2002

A QUALITATIVE INVESTIGATION FOR DESIGNING INTERMEDIATE (GRADES 4-6) INFORMATION LITERACY INSTRUCTION: INTEGRATING INQUIRY, MENTORING, AND ON-LINE RESOURCES

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ABSTRACT OF DISSERTATION

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A dissertation submitted in partial fulfillment of the
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By
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Lexington, Kentucky

Director: Dr. Joan Mazur, Associate Professor of Instructional Design

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Information literacy has become a priority in education. Elementary school library media specialists daily encounter the dilemma of having to teach information literacy skills without having time to do it adequately. With the proliferation of computers in schools, the possibility exists that students could use web-based information literacy tutorials or guides when teachers or librarians are not available. This study examines fifth grade students' perceptions of using on-line, web-based assistance to help them work through a research process, the *Big6*. Qualitative research was conducted in 1998-1999 with ten students of diverse background and reading ability who were ten or eleven years old. Data collection instruments included questionnaires, interviews, observations, computer log files, student journals, researcher field notes, and student projects. The investigation raised new questions about the practice of inquiry with fifth grade students. Findings show that students were reluctant to use the on-line assistance, were looking for answers to factual questions, and had a "school research" mindset that did not result in disciplined inquiry. Although some students learned new research strategies, the on-line assistance did not prompt students to practice disciplined inquiry that begins with meaningful questions includes human mentoring and confrontation. Discussion revolves around the implications of the findings for information literacy standards, the *Big6* approach on which the instructional intervention was designed, and classroom instruction for disciplined inquiry. Findings from this dissertation study suggest that students need to learn to use a framework or process to perform inquiry, guided by teachers and librarians who collaboratively follow students' processes with support and scaffolding through mentoring and social negotiation.

KEYWORDS: Inquiry, Information Literacy, Information Problem-Solving, Intermediate Students, On-line Resources

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Melissa Ruth Gibson
October 22, 2002

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October 22, 2002

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I dedicate this work to my husband, Gary Lee Gibson, in grateful acknowledgement of his love and support.

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Chapter One

Introduction

Background and Approach to the Study

Increasingly, researchers and professional organizations alike have advocated that the priority in education is for our populace to be informationally literate, life-long learners in today's society (AASL & AECT, 1998; Breivik, 1987; Breivik & Ford, 1993; Gibson, 1997c; Walster, 1995). The nine information literacy standards for student learning from the American Association of School Librarians (AASL) and Association of Educational Communications and Technology (AECT) Vision Committee (AASL & AECT, 1998) state that students who are informationally literate are competently and effectively able to access, evaluate, and use information. In Kentucky, educational restructuring through the Curriculum Framework (Kentucky Department of Education, 1993) mandated that the state's children should become literate for life. Within each of the Framework's six learning goals, academic expectations address the worth of library skills that promote information literacy. Located in Appendix A, p. 107, is a table showing the relation of the Curriculum Framework's academic goals and expectations to the Kentucky benchmarks (Kentucky Department of Education, 2000) for the National Information Literacy Standards.

Today's children are immersed in an information explosion such as the world has never known. Students no longer have the comfortable solution of simply conferring with another individual to answer a question, especially if answering that question requires in-depth information. Therefore, we should instruct our children to be informationally literate. Are the standards enough to ensure that literacy?

Information literacy involves the practices of inquiry, research, and information problem-solving, and this study focuses on information that exists in print and non-print sources. In beginning this dissertation, I believed that the terms inquiry, research, or information problem-solving had the same intent, if not very similar definitions. Inquiry is the act of asking; it is the search for information, knowledge, or truth. One must do research in order to answer the question. Research is a search for information, which could begin with a question, a problem, or a teacher-given topic, but research can also signify a process of searching for and using information. Information problem-solving is a step-wise process for solving problems, answering questions, or researching a topic by using information, therefore, it is a way to do research. The three terms differentiated very little, although the umbrella term seemed to be inquiry, supported by research and information problem-solving. However, for the sake of clarity, I have defined the three terms as used throughout the dissertation at the end of the chapter.

The practice of inquiry can help students become self-regulated learners. A self-regulated learner has the ability to ask questions that focus on an issue and is able to weigh all the aspects of a problem to decide what is important. Thus, one part of inquiry is asking good questions, a skill that needs to be developed (Martinello et al., 1996). Kentucky's Curriculum Framework fails to specifically mention formulating questions, although that may be assumed in the sections advocating critical thinking skills and scientific skills for problem solving. The AASL National Information Literacy Standards, in the indicators for each standard, includes formulating questions based on information needs under Standard 1 (Indicator 3). The Kentucky Benchmarks refine Indicator 3 as follows:

Benchmark 1.1.1 - Students can develop essential questions, make choices, and refine task.

Benchmark 1.3 - Students formulate questions based on information needs.

Benchmark 1.3.1 - Students recognize and develop questions to ask for accurate task definition with help from the library media specialist and/or teacher.

Research and information problem-solving support the practice of inquiry. Thus, librarians know that instruction in library location skills and research methods are not enough unless they are integrated with a real-life use of content for some concrete reason (McCarthy, 1997). Todd's (1995, 1995b) preliminary work with Australian secondary school students shows that an integrated information skills program has a positive effect on students' academic mastery and their development of information problem-solving strategies. Indeed, such a program may have a positive effect on students' attitudes toward school life, their self-esteem, and their confidence to take charge of their own learning.

Kuhlthau's (1991) research on information-seeking indicates that students follow a general process when they do research; she entitled it the Information Search Process Approach (*ISPA*). Kuhlthau also found that students have similar feelings during these research stages of initiation, selection, exploration, formulation, collection, and presentation. A number of other research processes, such as *Big6*, *I-Search*, and *REACTS*, have been developed and used to teach students how to search for and use information (Bateman, 1990; Eisenberg & Berkowitz, 1996; Macrorie, 1988; Stripling & Pitts, 1988). These processes appear to be helpful but have not been verified with research. This dissertation uses the *Big6* information problem-solving process (Eisenberg & Berkowitz, 1996) as *Big6* synthesizes the steps of the other processes, adds the necessary step of evaluation, and is applicable to other situations, such as Kentucky's required performance events. Figure 1 shows a comparison of three processes: *Big6*, Kuhlthau's *ISPA*, and Marchionini's steps for information-seeking.

Big6	**Kuhlthau's *ISPA***	**Marchionini's Information-Seeking**
Task Definition	Initiation Selection Exploration Formulation	Recognize and accept Define and understand
Information Search Strategies		Choose a search system
Location & Access	Collection	Formulate a query Execute the search Examine the results Extract the information
Use of Information		Reflect Iterate Stop
Synthesis	Presentation	
Evaluation		

Figure 1: Comparison of *Big6*, Kuhlthau's *ISPA*, and Marchionini's Information-Seeking.

For an inquiry approach to learning, students need to develop the skills necessary to become effective information users (Jay, 1988). However, information problem-solving and learning processes take time. The KERA goals repeatedly use the phrase, "students will construct meaning." That is, students will individually make sense of information for themselves, which is a time-consuming process. The school library provides a resource-rich place for children to integrate the content of many domains with the mental and social skills that they are required to use for research, but in many schools, library time is scarce.

Research also suggests that students need scaffolding throughout inquiry (Ellis, Small-McGinley, & Hart, 1998; Levstik & Barton, 1997; Martinello, 1998; Oliver & Oliver, 1997; Todd, 1998). Mentors, providing scaffolding through questions and advice, can guide students through an inquiry process as well as boost self-esteem and class performance (Ellis et al., 1998). Guidelines (AASL & AECT, 1998) for school libraries recommend that the librarian become a collaborating partner with the classroom teacher in order to integrate the library skills curriculum into the content areas. Collaboration would also provide excellent opportunities for mentoring and becoming a community of learners (Wells & Chang-Wells, 1992). Through teacher/librarian collaboration, children can be motivated to learn on their own, especially if allowed to do it at point of need (when the need arises) (Shannon, 1996). Again, being able to assist students in such a manner consumes an inordinate amount of time.

One solution to the problem of insufficient time, suggested by research (Shannon, 1996; Tallman & van Deusen, 1995; Van Deusen & Tallman, 1994), is flexible scheduling. In a flexibly-scheduled library, classes visit at point of need, i.e., when students want to know

something or when they are working on a specific project. There would be no once-per-week, set time for coming to the library, and teachers could schedule library time when they needed it. In this way, teachers could reserve large blocks of time in the library for students to do research.

However, flexible scheduling meets with resistance on the part of classroom teachers because of the loss of time they feel is needed for planning and breaks (McCarthy, 1997; Shannon, 1996). For years, no one considered a fixed schedule problematic, although our middle school and high school colleagues wondered why the children graduated to the secondary level with few library skills. One could attribute this lack of student preparation to the possibility that elementary teachers and librarians did not understand that information literacy and information skills are an expansion of library skills. Library skills prepare students to locate material, whereas information skills prepare them to learn in an information-rich environment, a concept which encompasses life-long learning and the application of information skills to everyday living (Kuhlthau, 1995). How then can librarians, without the options of collaboration or flexible scheduling, help students acquire the skills they need to be informationally literate?

Additional questions that need to be raised include: How do students develop information literacy skills? Are there on-line tools and resources that might assist teachers and their students in achieving information literacy? What are the students' experiences with such resources? In order to investigate these questions, I studied students' perceptions of using an on-line program I developed called the *Research Buddy*, which employs the information problem-solving process *Big6* (Eisenberg & Berkowitz, 1996) to assist students with research projects. The Research Buddy is a web-based program (http://www.dwu.edu/cat/rb/default.htm) designed to guide students through the process of delineating a topic, and then finding and using information to create and evaluate a presentation.

