
q12demail:	3	2	1				
q12ds:	1						
q12ewhuse:	3	2	1				
q12es:	1						
q12fftps:	3	2	1				
q12fs:	1						
q12gmsuse:	3	2	1				
q12gs:	1						
q12hmbuse:	3	2	1				
q12hs:	1						
q13s:	1						
q14ft1s:	1						
q14ft2s:	1						
q14ft3s:	1						
q15s:	3	2	1				
q17seval:	4	3	2	1			
q18alocate:	2						
q18blocate:	2						
q18clocate:	2						
q18dlocate:	2						

q18elocate:	1						
q18s:	1						
q19s:	3	2	1				
q20srch:	6	5	4	3	2	1	
q21yahoo:	2	1					
q21exs:	3	2	1				
q22uofand:	3	2	1				
q22yexs or q22nexs:	1						
q23s*:	2	1					
q24s*:	3	2	1				
q25ayhoo:	1						
q25byhoo:	1						
q25cyhoo:	1						
q25dyhoo:	1						
q25eyhoo:	1						
q26s:	3	2	1				
q27s:	3	2	1				
q28s:	3	2	1				
High score	117						

Networked Environment Questionnaire Scored Questions Values Descriptions

q6s: network definition
Score definition 1-3 based on level of information and example provided.
1-basic concept or gave just an example
2-explained well
3-explained well with an example

q7adefurl: URL definition: exact
3- Uniform Resource Locators

q7bdefweb: URL definition description
2- Web Address unique only to one Web site

q7cdefeadd: URL definition: inaccurate response
0- Mickey@aol.com

q7ddefwadd: URL definition: example
1- http://www.dogpile.com

q8adef: file structure: inaccurate response
0- They help locate pictures

q8bdef: file structure: accurate response

2- They are all common types of files

q8cdef: file structure: exact response
3- They are used in Web addresses

q8ddef: file structure: no response
0- Do not know

q9s: character definition
Score 1-3 based on the level of description given
1-used a word
2-described with words
3-described with detail

q10ablty: abilities
3- Expert
2- Experienced
1- Beginner

q11ciuse: use of internet days of week
1-1 day(s) a week.
2-2
3-3
4-4
5-5
6-6
7-7

q12achat: (Chat services) use of networked services
3-always
2-sometimes
1-never

q12s: What types of chat rooms do you visit?
Score of 1 if examples provided

q12bnguse: (News group services) use of networked services
3-always
2-sometimes
1-never

q12bs: What types of news groups have you joined?
Score of 1 if examples provided

q12cwebs: (Web Services--e.g. auctions, shopping, games, searching, business): use of networked services

3-always
2-sometimes
1-never

q12cs: What types of Web services do you use?
Score of 1 if examples provided

q12demail: (E-mail services) use of networked services
3-always
2-sometimes
1-never

q12ds: Which e-mail provider(s) do you use?
Score of 1 if examples provided

q12ewhuse: (Web hosting services) use of networked services
3-always
2-sometimes
1-never

q12es: Which Web hosting service(s) do you use?
Score of 1 if examples provided

q12fftps: (ftp services) use of networked services
3-always
2-sometimes
1-never

q12fs: What ftp software do you use?
Score of 1 if examples provided

q12gmsuse: (Messenger services) use of networked services
3-always
2-sometimes
1-never

q12gs: Which messenger services do you use?
score of 1 if examples provided

q12hmbuse: (Message boards) use of networked services
3-always
2-sometimes
1-never

q12hs: What types of message boards do you visit?
Score of 1 if examples provided

q13s: Browser
Score of 1 if legitimate browser answer provided

q14t1s: search tool use
Score of 1 if legitimate answer provided

q14t2s: search tool use
Score of 1 if legitimate answer provided

q14t3s: search tool use
Score of 1 if legitimate answer provided

q15s: school networked resources used
Score 1-3 based on the level of description given
1-brief description of generic resource offerings (library cat, databases etc)
2-described the types of resources in detail
3-described multiple resources used with specific names given

q17seval: self assessment
4-All the time
3-Most of the time
2-Sometimes
1-Not very often

q18alocate: locating information
2- Use Search Engines

q18blocate: locating information
2- Use Pathfinders

q18clocate: locating information
2- Use Library Online Catalog

q18dlocate: locating information
2- Use Online Databases

q18elocate: locating information
1- Use my own style of finding information

q18s: locating information
Score 1 point if provide example

q19s: knowledge of school's networked resources available at home
Score 1-3 based on the level of description given
1-brief description of generic resources available from home (library cat, databases etc)