It is relevant to note that *Big6* includes six steps to help students work through an information problem: 1) Task Definition; 2) Information-Seeking Strategies; 3) Location and Access; 4) Use of Information; 5) Synthesis; and 6) Evaluation. *Big6* is procedurally designed, but the steps are logically iterative, used whenever needed during the problem-solving task. The process to me is synonymous with research, which is often confusing, messy, intensely frustrating, and fundamentally non-linear (Marshall & Rossman, 1994). *Big6*, as a research process, is also inherently non-linear. Thus, information problem-solving can be categorized as an ill-structured knowledge domain because it is an iterative, non-linear process. Higher levels of cognitive processing, such as evaluating, synthesizing, and analyzing are often required as students information problem solve.

In such ill-structured domains, hypertext (text which is linked to media in different locations) has been touted as a medium that can help people learn (Spiro, Feltovich, Jacobson, & Coulson, 1992). However, empirical research in hypertext shows that people have trouble with navigation, tending to get lost in the information space (Nielsen & Lyngbaek, 1989; Rouet, Levonen, Dillon, & Spiro, 1996). Problems arise when people are not familiar with hypertext. Multimedia educational software, including encyclopedias such as Encarta and World Book, use hypertext extensively as a learning aid.

Children make a beeline to hypertext sources such as the WWW (World Wide Web) before they will even consider the use of the print ones (Burdick, 1998; Dalrymple, 1991). Credulity accompanies this tendency to choose computers over print sources. Children seem to have more faith in what they see on the computer screen than in any other source (Breivik & Senn, 1998).

For the reasons that children are enamored of computers, and that information problem-solving is an ill-structured knowledge domain, I used hypertext to develop the Research Buddy (Gibson, 1999) to guide students during their research process. The Research Buddy program (described fully in Chapter 3), available on the WWW (http://www.dwu.edu/cat/rb/default.htm), is comprised of information files (HTML, which is HyperText Markup Language) that reside on the school district's web server. Using the Research Buddy, students can get examples of how to use *Big6*, be prompted with questions that guide them through the process, and find instructional print-outs. The Research Buddy is accessible any time as an additional resource to support students' inquiry, and is available to use at their point of need. The Research Buddy was designed to facilitate students' information literacy progress.

The Research Problem

Librarians attempt to instruct children to find and use information in a library that will solve their information problems and questions. In the short term, library skills related to doing research are taught. Ideally, students learn research skills by practicing inquiry, a process that takes time and requires scaffolding, both of which are not available in a library with a fixed schedule of classes. A solution may be to offer on-line assistance through the Internet. However, we know little about the actual information problem-solving process of fifth graders in a web-based environment. We need to conduct research that specifically examines the experiences and perceptions of students who may use such on-line resources.

Research Focus Questions

It is important for educators and librarians to understand children's thought processes as they go about their tasks. As Kuhlthau (1988d, p. 426) suggests, "Perceptions lead to expectations that direct action." If we can discover a child's thinking patterns in order to find misconceptions, we may be able to provide the scaffolding necessary to help them become better inquirers.

This study focuses on the perceptions of ten fifth-grade volunteers who attended a public school in a large city school district. When I began the study, the central question for this dissertation study was "What are fifth-grade students' perceptions of using on-line assistance (the Research Buddy) for information problem-solving?" Related questions explored were:

1. How do students use the Research Buddy for information problem-solving skills? Does on-line guidance occur? What human mentoring will be required?

2. Do students' perceptions of the research process differ from their actual process, and if so, how?

3. Will students report and/or demonstrate they have learned new research skills because of the Research Buddy? What might they be?

4. Do students' perceptions of the Research Buddy differ from their actual use of this tool, and if so, how?

However, in gathering data during the study to answer these questions, I found that students did not use the Research Buddy as I expected. Students began their work already ingrained with a sense of how to do research, and tried the Research Buddy guidance with reluctance or not at all. Additionally, I never used the word inquiry with the students, nor did I consider that there was that much difference between inquiry and research at the study's inception. Thus, other more compelling insights emerged concerning the nature and importance of inquiry and what really happens when students do research without human mentoring.

By telling the students' research stories, this study shares information and insights about instructional methods and practices in the area of on-line assistance during research and inquiry. The students' stories inform librarians and teachers regarding the benefits and drawbacks of such an instructional approach, and of the importance of embedding inquiry practices into the curriculum.

Primary data-collection instruments were interviews, questionnaires, and informal observations, collected from February through May 1999. Other data that informed the research were computer log files, student journals, and student projects. The data provided insight into the students' thought processes that were compared to the students' observed and reported behavior. Findings corroborate research studies on inquiry (Levstik, 1997; Martinello, 1996) that stress the socially negotiated nature of inquiry and the need for mentoring throughout the process. Implications for designing on-line instructional support tools and structuring mentoring are drawn.

Scope, Limitations and Significance of this Study

During the period of this dissertation study at Cabin Creek Elementary School (pseudonym), I was employed as the school library media specialist (the term librarian will be used throughout the dissertation). I had learned from a preceding study (Gibson, 1997a) and a formative evaluation of the Research Buddy (Appendix B. p. 130) that doing research at one's worksite is difficult. The job of librarian is primarily a job of interruptions, and one can never plan to have a quiet half-hour or even fifteen minutes at a time. Whether I came to school an hour before or stayed an hour later, the students and staff considered me at work. Therefore, as interruptions would be common, I was fully cognizant that questions may arise about reliable documentation of interviews, observations, and writing of field notes. However, I systematically planned, documented, and quickly transcribed these data, so common themes could be sought and studied throughout the data collection process. The triangulation from the students' journals, log files, projects, presentations, and my own journal served as evidence to corroborate interview and observation data.

Another limitation of being "on the job" in the research site was the desire of students to please me, perhaps making statements that might not be true about the Research Buddy and their work. Additionally, I was paid by the school district to teach and assist students, so when three of them wanted to begin their project early, I could not squelch their enthusiasm. I was ethically obliged to help provide assistance and information, even though I wanted them to wait. However, the dissertation study's time period was not as crucial as the process that students followed. Further, the students worked on this project as volunteers, not for a grade, but for Book Fair Bucks and other intrinsic motivating factors, such as being part of a special group. Therefore, some students did not finish, and others did not turn in required documentation, which left gaps in my understanding of their research processes.

An additional limitation was researcher bias. I developed the Research Buddy because I believe in the importance of information problem-solving. I realized that this personal attachment to the Research Buddy could color my interpretation of the data. As a result, I tried to distance myself from those beliefs as much as possible by using reflection, rigor, and care during the data analysis (Coffey & Atkinson, 1996). I wanted to be open to the possibility of questions that I had not considered. I was not "locked in" to finding a particular metaphor for my study or to writing up a certain category of narrative. Instead, I wanted to strengthen the qualitative work by insuring that the research participants had a voice, even though I was collecting the data and making inferences from it.

A final limitation is that of the nature of the activity I planned for the students. Rarely are students allowed the opportunity to choose what they want to learn or study. Because in this dissertation research the students did get to choose, the possibility exists that students may consider their work artificial, and not take it as seriously as they would regular schoolwork. However, this limitation is qualified by the fact that information needs for lifelong learning are not always school-related.

Although not all schools have the advantage of Internet service, I think the results of this study may be useful in many different school settings. In 1996, 65% of U. S. public schools had access to the WWW (Heaviside, Riggins, Farris, & Westat, 1997). From 1994 to 1997, the percentage grew from 35% to 78% (NCES, 1998). Schools could use a Hypertext instructional package such as the Research Buddy on a school-based Intranet (a local building network) or on a stand-alone machine that is equipped with a Web browser. Consequently, the findings from this study have potential for widespread utility in U. S. public school media centers and classrooms.

Finally, no research studies to date incorporate the use of hypertext, library skills instruction, on-line guidance, and information problem-solving for inquiry with intermediate-aged children. An important value of this study is the discovery of new questions about the use of on-line guidance for information problem-solving and about the practice of inquiry for this particular population of students.

Definitions of Terms Used in this Study

To clarify meaning, this section includes definitions of terms used throughout the dissertation.

Information literacy is the ability to effectively access, evaluate, and use information (AASL & AECT, 1998). The basic elements of information literacy are: 1) defining the need for information; 2) initiating the search strategy; 3) locating the resources; 4) accessing and comprehending the information; 5) interpreting the information; 6) communicating the information; and 7) evaluating the product and process.

Information-seeking is the process used to search for and find information. Kuhlthau (1990) uses the term more broadly, to include the use of information.

Information problem-solving involves using a set of skills, including a range of competencies within each, which are necessary to solve problems that require information. These skills include clearly understanding a task, determining a range of available information sources, physically finding resources and locating the information therein, interacting with and extracting information, communicating the information in an appropriate manner, and reflecting on the

efficiency of the process (Eisenberg & Berkowitz, 1996). Not all information problems begin with questions, and in this dissertation, the problem-solving focus is on research that involves drawing on existing information rather than creating it, such as with experimental data, for example.

Big6. The *Big6* information problem-solving process represents a general approach to information problem-solving consisting of six steps or stages (Eisenberg & Berkowitz, 1996).

Inquiry is the process of asking meaningful questions, finding information, drawing conclusions, and reflecting on possible solutions (Levstik & Barton, 1997). In this dissertation, inquiry refers to research work that begins with a meaningful question, and follows a process for finding, accessing, using, and evaluating information.

Research. Throughout the study, two definitions for research are used. My interpretation of research was to use the information problem-solving process; therefore, research was a research process, or in-depth research (Horowitz, 1984). The students' definition of research was to seek for information; they did not consider it a process. Their mindset was what Horowitz (1984) referred to as "the quick-answer kind of research."

Mentoring is an activity used to support student learning. It involves using "a wise and trusted advisor" (Barnhart & Barnhart, 1983), who is more expert than the learner. A mentor assists the learner by scaffolding (which provides structure to the learner), modeling, and providing feedback (Levstik & Barton, 1997).

Essential questions require students to evaluate, synthesize, or analyze, causing students to make their own meaning from gathered information. Essential questions engage students in real-life problem-solving (McKenzie, 1996).

Seed questions, used as a brainstorming strategy during the Task Definition phase of *Big6*, begin with "who," "what," "when," "where," "why," and "how." Seed questions help students formulate what they want to know, and help by providing keywords for searching.

On-line guidance is the term I chose to use in this study for the scaffolding and modeling in the Research Buddy design. The purpose of the scaffolding and modeling is to teach students information problem-solving skills.

On-line searching refers to looking for information using computers. The literature includes several types: OPACs (On-line Public Access Catalogs), CD-ROM encyclopedias such as *World Book* and *Encarta*, subscription-based databases such as *Dialog* and *FirstSearch*, and the WWW (World Wide Web).

The Internet is a system of communication via a worldwide network of computers. Participants in this study generally referred to the WWW as the Internet.

The Research Buddy (http://www.dwu.edu/cat/rb/default.htm) is a web site containing information about the *Big6* information problem-solving process, suggestions, journal prompts, graphic organizers, and examples for students to use for their projects.

Dissertation Organization

The following chapters include the literature review, research design, and findings of the study. The second chapter is a review of relevant literature. Chapter Three describes the Research Buddy and Cabin Creek, the school site for the study, and Chapter Four describes the methodology. The fifth chapter profiles the research participants, and Chapter Six discusses additional findings of the study. Finally, Chapter Seven gives implications of the findings for classroom instruction of information literacy and designing on-line tools for scaffolding inquiry, and raises further questions. The appendixes include interview protocols, examples of student work, examples of data analysis, and other informational tables.

Chapter Two

Literature Review

Based on a search of databases such as *ERIC, Education Index, Psych-Lit, Dissertation Abstracts, PsycINFO, First Search, Library Lit, ABI/INFORM*, and the U.S. Department of Education web site (http://www.ed.gov), no studies were available on intermediate students' perceptions of on-line guidance for research and information problem-solving provided by programs such as the Research Buddy. Thus, this review of literature outlines relevant studies and theoretical points of view that serve as pertinent background knowledge for the study. This review explores the concepts related to information literacy: using an on-line environment, information-seeking, inquiry, research, and mentoring.

Information Literacy

Information literacy is "knowing how to obtain and use information properly" (American Library Association [ALA], 1998), or "learning how to learn" (Loertscher & Woolls, 1997, p. 345). It is the term applied to the skills and attitudes required to master information problem-solving (Callison & Tilley, 1998). Students who are learning to be informationally literate can positively influence their success in school (Todd, 1995), as well as provide a foundation for life-long learning. The National Information Literacy Standards (AASL & AECT, 1998) include nine standards for success in life-long learning. According to the Standards, informationally literate students are able

1) to access information efficiently and effectively;
2) to evaluate information critically and competently; and
3) to use information accurately and creatively.

In addition, informationally literate, independent learners possess abilities such as

4) pursuing information related to personal interests;
5) appreciating literature and other creative expressions of information; and
6) striving for excellence in information-seeking and knowledge generation.

Finally, socially responsible students who are informationally literate contribute positively to the learning community and society by

7) recognizing the importance of information to a democratic society;
8) practicing ethical behavior in regard to information and information technology; and
9) participating effectively in groups to pursue and generate information.

Librarians normally teach students to access data, not analyze it. In the current "Information Age," students need to have basic cognitive skills that involve application, comparing and contrasting, and problem-solving (Gray, 1994). A research summary by Loertscher and Woolls (1997) states that research is being conducted from many segments of the

community on information literacy, but it is still in its infancy. Loertscher and Woolls examined literature about computers and information literacy, critical thinking, and process models. Findings showed that information literacy models are keeping up with the advance of research in cognitive development, yet behaviorist approaches in education are still prevalent. "To date, librarians are not making great strides instructing students or teachers to handle the oceans of new information currently available to most students" (Loertscher & Woolls, 1997, p. 364).

Library skills instruction alone has often been ineffective in preparing students to learn independently (Moore, 1995). Hannis (1997), in *Information Literacy Development,* includes a short review of experimental studies related to information literacy, which show positive results of training in library and problem-solving skills. Students are learning information literacy skills with process models, such as Kuhlthau's (1990) *ISPA* and Eisenberg's and Berkowitz's (1996) *Big6*, which connect students to real-world use of information. Stripling (1995) states that learners develop new understandings through mental processes that contextualize information to form new frameworks, or mental models. Forming new mental models denotes making meaning for oneself, a posit of the constructivist learning theory. The entire framework of information literacy using such process models is embedded in constructivist learning theory.

Learning theories provide instructional designers, teachers, and librarians with strategies and techniques for facilitating learning as well as a foundation for intelligent strategy selection (Ertmer & Newby, 1993). For most of the first half of this century, behavioral theories provided the most common conception of learning (Jonassen, 1991a). At that time, the major principles of instructional design evolved from the work of Skinner and Gagné (Dick, 1991). In the last two decades, a paradigm shift in instructional technology has progressed from the stimulus-response formulations of behaviorism to cognitive science and, most recently, to constructivism. Jonassen (1994) interprets the theory of constructivism as the building or interpretation of a learner's reality based on the learner's prior experiences, cognitive structures, and belief system. He believes that learning is individually constructed, can be assisted by mentoring, and that meaning is created from experience (Jonassen, 1991a).

Relative to the theory of constructivism, several models and guidelines of instructional design have been proposed (Brooks & Brooks, 1993; Cennamo, Abell, & Chung, 1996; Jonassen, 1994; Lebow, 1993; Madhumita, 1995; Richey & Tessmer, 1995; Sadler-Smith, 1996; Savery & Duffy, 1995; Schoenmaker, 1993; Tennyson, 1995; Wilson, Teslow, & Osman-Jouchoux, 1995; Winn, 1991). Rather than prescribing learning, constructivist models describe environments, or contexts for learning, which Jonassen (1991) says are most appropriate for advanced knowledge acquisition. Constructivism supports an instructional approach that allows for the development of inquiry, analysis, and decision-making (Ertmer & Newby, 1993).

Librarians should be able to work with a range of teaching and learning styles in order to facilitate information literacy (Loertscher & Woolls, 1997). Yee (1989) states that cognitive learning modalities have a critical impact on information literacy instruction. These cognitive styles are the learners' typical method of organizing, remembering, and problem-solving. Process models of information problem-solving can address varied cognitive styles by providing various research techniques and instructional strategies.

Gagné may have been the first to define problem-solving as a form of learning (Ragan & Smith, 1996). Indeed, the task of acquiring new information can be viewed as an instance of problem-solving (Bransford, Sherwood, Vye, & Rieser, 1986). Problem-solving strategies and skills allow learners to acquire knowledge of theory and process, to generalize knowledge across domains, to retrieve and use knowledge and skills, to identify and carefully define a problem, to

apply appropriate strategies, and to evaluate the effectiveness of the strategies (Bransford & Stein, 1984; Hannafin, Hannafin, Hooper, Rieber, & Kini, 1996). Horne (1990) stated that problem-solving is reflected as successful and unsuccessful questioning behavior, that question generation arises from an information need (information problem), and that questioning satisfies that need. The use of four constructivist strategies–situated cognition, collaboration, problem-solving, and metacognition–require students to assume more responsibility for the quality of their education and prepare them for better decision-making and risk taking (Breivik, 1987).

Situated cognition is a strategy that places learners in real-world problem-solving environments where knowledge emerges in relevant contexts. This approach provides motivation to the learner (Brown, Collins, & Duguid, 1989; Ertmer & Newby, 1993; Perkins, 1992; Shute & Psotka, 1996). Collaborative learning develops cognition through goal-directed activities, in which the learner encounters particular problems and comes to understand and resolve the problems by cooperative efforts with others (Jaramillo, 1996; Johnson & Johnson, 1996; Perkins, 1992; Wells & Chang-Wells, 1992). Finally, in metacognition, students analyze their current problem-solving processes and learn about themselves as learners (Bransford et al., 1986). Studies in metacognition suggest that awareness and self-control of constructive learning processes increase achievement in several areas (Wittrock, 1991). Such conscious control of knowledge includes evaluation, planning, and self-regulation (Mancall, Aaron, & Walker, 1988), all facets of problem-solving.

The use of constructivism as a theoretical base requires a change in much of the learning environment, including the teacher, methods, classroom, and students. The application of constructivist techniques advocates learner-centered systems that require changing the role of the teacher from dispenser of information to coach or facilitator (Reigeluth, 1995). According to Jonassen (1994), context, collaboration, and construction are elements that probably should exist in constructivist learning environments, and these elements are more process-oriented than product-oriented. Research processes such as those proposed by Eisenberg's and Berkowitz's *Big6* (1996), Kuhlthau's *ISPA* (1988d), and Macrorie's *I-Search* Paper (1988) are successful because they are process-oriented and the students are actively involved in the learning process. An "anywhere/anytime learning environment" (Gamas & Nordquist, 1997, p. 17) is one that allows students the freedom to plan and control their participation and use of sources. The Research Buddy design (described in Chapter 3) attempts to provide an anywhere/anytime learning environment.