2-described the types of resources in detail
3-described multiple resources used with specific names given

q20srch: locating specific information
6-Know the address to the homepage
5-Use a search tool (Yahoo, Excite, Dogpile)
4-Use an online dictionary
3-Use an online library catalog
2-Ask a friend
1-Not certain

q21yahoo: search tool knowledge
1-No
2-Yes

q21s: search tool knowledge
Score 1-3 based on words given
1. Keywords listed
2. Some directions with keywords given or categories selected
3. Specific directions of begin a search with yahoo (ex. first this, second that)

q22uofand: Boolean operator knowledge
3-Yes
2-No
1-Do not know

q22s: Boolean operator knowledge selection explanation
Score 1 point if selection explained

q23s*: search tool knowledge (added field scored by researcher from response to Question 23)
2. Correct answer #3
1. Do not know or do not use Google

q24s*: search tool knowledge (added field scored by researcher from response to Question 24)
3. Correct answer #4
2. Second best choice #3
1. Do not know

q25ayhoo: search tool knowledge
1-Subject search directory

q25byhoo: search tool knowledge
1-Web host

q25cyhoo: search tool knowledge
1-E-mail host

q25dyhoo: search tool knowledge
1-Keyword search engine

q25eyhoo: search tool knowledge
1-Browser

q26s: Problem Solving
Score 1-3
Score 1-3 based on the amount of description given
1. Few keywords listed
2. Some of the steps listed taken to answer question listed
3. A full description of each steps take to answer the question

q27s: Problem Solving
Score 1-3
Score 1-3 based on the amount of description given
1. Few keywords listed
2. Some of the steps listed taken to answer question listed
3. A full description of each steps take to answer the question

q28s: Problem Solving
Score 1-3
Score 1-3 based on the amount of description given
1. Few keywords listed
2. Some of the steps listed taken to answer question listed
3. A full description of each steps take to answer the question

APPENDIX G

PROBLEM SOLVING CODE SHEET

PROBLEM SOLVING CODES			
Recognize/Accept Problem (RAP)			
	Understand Problem		
		Underline & Circle	
	Make Selection		
Plan Process (PP)			
	Formulate Multiple Options		
	List out in steps		
Define Problem (DP)			
	Questioning		
		Sibling, Observer, Teacher, Parent, Librarian, Self	
	Gather needed information/make list		
	Verification		
Enter Networked Environment (ES)			
	Home		
		Parental Permission	
	School		
		Student Account/Access Codes	
Select Tools (ST)			
	Networked Application		
		Internet	
			Internet Explorer, AOL, Email
		Email	
			Outlook Express
		Accessories	
			Calculator
		Word Processing	
			Microsoft Word
		Media Player	

	Resource		
		Browser	
		File-Sharing Application	
		Search Tools, Directory	
			DMOZ, Yahoo
		Search Tools, Engine	
			Ask.com, Browser URL/Search Bar, Google, Google Image, Metacrawler, Yahoo, Yahooligans
		Search Tools, Databases	
		Search Tools, Library Catalog	
		Specific Web Sites	
			School Web Page, Government, News Source, Personal/Official, Commercial, Created Shortcuts
		Print Resources	
			Books, Newspaper,
		Telephone, Directory/Information Services	
		Commercial Store	
		People	
			Friends, Parents, Teachers, Self
Create Search Strategy/Formulate Query(CSS/FQ)			
	Analytical		
		Keyword(s)	
			Broad, Narrow
		Specific Names	
		Phrase	
		Subject	
		Natural Language	
		Boolean Logic	
			limiter symbol operator used, options selected, advanced search
		Extracted from problem	
		Background Knowledge	
		Copied information from another resource	
	Browse		
Execute Query (EQ)			
	Modify Search Field		
		Dates, Geographical, Personal Data, Specific Names	
	Modify Strategy		
	Results		

Examine Results (ER)			
	Resource Examination		
		Browse	
		Scanning	
			Descriptions/summaries for user defined criteria
		Skimming	
	Evaluate Information		
		Scanning	
		Skimming	
		Highlight	
		Read	
Resource Selection/ Location (RS)			
	Specific site		
			By user determined relevance
	Site sub page link		
	Link on page		
		Help Link	
		Image	
		Auto generated Web pages provided by host: Correction	
		Web pages pre-selected by school	
	Link on result list		
		Image	
		Newspaper & magazine articles	
			By user determined relevance
		Web page	
			By title & description, user determined relevance, result listing position, Search Tool sponsored link
Extract Information from Resource (EI)			
	Print		
	Shopping Cart		
		Conduct Monetary Transaction	
	Keywords		
	Record Data		
		Copy & Paste	
	Relay Findings		
	Save		
	Download		

	Burn to CD		
Reflect (R)			
	Make Decision		
	Verification		
		Resource Credibility	
			Additional Resources for cross evaluation
		Task Completion	
Continue Process (CP)			
	Modify Query		
		Alter Keyword(s), Specific Names, Phrase, Natural Language	
			Copied from another resource
		Narrow	
			Add Keyword(s), Boolean Operators, Phrase, Subjects
		Broaden	
		Create New Search Strategy	
	Repeat Stage using Ordered Behaviors		
	Switch Application		
		Previously Used, New	
		New Application	
	Switch Resource		
		New Resource	
		Previously Used Research	
Stop Process (SP)			
	Task Completion		
	Self Imposed		

APPENDIX H

INFORMATION SEEKING BEHAVIORS CATEGORIES

CODES AND DEFINITIONS

Table Appendix H

Code Sheet for Categorized Information Seeking Behaviors

INFORMATION SEEKING BEHAVIORS CODE SHEET	
AFFECTIVE	COGNITIVE
A1. Affirmation A2. Familiarity A3. Frustration A4. Hesitation A5. Intuition	C1. Realization C2. Thinking Mode C3. Error Creation C4. Correction C5. Relay Findings C6. Decision-Making C7. Confirmation C8. Process Completion C9. Background Knowledge Use
PHYSICAL	STRATEGIES
PM1. Exploratory PM2. Navigational PM3. Operational PM4. Constraints	S1. Resource Selection S2. Keyword Search-broad S3. Keyword Search-narrow S4. Deleted not used S5. Deleted used as Problem Solving S6. Deleted moved to Cognition. S7. Verify Information S8. Predetermined Resource Selection S9. Natural language Search S10. Previously Acquired Information S11. Boolean Code Search S12. Subject Search S13. Application Use
TACTICS	MOVES
T1. Review Material T2. Modify Query T3. Switch Resource T4. Copy Information T5. Deleted move to Strategies	M1. Scroll M2. Backtrack M3. Deleted not Used M4. Type M5. Arrow

T6. Multitask T7. Minimize T8. Maximize T9. Switch Application T10. Save Documents/Information Collection T11. Modify Collected Information/Format	M6. Keyboard M7. Drop-down Menus M8. Right Click M9. Combined with M2 M10. Print M11. Home M12. Select Information/Highlight M13. Direction M14. Buttons/Icon selection M15. Delete Material M16. Close M17. Main Toolbar Options M18. History M19. Find M20. Task Switcher M21. Stop M22. Favorites/Bookmarks M23. Refresh
PATTERNS	OBSERVER
P1. Assistance Utilization P2. Knowledge Application P3. Ordered Behaviors P4. Personal Interest Utilization	R1. Clarify Question R2. Initial Question R3. Give Directive R4. Clarify (How) R5. Clarify (Why) R6. Confirmation R7. End R8. Prodding RA. Resource Available RM. System Generated Message/Action RN. Researcher Notes RS. Read Scenario

Categorized Information Seeking Behaviors Defined

Affective Behaviors

Affirmation: Students gain a sense of clarity. Physical or verbal signs of elation made when students move forward in the search process or complete a task.

Familiarity: Students choose to perform a certain way based on previous behavior, personal likes or dislikes, comfort level or ease.

Frustration: Students’ feelings of difficulties in completing a task expressed in physical or verbal signs.

Hesitation: Students show physical or verbal acts of pausing, uncertainty, or indecision.

Intuition: Students' believe that a particular act would or may happen if a strategy, tactic, or move is applied (i.e., a guess, hope, etc.). A cognitive process underlined with affective feeling, uncertainty.

<u>Cognitive Behaviors</u>

Realization: Students reach a level of understanding to a specific action taken.

Thinking Mode: Physical or verbal actions students take when deciding a route to take regarding a task.

Error Creation: The unconscious process of making an error that affects the outcome of an applied strategy.

Correction: The conscious process of correcting an error in order to redirect seeking process or alter collected information.

Relay Findings: Students verbalize findings from information gathered or deduced.

Decision-Making: Students make choices or judgments regarding the given information then selecting a direction to take to complete a task.

Confirmation: Students acknowledged researcher directive or question.

Process Completion: Verbal acknowledgement or physical action students make when information seeking process is complete.

Background Knowledge Use: The students use background knowledge when making decisions about resources, information, or task completion.

<u>Physical Behaviors</u>

Exploratory Moves: Use of embedded features in networked applications or resources.