However, students often use a research process in an environment that is divorced from classroom content, which is highly problematic, as Hirsch (1996) states that content is critical. Information skills use must be placed into the standard curriculum as an integral part of the students' educational experience (Creanor, Durndell, & Primrose, 1996). Hancock (1995) states that learners cannot acquire information literacy skills independent of content, or without attention to their own cognitive skills. Strategies necessary to accomplish this integration of content and process are basic cognitive skills that involve application, comparing and contrasting, and problem-solving (Gray, 1994). The teacher, serving as facilitator and guide, helps students to extract information and discover relationships as they interact with a variety of print and non-print materials (Hancock, 1995). A teacher's use of such constructivist strategies helps students to stay active during instruction and to produce generative knowledge, i.e., knowledge which is retained, understood, and actively used (Perkins, 1992).

Inquiry and Mentoring

Inquiry is a messy, recursive, and time-consuming process (Stripling, 1995). It is a constructivist activity of asking questions, finding answers, learning information, discovering something for oneself, building schemas, cooperating with others to discover something, solving problems, searching for information, and asking more questions. In theory, effective inquiry should empower the learner to take charge of his or her own learning (thus providing information literacy). In the context of inquiry, mentoring assumes a crucial role. Mentoring helps inquirers learn to inquire by providing "wise and trusted advice" (Barnhart & Barnhart, 1983). Research shows that inquiry is enhanced by instructor guidance, support, and facilitation that provides the structure students need in order to learn (Bateman, 1990; Levstik & Barton, 1997; Martinello et al., 1996; Stripling, 1995; Wells & Chang-Wells, 1992). Studies have shown that this support can be provided by presenting a defined research process (Eisenberg & Spitzer, 1991) as well as by mentoring (Martinello et al., 1996). Perhaps the best way to provide mentoring is in a community of literate thinkers (Wells & Chang-Wells 1992). In this type of collaboration, inquiry becomes a cultural practice whose procedures and purposes are negotiated in interaction with members of different social and cultural groups (Levstik & Smith, 1996). Instruction with communities of literate thinkers is based on a Vygotskian view, in which human development and learning are seen as intrinsically social and interactive (Wells & Chang-Wells, 1992). From this perspective, others who are better at inquiry can guide learners, immerse them in the context of a meaningful activity, and teach them to become information-literate, independent inquirers.

Jamie McKenzie (1997) states that the most important thinking requires "Why?" "Which?" and "How?" questions. "Why?" questions require students to analyze cause-and-effect and leads naturally to problem-solving. "Which?" questions require thoughtful decision-making based on clearly stated criteria and evidence, and "How?" questions are the basis for problem-solving and synthesis. These are questions that cannot be answered directly from a book (McKenzie & Davis, 1986). Students will enjoy a more meaningful, curiosity-driven version of their research projects if they begin with a question (McKenzie & Davis, 1986).

I found few studies that dealt with mentoring children through an information problem-solving process. Important to the idea of a mentor is the study of Martinello et al. (1996) that paired elementary children with adult mentors who helped them through a process that the researchers termed inquiry. These mentors helped the children from age seven to thirteen to engage with their environment, revisit experiences, and internalize meanings. The mentors reported that often the children did not find the true focus of the inquiry until three or four weeks into the process. This mentoring helped the children to move beyond gathering information to find patterns and interrelationships among facts and ideas, and to evaluate what they found. The mentors used several strategies to help the children do inquiry: charts to record what the children already knew and what they wanted to find out, use of library and human resources, site visits, experiments, graphic organizers, and inquiry journals. Several of the process strategies stress that finding the focus of the task is the most critical (Callison, 1997; Eisenberg, 1997a; Eisenberg, 1997b; Moore, 1995; Stripling, 1995).

Burdick (1998), who studied high school students during their research for an English paper, indicated that time was one barrier for successful completion. With more time, students would be able to conference with the teacher or librarian for needed mentoring through their information problem-solving process. Studying sixth grade students, Moore (1995) found many instances in which mentoring would have aided the complex concept formations needed for

sophisticated information use. Using interviews with fourth grade students, Kobasigawa (1983) found that students knew how to search for information, but only used their knowledge when direct instructions were given. Finally, Dreher, Davis, Waynant, and Clewell (1997) found that fourth grade students who were taught a research strategy integrated with a content-area project demonstrated improved abilities to search independently for information, write a response to a research question based on that search, and apply their learning to a new problem.

In any process, one must realize that it takes a meaningful question, sufficient time, and sustained dialogue for inquiry to occur. The children themselves must perform the work, and they must think and re-think their information (Stripling, 1995). An excess of data overwhelms children, and the use of graphic organizers such as time lines, webs, charts, and Venn diagrams can help them to search for interrelationships among the facts, and to narrow a focus. Conclusions from the Martinello et al. (1996) research show that the mentors' active engagement with the children during inquiry was the single most critical enabling factor for the children's success.

Inquiry vs. research.

A discussion of the definitions of research and inquiry is necessary to explain problems and insights that occurred during the dissertation process. I found that the word research meant different things to me, to the study subjects, to my co-teachers, and to my dissertation committee. As an educator guided by state and national standards, I felt that I could use information problem-solving to fulfill those standards by teaching information literacy skills with a research project. The student subjects declared that research was merely "finding information." My committee knew that inquiry included an emphasis on questioning. Clear definitions of research and inquiry were necessary to understand these different ideas.

Information needs or problems lead people to do research. Everyone has information needs. "Not having the information you need, when you need it, leaves you wanting. Not knowing where to look for that information leaves you powerless" (Horowitz, 1984, p. 1). For disciplined inquiry to occur, information needs should develop into questions. This is a step students often skip when doing research, as they frequently perform the type of research defined by Horowitz (1984, p. 28) as the "quick-answer" kind of research. Shulman (1988, p. 3) states that "method is the attribute that distinguishes research activity from mere observation and speculation; and that research is a family of methods sharing the characteristics of disciplined inquiry."

What characteristics do research and inquiry share? Definitions for the terms inquiry and research do not universally agree. Anglin (1995, p. 340), equating research and inquiry, states that research is "disciplined inquiry which involves the use of established research methodologies." McNiff, Lomax, and Whitehead (1996) also use the terms interchangeably, stating that research is systematic enquiry. Glesne and Peshkin (1992) include both quantitative and qualitative research as types of inquiry. Further, Shulman (1988) imparts that disciplined inquiry follows sets of rules and principles for pursuing investigations (are these investigations then to be called research?).

In order for disciplined inquiry to take place in classrooms it is evident that clear definitions are needed. Since students often omit questioning when learning to do research, teachers should employ the term inquiry and emphasize questioning. Consequently, the term research as a "systematic investigation" can be used as the methodology for inquiry.

Self-regulatory skills.

"Students' perceptions of themselves as learners and their use of various processes to regulate their learning are critical factors in analyses of academic achievement" (Zimmerman & Schunk, 1989, p. 1). Although there is no measure of academic achievement in this dissertation, self-regulation is a possible component in the students' perceptions and processes. Self-regulated learners are those who are metacognitively, motivationally, and behaviorally active participants in their own learning process. A self-regulated student purposely uses specific processes, strategies, or responses to improve his or her academic achievement. Self-regulation appears to be an essential element for life-long learning. This learner characteristic is based on Bloom's (1976) general ability and study skills and included in the definition of aptitude (Gagné, Briggs & Wager, 1992), i.e., general ability, prior knowledge, and self-regulation.

Vygotskians assume that most children develop a capacity to self-regulate during the elementary-school years, as they learn "what strategies are available, how they are applied, and when and why they are effective" (Paris & Newman, 1990, p. 92). Instructional conditions that promote the development of self-regulated learning include instruction that provokes children to change their theories, that makes children's thinking public, and that promotes active participation and collaboration (Paris & Newman, 1990). Yang's review of the research on self-regulated learning found that self-regulatory skills, as well as general ability and previous knowledge, are regarded as cognitive characteristics that have a major influence on learning (Yang, 1991). In his research, Yang found that sixth-grade students with high self-regulatory skills obtained significantly higher post-test scores than did those with low self-regulatory skills. Yet, many students are deficient in skills for self-management and self-control of learning. Such skills include learning capabilities such as planning, goal setting, scheduling time, decision making, self-assessing, and monitoring (Yang, 1991). Eom and Reiser (2000) conclude that self-regulated learners are self-directed and self-motivated. In their study of thirty-seven sixth and seventh graders, they found that both high and low self-regulators performed better in a program-controlled condition than in a learner-controlled condition. However, the low self-regulators performed more poorly overall than the high self-regulators, and further, spent 26% less time involved with the learner-controlled instruction than with the program-controlled instruction. Left on their own, they had no self-motivation or self-regulated strategies to investigate the material.

Information-Seeking

Literature relevant to this study defines information-seeking in various ways. According to the national standards (AASL & AECT, 1998), inquiry and information-seeking significantly contribute to information literacy. Information-seeking can be narrowly defined as the process followed to retrieve sources of information from indexes and electronic databases (Marchionini, 1995). However, Kuhlthau (1991) uses the term information-seeking more broadly in the title of her research process, called the Information Search Process Approach (*ISPA*). Her process encompasses not only finding the sources, but extracting and making meaning from the information as well (see Figure 1, p. 3). Kuhlthau notes that information-seeking is the process in which humans purposefully engage in order to change their state of knowledge. It is a fundamental human process closely related to learning and problem-solving (Marchionini, 1995). In this dissertation study, information-seeking is defined narrowly as the process to find and retrieve information from identified sources.

A study of fifty-three Canadian sixth graders (Large, Beheshti, & Breuleux, 1998) investigated ways that students searched multimedia sources in order to determine how they searched. Students worked in collaborative groups to research by writing a paper comparing an occupation from the middle ages (e.g., knight, monk, serf) with a modern-day counterpart. Additionally, students were required to build a model of a manorial system and perform an oral presentation on three topics (e.g., knighthood, armor, heraldry, medieval tools). Findings showed that students read little of the screen for evaluation purposes, had problems searching and did more browsing. It was evident that students needed more help than the electronic interface could give for searching techniques.

Hirsh (1999) studied ten fifth grade students as they gathered information from *SIRS, World Book Encyclopedia,* and the Internet to write a research paper on any chosen sports figure. Those students needed assistance from the librarian in formulating search queries, locating materials, and improving research strategies. Hirsh reported that students did not question the accuracy or validity of the information found, and needed to develop critical thinking skills and better search skills.

Information problem-solving.

Within a supportive community, children should learn strategies to help them do inquiry. A strategy is the information-seeker's approach to solving a problem, those sets of ordered tactics that are consciously selected, applied, and monitored to solve the information problem (Marchionini, 1995). When students focus on a framework for their learning, such as a problem-solving model, they are able to look past the specific activities and short-term goals to the larger goal of understanding (Bereiter & Scardamalia, 1989, as cited by Stripling, 1995, p. 164). Wells and Chang-Wells (1992) describe this at a curriculum level, where a broad thematic topic is chosen and children or groups negotiate to choose a meaningful question. Students then research and inquire, compose and construct, and present their outcomes. Next, students collect information through reading, observation, and experimentation. Finally, students assemble, organize, and interpret the information in order to make sense of it. Carol Kuhlthau (1988e) discovered in her longitudinal research that students go through a similar process when they do individual research. She developed the Information Search Process Approach (*ISPA*) from her research, which includes the steps of initiation, selection, exploration, formulation, collection, and presentation. Kuhlthau (1995) found that an understanding of the constructive process through guided self-awareness substantially increased students' confidence and competence in learning from information. Another process approach model is the *Big6* information problem-solving process, created by Michael Eisenberg and Robert Berkowitz (1996). This model adds the critical step of evaluation to the research process. The *Big6* steps are Task Definition, Information Search Strategies, Location and Access, Use of Information, Synthesis, and Evaluation. *Big6* is also applicable to other real-life uses, such as making decisions and completing homework assignments.

Other models for information-seeking and library research that have been successful in practice include Macrorie's (1988) *I-Search* paper, Marchionini's (1995) search steps, and Stripling's and Pitt's (1988) Recalling, Explaining, Analyzing, Challenging, Transforming, and Synthesizing (*REACTS*). Macrorie's *I-Search* paper includes the steps of choosing the topic, pre-notetaking, choosing resources, reflecting in journals, recognizing bias and opinions in sources, interacting with source material, transitioning to final product, and assessing. Teachers who used the *I-Search* writing process found that students seemed to have higher self-esteem, a stronger

grasp on their task management, better writing quality, more comfort doing library research, and a sense of expertise in their topic (Tallman, 1995). Marchionini, who specializes in electronic searching environments, narrows the first part of the information problem-solving process and breaks it down into even more steps. A searcher must recognize and accept an information problem, then define and understand the problem, choose a search system, formulate a query, execute the search, examine the results, extract the information, reflect, iterate, and stop. These sub-processes fall into three broad areas, that of understanding the problem, planning and executing the search, and evaluating and using the search (see Figure 1, p. 3). In Stripling's and Pitt's (1988) taxonomy of thoughtful research, *REACTS* (acronym for Recalling, Explaining, Analyzing, Challenging, Transforming, and Synthesizing), students follow the steps of fact-finding, asking and searching, examining and organizing, evaluating and deliberating, integrating and concluding, and conceptualizing. Stripling and Pitts think that the third level of examining and organizing might not be developmentally applicable until the end of elementary school. This level involves the "why" questions, and learning to organize information. All these models indicate that time and dialogue with an instructor as well as a process approach should be provided for students to "learn how to learn," i.e., gain their own mental models of how to find and integrate new information.

The Research Buddy is based on the *Big6* information problem-solving process. In comparison with all other models, *Big6* includes and refines the many steps of research into six basic ones, which is presumably easier for children to understand. Additionally, *Big6* integrates library skills instruction with subject area curriculum as teachers apply those skills to real-world problems with every step. Finally, the process includes an evaluation step, which some other models omit. This reflective step prompts a student to use metacognitive abilities, providing some on-line "mentoring." Although *Big6* is a systematic process, it does not have to be used in a linear manner. This characteristic makes it an appropriate choice for the non-linear medium of hypertext, which does not require students to use a set procedure, appeals to students' differing learning styles, and offers choices of activities.

Using On-Line Environments

Research was investigated about hypertext and on-line work with mentoring, library skills instruction, OPACs, and other database searching. Since younger children are under-represented in library user research (Walster, 1996), studies with other age groups are included here. Studies and discussions of on-line mentoring primarily involve the use of telecommunications to provide students with actual (live) subject matter expert mentors (Gamas & Nordquist, 1997; Nissen & Ross, 1996; O'Neil & Gomez, 1996; Rogan, 1997; Sanchez & Harris, 1996). Stuhlmann and Taylor (1998) report that telecommunications can easily support and enhance elementary classroom learning activities. Echavarria, Mitchell, and Newsome (1995), using electronic mentoring in an experiment with college library science students that focused on library and information science research, find that modest success was made toward refining and varying students' research skills. No research studies were unearthed that dealt with elementary students, on-line assistance, and library research skills.

Several studies examine information-seeking and an electronic access point. The on-line instruction of library and study skills was evaluated in Glasgow University's Teaching with Independent Learning Technologies (TILT) project with college age students (Creanor et al., 1996). TILT was perceived by students to be useful for learning to evaluate books and journals, to devise searches, to use on-line bibliographic sources, and to practice study skills. Evans'

(1993) dissertation on the enabling and disabling effects of a hypermedia information environment on information-seeking found that success in adult use of a content-based system depended on several factors. These factors include the characteristics of the user, the tasks, the tools and the information found in the system.

On-Line Public Access Catalogs (OPACs) And On-Line Searching

Research involving children and On-line Public Access Catalogs (OPACs) concentrates on discovering how children use them for finding information (Edmonds, Moore, & Balcom, 1990; Lewis, 1989; Sandlian, 1995) and how to change the OPACs to facilitate better use (Lewis, 1989). Before 1990 (Edmonds et al., 1990), there was no reported systematic study of on-line catalog use by children. The important question in the Edmonds et al. (1990) study was whether children could actually use existing on-line programs to find materials. The researchers documented comparisons of preference and success in using the card catalog versus the on-line computer catalog, cited impediments to effective catalog use, and noted whether independent bibliographic access was improved or diminished with an on-line catalog. The Edmonds et al. study raises several questions for children, including the findings that there was a need for better design in the catalog and for assistance from a librarian in gaining access to information. The children preferred the card catalog to the OPAC; however, the children had no prior instruction on the OPAC. Additionally, Edmonds et al. found that students at the fourth-grade level depended on trial-and-error problem-solving techniques to solve a problem. These students also had difficulty using rules, generalizing, or applying logic to problem-solving. In other words, the OPAC did not provide structure to assist students in critically thinking about the information they were accessing. The Edmonds et al. study concludes that children require simpler library catalogs, as the use of a catalog is dependent on developmental level, experience, and training.

Sandlian (1995) also concludes that children do not often find the on-line catalog a useful tool for several reasons. First through fifth grade students had trouble choosing the right terms to initiate a search and found it hard to sift through the list of books to decide which ones held the needed information. The children made spelling errors, had trouble finding the letters on the keyboard, and had problems with the computer procedures. The Dewey Decimal System also perplexed them. Sandlian created a "Kid's Catalog" which greatly simplified many of the things that were troublesome for children on an OPAC. Her success rate in a comparison study, in which children found what they needed 68% of the time on the Kid's Catalog versus 28% of the time on the OPAC, shows that children will do better by sifting through and thinking about less information.

Walter, Borgman, and Hirsh (1996) examined children's searching skills as they queried the Science Library Catalog, designed specifically for children. They noted that complexity, spelling, and vocabulary problems created barriers, but that age, gender, and computer experience had minimal effect on students' ability to use the catalog.

For web searching, Kafai and Bates (1997) found that fourth grade and younger children are capable of finding information on the Web but are not critical regarding what they find. The children knew what they liked but had problems articulating why. Additionally, the children preferred more animation and interactivity, and were reluctant to write annotations for the sites they found.

Earlier, Marchionini and Teague (1987) studied whether fourth through sixth grade students could effectively use selected electronic information services. Children in this study obtained instruction on the computer to the on-line environment, including electronic bulletin

boards and encyclopedias. The research showed that all students had a good performance, with no significant differences in the ages, indicating that intermediate-aged children can learn the basic concepts related to electronic information services. On the down side, they found that most students used the strategy of exhaustion, and often did not move efficiently through menus. However, the students used far less time per search than the researchers expected, and each one found several articles of interest. Marchionini and Teague concluded that in the long term, easy access to comprehensive data through intelligent systems would allow students and teachers to focus on the content of their projects, thus allowing them to concentrate on the critical skills of filtering, evaluating, and synthesizing information.