Navigational Moves: Use of moves to navigate through the networked applications and resources.

Operational Moves: Use of networked environment peripherals (e.g., keyboard, mouse, drives, printers) to locate and manipulate information.

Constraints: Operation of networked environment to locate information under constraints. Constraints may be negative (i.e., physical discomfort with screen) or positive (i.e. use of Web to relieve physical exertion of going to multiple places to locate information).

<u>Strategies</u>

Resource Selection: Students selects a source (search tools, official homepages; Web pages,) to begin locating information. Students select resources to continue to solve information needs.

Keyword Search-broad: Students use broad or simple keywords to formulate queries.

Keyword Search-narrow: Students use multiple topics to narrow focus to formulate queries.

Verify Information: Students check to make sure the information given is correct or that they understand the meaning of the task (i.e., questioning).

Predetermined Resource Selection: Students select search tool generated result list links or Web site menu, categorical, or textual links.

Natural Language Search: Students use questions to formulate queries.

Previously Acquired Information: Students use acquired information to continue to solve information problems.

Boolean Search: Students use Boolean code operators within search tool's query box to formulate queries.

Subject Search: Students use subject search features to formulate queries.

Application Use: Students selects applications to use to complete tasks.

Tactics

Review Material: Students reviews material on screen to see if it is information needed.

Modify Query: Students modify queries by changing or adding terminology in the search box.

Switch Resource: Students move from one resource to another (e.g., search engine to subscription database).

Copy Information: Students copy information from one resource and uses it in another to locate information or complete information need.

Multitask: Students use multiple applications or resources to complete information needs.

Minimize: Students remove an application from screen.

Maximize: Students bring an application to full view.

Switch Application: Students move from one application on network to another (e.g., Word to an IE Browser).

Save Documents/Information Collection: Students save documents or gathering information using an application (e.g. word processor, spreadsheet).

Modify Collected Information/Format: Students modify collected information or format page/text of information to be collected.

Moves

Scroll: Students use the scroll bar to look over the page.

Backtrack: Students go back to or go forward to a previously viewed page (i.e., Back button, Forward button).

Type: Students type information into search box, empty field box. (e.g., URL, search term, collected data).

Arrow: Students use the arrow (i.e., mouse) to scan over information or check for hyperlinks.

Keyboard: Students use the keyboard to make selections, manipulate pages, or activate shortcuts.

Drop-down Menus: Students use drop-down boxes to select options when formulating queries or locating resources.

Right Click: Students use the right click functions to manipulate context menus (e.g., copy and paste information).

Print: Students use print to extract information.

Home: Students return to the browser set home page.

Select Information/Highlight: Students select or mark important information.

Direction: Students place the cursor at a particular location to continue information seeking process.

Buttons/Icon: Students select buttons or icons to activate commands.

Delete Material: Students Delete material typed or collected. Un-highlight information selected.

Close: Students close a resource or application when no longer needed.

Main Toolbar: Students use functions on Main Toolbar

History: Students locate previously viewed Web sites.

Find: Students use find function to locate desired information on a page.

Task Switcher: Students use the task switcher box to move from one resource/application to another resource/application.

Stop: Students stop a process on Internet browser.

Favorites/Bookmarks: Students add a Web site to favorite's location or obtain Web site from favorites.

Refresh: Students use refresh to reload a Web page.

Patterns

Assistance Utilization: Students use assistance from an outside source (e.g., teacher, librarian, friend, electronic resource) in the decision making process of seeking information

Knowledge Application: Students applying previously known strategies, tactics or moves to an information current information problem

Ordered Behaviors: Students performing specific strategies, tactics, or moves in an ordered fashion repeatedly with different information problems and specific search queries

Personal Interest Utilization: Students use personal interest to decide the continuation of a query or selection of information.

Observer: Actions produced/instructed by research observer or network system

Clarify Question: Researcher clarifies direction or answers question about the scenario/information

Initial Question: Researcher asks why participant chose particular scenario

Give Directive: Researcher asks participant to do *y*

Clarify (How): Researcher asks participant how they did *x*

Clarify (Why): Researcher asks participant why they did *x*

Confirmation: Researcher acknowledges participant action/question

End: Researcher asks if participant has completed task

Prodding: Researcher prods participant to talk about seeking process

Resource Available: A page loads or application opens.