In essence, research in the area of searching for information by children in electronic environments agrees with the factors that Evans (1993) found for adult success. Characteristics of the user include being able to spell, use appropriate vocabulary, find letters on the keyboard, evaluate information, and use logical problem-solving techniques. Characteristics of the tools, tasks, and system information proved to cause difficulties for younger students. Research shows that this is not necessarily a developmental problem, but one that can be remedied by assistance in prompting, instruction, or mentoring (Marchionini & Teague, 1987).

Hypertext

Nelson is credited for the term, "hypertext" (Jonassen, 1989). A hypertext document is a computer file containing words or pictures that act as links to other computer files. On the WWW, the links appear as blue underlined words or phrases. When the computer mouse moves the cursor over these links, the cursor changes from an arrow icon into a hand icon. A left-button click of the mouse transports the user to a different file, or page, which relates to the link on the preceding page. Hypertext provides the capability of reading in a non-linear fashion (Dillon, 1996). Linearity means that one reads a text step-by-step, in a particular order defined by the author. Conversely, non-linearity gives that reading control to the learner, who may choose to read step-by-step, or jump instantly from a table of contents to the last chapter and then to the third chapter, and so on. This allows learners greater control over their reading and learning. Stanton and Stammers (cited by McKnight, Dillon, & Richardson, 1996, p. 627) suggest that non-linear environments allow for different levels of prior knowledge, encourage exploration, enable subjects to see a subtask as part of the whole task, and allow subjects to adapt material to their own learning style. Non-linearity provides the direct experience and environments necessary for situated learning. Since a task may depend on the context of the learning situation, hypertext can be used to provide for different contexts (Spiro et al., 1992). Context in information use may include prompting students about what to use, how to use it, and what kinds of questions to ask in critically evaluating information. Hypertext provides context when used to present examples of information-use in differing situations. These critical evaluation skills in context are increasingly more important as technology gives us the opportunity to connect with vast amounts of information.

Results from empirical studies on media use in learning are inconclusive due to the use and variety of factors involved (Seels, Berry, Fullerton, & Horn, 1996). The same is true with research in hypertext. Problems in hypertext research include difficulties in controlled experimentation, in finding ecologically valid tasks, and in describing the process and outcomes of learning (McKnight et al., 1996). Empirical studies in hypertext to date include studies with browsers, maps, and other devices used to create structure (Dee-Lucas, 1996; McAleese, 1988; Nielsen & Lyngbaek, 1989; Wenger & Payne, 1994), comparison of hypertext with linear texts

(Foltz, 1996), information-seeking (Marchionini, Lin, & Dwiggins, 1990), and screen factors, methods of connecting, and structuring and retrieving information (Clibbon, 1995; Jacobson, Maouri, Mishra, & Kolar, 1996; Pennell & Deane, 1994). Much research has concentrated on the computer science and interface issues rather than on learning issues or user studies (Foltz, 1996).

Within the user-studies area, three approaches to research include those of 1) cognitive science–how people read and learn from print and strategies to use with hypertext; 2) ergonomics/human factors–interaction of user with system; and 3) education–provision and support of learning environments. Jonassen (cited by McKnight et al., 1996, p. 629) suggests that "a fair evaluation of learning from hypertext can come only from hypertext-literate learners who have developed a useful set of strategies for navigating and integrating information from hypertext." As concluded in media studies, it is the manner of use that determines effectiveness. New levels of information literacy will be necessary in order to take advantage of the types of learning that hypermedia makes possible (Marchionini et al., 1990).

Another way that learners can synthesize new knowledge structures for information contained in the hypertext is by using hypertext as a mindtool with which to construct and learn rather than as a source of knowledge (Jonassen 1996). Jonassen uses the term "mindtools" to describe technologies that can be used as cognitive tools that enhance thinking, problem-solving, and learning (Jonassen & Reeves, 1996). However, these tools rely on the users to provide the intelligence, planning, decision-making, and self-regulation in order to make them a valuable learning instrument. Research on effective study behavior (Anderson-Inman & Tenny, 1989) is related to Jonassen's notion of mindtools. Anderson-Inman and Tenny found that in order to learn while studying, students should actively and meaningfully manipulate the information (using word processors, databases, and hypertext systems). In addition, the researchers indicated that students should accurately monitor their own study progress and take personal responsibility for the process. Finally, Anderson-Inman and Tenny conclude that students would learn if prompted by a belief that their efforts would pay off.

In his treatise on hypertext, Dillon (1996) stated that learning is a process involving information access and use. A number of studies have pointed out that successful comprehension and use of complex information is highly dependent on readers being able to locate and then relate or integrate information from different locations within a document (Pennell & Deane, 1994; Rouet et al., 1996). This is possible if relevant cues are present for the readers (Spyridakis, as cited by Wenger & Payne, 1994). Wenger outlined Guthrie's (cited by Wenger & Payne, 1994) analysis of the steps necessary to complete such information problem-solving tasks. Locating and relating information within texts starts when readers formulate a goal that can be verbalized. As they read, readers formulate categories of the information and select from among these categories to organize new material. The next step involves extraction and encoding of the information, and integration with information and background knowledge already encountered. Finally, readers cycle through these steps until reaching their goal. Reading hypertext is not just a reading process, but also a problem-solving one (Foltz, 1996).

Hypertext can be used to create an open-ended learning environment (OELE) that electronically provides assistance in information problem-solving. OELEs are learner-centered systems designed to facilitate problem-solving and critical thinking in resource-rich environments (Land & Hannifin, 1996). Hill and Hannifin (1997) identified elements that are likely to influence learning from OELEs such as the WWW. These factors were metacognitive knowledge, perceived orientation, perceived self-efficacy, system knowledge, and prior subject knowledge. These key factors were then used as the focus of a research study to determine

whether they impacted strategies used by adult learners in an OELE (that of searching the WWW for information). The researchers determined that while metacognitive knowledge influenced strategy use most, the other factors also appeared to affect the number of types of strategies used. Hill and Hannafin (1997) conclude that teaching strategies for finding information in an open information system like the WWW may assist learners in their tasks.

To investigate searching styles, Chang and McDaniel (1995) used a hypertext treatment to see how college students performed searches in ill-structured environments. An ill-structured environment requires higher levels of cognitive processing, such as evaluating, synthesizing, and analyzing (Spiro et al., 1992). Chang and McDaniel knew that students made sense of such environments by selecting, connecting, organizing, integrating, elaborating, and interpreting information. In their findings, students fell into one of four levels of searching: aimless wanderers, fact retrievers, casual investigators, and integrative analysts. Additionally, they found that cognitive complexity, which is the intention to understand, to avoid premature closure, to consider alternative viewpoints, and to arrive at reasonable conclusions, would affect search strategies in an unconstrained task.

Jacobson et al., (1996) based their research with freshmen university students on the Cognitive Flexibility Theory's "knowledge in use," and on situated cognition theory's "indexicality of learning and knowledge." These theories call for variable rather than fixed hypertext links, which provide for multiple representations and conceptual interconnectedness of the same knowledge. Cognitive Flexibility Theory emphasizes knowledge assembly and introduces conceptual and domain complexity early on. The studies of Jacobson et al. found that, on a knowledge-transfer task, students using a hypertext treatment performed at a higher level than control students. Three interacting factors contributed to the findings: knowledge represented in the hypertext, the learning activity, and the cognitive support provided. Additionally, Jacobson et al. measured the students' level of epistemic beliefs, which are the general assumptions held by the learner about learning and knowledge. They found that students who held complex epistemic beliefs benefited more from the treatment. The researchers also suggested that there may be a need for support from either hypertext design elements or in the social environment to help students develop an appropriate metacognitive awareness of their learning when using such systems.

What should designers and researchers of hypertext be careful to consider? User confusion is common because of the great degree of freedom allowed with hypertext, since decision making is under the control of the user. Marchionini (1988) states that work must be done to decrease disorientation and distraction. The scrolling interface used for the WWW makes comparison of texts difficult, with no way for users to set marks within a text (Pennell & Deane, 1994). Clibbon (1995) states that cognitive overload and disorientation limit the effectiveness of hypertext for learning. Another problem is that it is impossible to anticipate how everyone will interpret instruction (Jonassen, 1996). Hypertext alone does not encourage students to determine what is important, react to or assess what they know, or construct any personal meaning for what they study. Reader and Hammond (1997), indicate a need for structure to support active learning. Park (1991) believes that the learner control principle is not effective for hypertext instruction because the student does not have sufficient knowledge about the content and cannot make appropriate decisions. Additionally, the student may not have the metacognitive ability to accurately assess and predict his own learning progress, and the student may not have the appropriate cognitive strategies for applying his experience and knowledge in the learning process. Yang (1991) implicates that instructional designers should consider the self-regulatory

skills of the users, giving more options to those users with high self-regulatory skills. When designing the Research Buddy, it was easier to consider the literature by constructing a table with columns for the citation, the suggestions for hypertext design, and the Research Buddy design elements. Appendix C, p. 133, is a three-columned table that synthesizes the literature from the preceding literature review for the design of the Research Buddy.

Summary

My understanding of research and research instruction at the time I began my doctoral work led me to read literature in the areas of information literacy, information-seeking, mentoring, and using an on-line environment. I used information from the literature to design the Research Buddy (see Appendix C, p. 133), operating under the assumption that the Research Buddy would promote information literacy by guiding students through an information problem-solving process (in this case, *Big6*).

In order to design an on-line guide that was viable, I needed knowledge of effective strategies for information literacy and learning in an electronic environment. Literature about information literacy incorporated problem-solving and critical thinking as instructional components, which could be effectively taught in a constructivist environment. From learning theory, the Research Buddy needed to incorporate strategies such as situated cognition, metacognition, and problem-solving. Hypertext research gave guidance in screen and text design, as well as suggestions for usability and navigational features. The Research Buddy needed to provide mentoring, or opportunities for mentoring.

Hancock (1995) states that technology alone cannot change students' inquiry behavior, reform the curriculum, or change the classroom environment unless it is linked with advanced instructional strategies such as cooperative learning, critical thinking skills, guided inquiry, and thematic teaching. Technology should help incorporate the open-ended instructional goals of learning how to learn and synthesizing concepts, as Marchionini (1990) suggests. The Research Buddy was designed to offer the critical thinking skills and guided inquiry through an information problem-solving process.

In the next chapter, I describe the research site and the development of the Research Buddy.

Chapter Three

The Research Buddy at Cabin Creek

In this chapter I discuss the need for the Research Buddy, based on my experiences in a school library setting and a literature review of research about hypertext and information-seeking. I detail the development of the various features of the initial Research Buddy design and describe the formative evaluation and iterative design of the Research Buddy features. A description of the exploratory study that was the initial field trial for the Research Buddy on-line tool is included. The chapter concludes with information about the site of the exploratory and dissertation studies.

An Information Problem-Solving Situation of My Own in the School Library

It was an incredibly hectic hour in the Cabin Creek library. I had described to the class of elementary students how to locate and access the sources they needed for their research. Some students needed the instructions repeated; others brought sources to me asking, "What next?" Two more students were already on the next step of the research process, and five of them wanted to use the two computers that were available. To complicate the already crowded scene, a small group of students arrived from another classroom requesting help in finding books on weather conditions in the United States. I had begun to teach a library unit on information problem-solving, and I needed help. I needed something that could help the children extend and apply the library skills I had been teaching them, something that would reduce the queue waiting to get my expertise.

I had noticed, as have others, that children are drawn to computers whenever they have to find information, and are reluctant to look for information in several sources. Dalrymple (1991) calls it "one-stop-shopping"–the desire to find information and sources from a single access point. A study participant confirmed this point, stating, *"The Internet has everything in it" (Nitajn3/30)*. Credulity accompanies this tendency of information choice. Children seem to have more faith in what they see on the computer screen than in any other source (Breivik & Senn, 1998).

Despite the concerns I might have about children's blind faith in computer-based information, it seemed reasonable to use their interest in the computer to provide assistance and instruction for the children's library work. The Research Buddy was born when I became webmaster of Cabin Creek in 1997. Since our school possessed many networked computers, it seemed logical to make this research assistance tool available through the WWW. Having Hypertext Markup Language (HTML) authoring and Authorware development experience in my doctoral coursework, it took a year to develop the Research Buddy. My goal was to create a web site to address issues that I observed daily at work, that are articulated in the literature, and that are suggested by the AASL information literacy standards. I designed the Research Buddy to 1) give individualized attention and support for accessing information to students when I was not available; 2) provide enough time and assistance for students to do research, given the lack of flexible scheduling in the library; and 3) develop students' information literacy and the disposition for life-long learning.

The Research Buddy: Program Description

The Research Buddy, built upon the *Big6* information problem-solving process, is a web site containing over one hundred pages on the WWW. It is located on the school district's web server (Figure 3.1).

Figure 3.1: The Research Buddy Home Page.

I authored the Research Buddy using instructional design principles such as identifying an instructional goal, identifying the audience entry behaviors and characteristics, conducting an instructional analysis, and developing instructional strategies (Dick & Carey, 1990). Additionally, the content domain of information problem-solving was embedded in the actual use of that content (Heinich, 1995). I designed the Research Buddy to coach a student toward expert performance of research by providing instruction, embedded metacognitive prompts, examples of strategies and procedures, and opportunities for mentoring. I used information from a formative evaluation–where it was evident that students did not use the on-line guidance–to revise the web pages and change my procedures during the dissertation study.

For the initial design of the Research Buddy, I employed a hierarchical structure, using a program map (Figure 3.2) and an index (Figure 3.3).

Figure 3.2: Program Map Outlining the Sections of the Research Buddy.

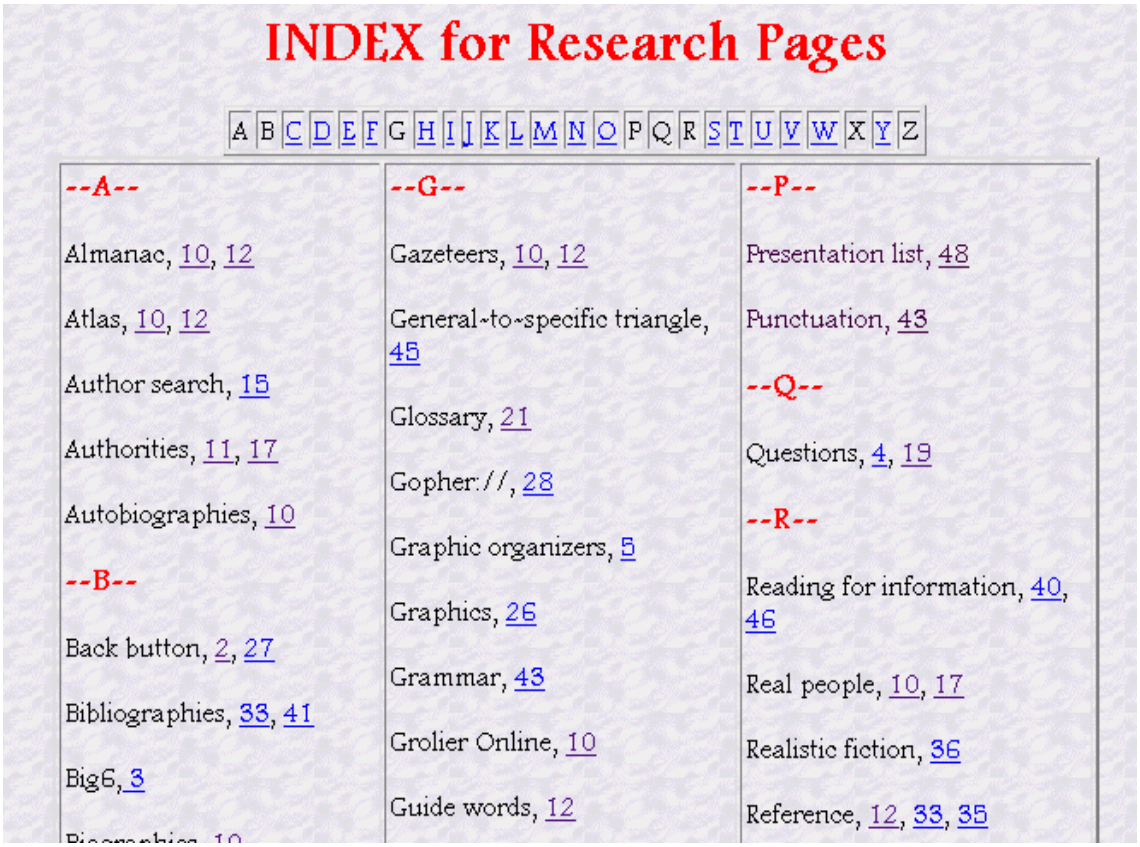


Figure 3.3: Index Page for the Research Buddy.

Pages contained links to one another as necessary. I included a help page (Figure 3.4) that included questions students typically ask me when they are using the computers to do research in the library.

Figure 3.4: Help Page of the Research Buddy.

It was important as part of the Research Buddy*'s* guidance system for students to be able to contact me with problems while using the Research Buddy, so I included an e-mail link at the bottom of each page. In addition, at the page bottoms I placed a navigation bar (a one-row table with seven columns; Figure 3.5) that included the choices of *Program Map, Big6, Research Project, Journal, Glossary, Help,* and *Index*. I kept most pages the size of one screen to eliminate scrolling. The Research Buddy incorporated large fonts to encourage reading, and color and graphics were included to create an inviting look.

Figure 3.5: Navigation Bar Appearing on Most Pages of the Research Buddy.

By design, the Research Buddy provides guidance with prompts, asking reflective questions, giving suggestions for further study, and providing content and process knowledge for information problem-solving. While designing the Research Buddy, I considered information gleaned from the literature reviewed about hypertext and information-seeking. Appendix C (p. 133) is a synthesis of the literature review that serves as an explanation for the elements included in the Research Buddy.

Formative Evaluation of the Research Buddy

I used three forms of evaluative input during the iterative development cycle (Shneiderman, 1998): expert opinion, one-to-one feedback, and small-group feedback. Before implementing the user study, experts from the library listservs, School Library Media & Network Communications (LM_NET), Big Six Approach to Information Literacy (Big6), and Kentucky Library Media Specialists (KYLMS) offered feedback and advice when I requested they view

the finished web site. Many of their comments helped me to correct grammar, typographical errors, HTML tags, and broken links. The workability of the program and validity of its content were determined from student one-to-one and small group feedback, observations, interviews, and projects. Students reported that the length and number of pages were barriers to reading, and their unfamiliarity with computers resulted in the confusion of one program for another.