System Generated Message/Action

Researcher Notes

Read Scenario: Participant reads scenario aloud

APPENDIX I

INTERVIEW QUESTIONS CODING SHEET

Theme	Interview Question	Category	Subcategories or Descriptors
Scenario Evaluation	What did you think about the types of scenarios you had to complete: level of difficulty?	Difficulty Level	Hard: Time issues Minimal Difficulty Easy Thought Provoking Fun Practical Useful Applicable: Prior Knowledge, interests, skills Realistic
	Did you feel you understood what information you needed to find to complete the scenarios?	Comprehension	All students: yes Straightforward
	Do you feel you completed the scenarios in a satisfactory manner?	Completion Satisfaction	All students: yes Time issues
	What might you have done differently?/Would there have been anything you would do differently?	Alternative completion	Locate more information Tried different resources Verify information found Target search Be more observant
	Do you think these types of scenarios would be helpful in teaching you how to find information more proficiently?	Instructional Benefits	All students: yes Provides experience Practice of everyday/practical information seeking
	Was how you completed the scenarios typical of how you find	Scenario Relationship to typical search	All students: yes

	information using the networked environment at home/school?		
Information Seeking Behaviors	How do you typically find information using the networked environment?	Information Location	Internet: Search tool Known resource
	What type of strategies do you use to locate specific information?	Strategies	Resource Selection: Search Tool: Search Engine, Subscription Database Resource Selection: Specific Web page Keyword Search: Broad Keyword Search: Narrow Boolean Search Browse Search Extract terminology
	What types of resources do you use?	Resources	Resource Selection: Search Tool: Google, Ask Jeeves, AOL Search Resource Selection: Search Tool: Subscription Databases Resource Selection: Specific Web site Reliable, Credible Resources
	How do you decide which is best?	Decision Making	Credibility Check Summaries Relevance: need
	Do you ask for assistance when locating information using the networked environment; and if so,	Assistance Utilization	Self Friends Teachers: School related Librarian: research

	whom do you ask?		related Computer Teacher: research related Parents: Topical information
Problem Solving Techniques	When you have a problem to solve, do you make a plan to complete it? What steps do you take?	Planning	Search and Go Create Outline Create questions Write out steps Follow question path Mental plan No Plan
	Do you feel it is important to make a plan before you begin locating information?	Planning Importance	Most students: yes One student: no Conditional to problem Time Factor Keeps focus on objectives
	What do you do when you cannot find information that you need or want?	Problem Resolution	Switch Resource Keep looking: Persistence Seek Assistance Switch Tactic
	How do you decide when to stop looking for information?	Process Completion	No relevance: Time factor Question answered Information repeats Information verified Reading fatigue Deadline imposed Frustrated
Networked Environment Use	What is frustrating to you when you use the networked environment for locating information?	Frustrations	Skills: Terminology Formulation Skills: Resource knowledge Pop-ups Blocked sites Speed: Information location System malfunction: objects loading time System malfunction: slow processing Search engine:

			relevancy of returned results
	What do you like about using the networked environment for locating information?	Likes	Speed: Information location Breadth of Information Easy Access: resources Easy Access: home, school, Network storage Multitasking capabilities “One-stop shopping”
	What do you think about your ability to find information using the networked environment?	Ability	Knowledgeable: assist others Comfortable user Competent Average: assistance needed Fairly Proficient Experienced
	What would make your abilities better?	Ability Improvement	Practice time Search tool knowledge Resource knowledge Classes Seek Professional assistance
	How much time do you spend on a network (at school, at home)?	Time	1hr 1-2 hrs 2 ½ -3 hrs 2-4 hrs School ½ hr: 3-4 hrs 5 hrs 6hrs School ½ hr – 1 hr: Home 4 hrs All day
	What types of activities do you do...research/homework for school, personal research, browsing,	Activities	Instant Messaging Browsing Shopping Play games Research

	chat, email, and any other activities?		Email Chat “Tinker” Entertainment Download information, music School work “Surfing” Message Boards Listen to music News Discussion groups Watch movies Manage home network
Network/ Information Seeking Instruction	How do you learn to find information using the network environment (self--play on Internet, friends, parents, teachers, others)	Learn	Self-taught Friends Parents Research class Librarian
	What type of classes have you taken to help you understand the network better; finding information?	Classes Taken	Computer Application courses Computer skills Web design Debate class Typing Computer Science Integrated into class projects
	How long have you attended the school?	Yrs at School	3 yrs 4yrs: 2 8 yrs 9yrs: 3 11 yrs 13 yrs 14 yrs
	What classes would you recommend the school teach in learning how to find information better using the networked	Course/Instruction Recommendations	None Class integration: Advanced search techniques Tips Class integration:

	environment?		search tool structure Project Web sites Experiential learning Internet class: History and use Class integration: More assignments using Internet Skills test Class integration: tool demonstration

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