In the spring of 1998 I conducted the exploratory study (more information included in Appendix C, p. 133). The purpose of the initial study was to determine what features of the web site needed modification as I studied how students used the Research Buddy. This dissertation study used a structure similar to the exploratory study, using the same age participants, setting, data collection strategies, and data analysis techniques. Besides the tendency for the three girls and one boy in the exploratory study to not use or understand the Research Buddy because of their unfamiliarity with hypertext programs, my observations of students suggested they may not have used the on-line tool simply because I was always available and willing to help. Despite these students' resistance to using the Research Buddy, they reported that the Research Buddy helped them stay organized, and three of the four student participants completed a project. This apparent contradiction implied that students' perceptions may not be in sync with their actual use or performance using the on-line support tool for research.

Given these exploratory findings, I determined that intermediate children needed other instructional activities to supplement the Research Buddy that would encourage them to use it. I considered timelines and weekly checks on journals, data charts, notes, and bibliographies as possible complementary strategies. I found, as in other studies (Hill & Hannafin, 1997; Howe, 1998; Small & Ferreira, 1994), that children did not efficiently or effectively use electronic resources without instruction. In addition, two months, which was the duration of the exploratory study, was a long time for these students, who tended to get bored and grow tired of the activity. From my experience with the exploratory study, I added the following to the dissertation study:

1) a progress chart so students could visibly track accomplishments;
2) motivation in the form of a Book Fair Buck for each completed part of the progress chart;
3) ten minutes at the end of each work session for journal writing;
4) more student instructional time on the OPAC, WWW, *SIRS*, and *Encarta* (2 months);
5) less availability of myself for questions during their work sessions on the Research Buddy;
6) an e-mail account for each student;
7) e-mail capability on school computers;
8) student research time shortened to one month.

Demographic Information About the Site

Built in 1987, Cabin Creek Elementary School is one of the newest schools in an urban Kentucky school district. Enrollment hovers around 600, including kindergarten through fifth grade students. Located in a suburban community, most of the parents of Cabin Creek are economically upwardly mobile. Among the lowest in the district, Cabin Creek's percentage of low-income, free lunch students is under 20 percent (1997-1998). Although predominantly Caucasian, there is a mix of races–African American, Hispanic, and Asian. Most of the children lived close enough to walk.

The Cabin Creek library resides in the center of the school with the gym and cafeteria located on a lower level. Student work and bright colors adorn the halls, ceilings, and classroom doors; and festive felt banners hang at several of the entrances add to the welcoming atmosphere the faculty hope to achieve at Cabin Creek. A playground with new equipment is located in the large grassy field behind the school.

Technology at Cabin Creek

Staff and parents worked together in 1994-95 to wire Cabin Creek to the Kentucky Educational Technology System (KETS) specifications, with six connections to the Local Area Network (LAN) in each classroom (Kentucky Department of Education, 1995, 1996). The server for the LAN is located in the library office. The server provides access to the library catalog (OPAC), *Encarta, SIRS Discoverer* (a magazine index with some full-text articles), *Accelerated Reader* (a reading incentive program), and includes space for student folders for files of projects and assignments. The LAN connects Cabin Creek to the district's Wide Area Network (WAN), thus connecting the school to the Internet and providing the staff with e-mail capabilities. Most classrooms have two computers with Internet access and connections to other LAN programs. The library has nine computers, with three Internet connections. Additionally, the computer lab has twenty-nine new Pentium machines. Students may use almost every computer in the school, other than the server. Several teachers restrict the use of their classroom computers, and the computer lab is busy with classes for many hours of the day. Cabin Creek employs a full-time computer resource specialist, who is also the School Technology Coordinator (STC). She manages the LAN, teaches computer skills, works to integrate technology skills into teachers' lessons, and assists with everyone's computer problems.

During the study, the district provided and installed new library automation software and a new server. This created computer havoc for a period of about a month, during which time the lab was unavailable, and the library computers frequently crashed. In addition to the myriad other duties I perform as the media specialist, I had to learn the management of this new system, and install new OPAC (On-line Public Access Computer) shortcuts on the computers throughout the school.

The school district gave each school an opportunity to create a web site. Cabin Creek's site (Figure 3.6) is designed with a large picture of the school and eleven key links, including *Hotlist* (a list of Internet resources), *Classrooms, Lunch, Meetings, Students, Search, Student Technology Leadership Program (STLP), Principal, Our School, New!* (news and activities) and *Library*. The site is a registered School Librarian Web Page (Milbury, 1999), and honored with the *Bright Site Award* from South Central Regional Technology in Education Consortium (1998). The library link on the main Cabin Creek web site connects to the library home page (Figure 3.7). Links on the library page include information about programs, policies and procedures, new items in the collection, finding information, and the Research Buddy.

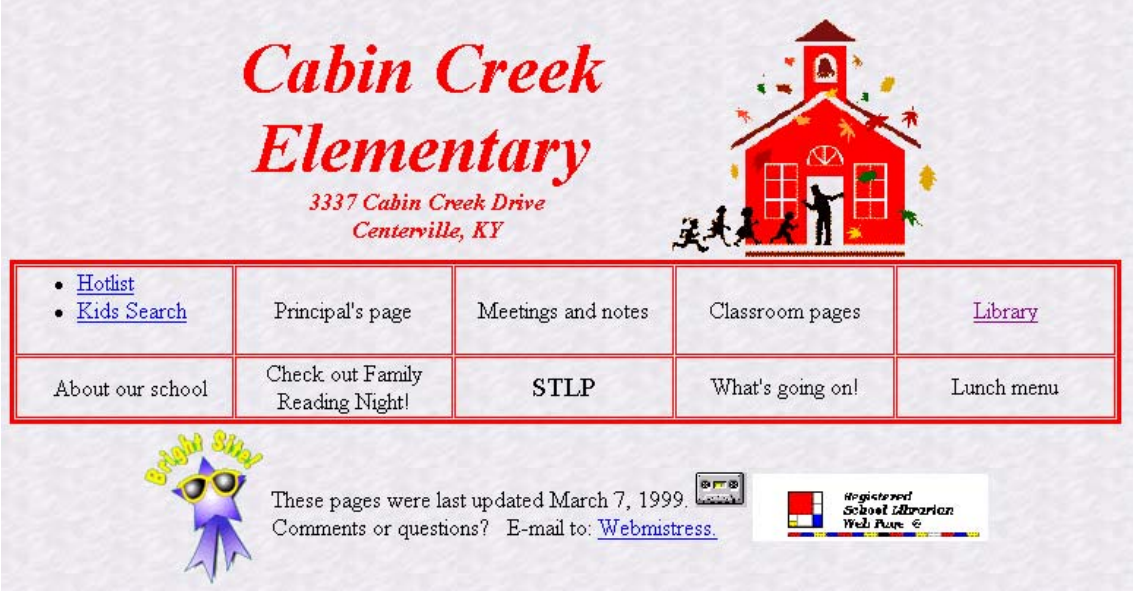


Figure 3.6: Cabin Creek Elementary School's Home Page.

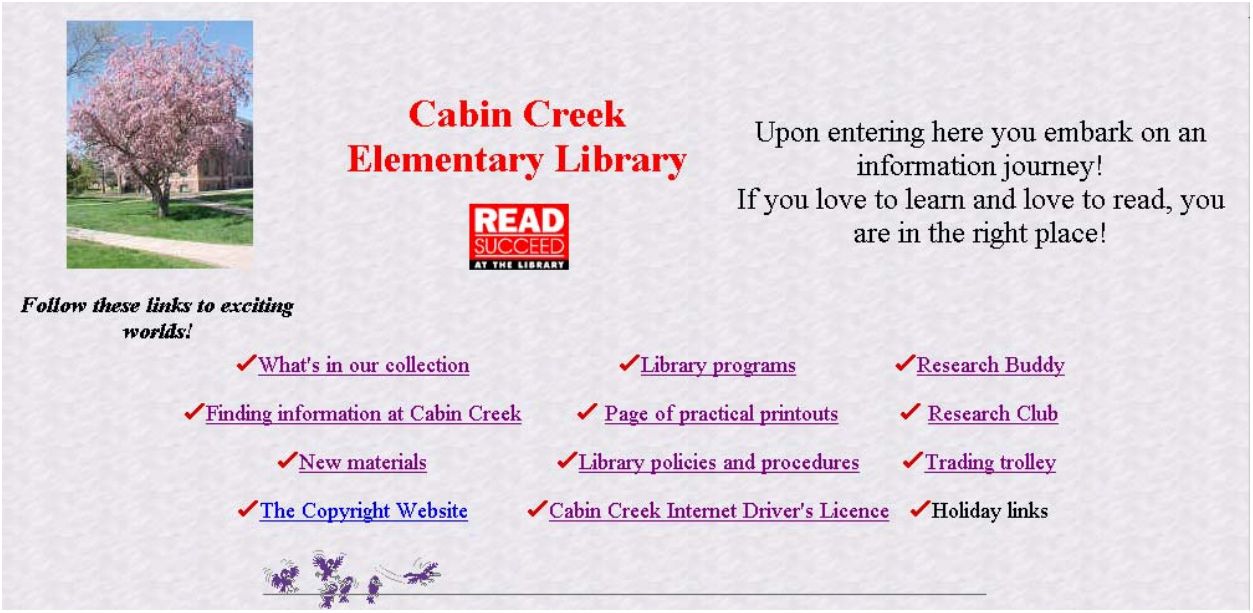


Figure 3.7: Cabin Creek Elementary Library's Home Page.

Through a library program I created called the Cabin Creek Internet Driver's License, students earn a laminated pass that allows them to use the Internet independently. To earn this license, students must study a driver's manual, have it signed by their parents, and pass a thirteen-item, multiple-choice test about Internet rules and procedures.

The Faculty and Staff

At Cabin Creek, cooperation is a key word for staff members. In my four years of working at the school, the status differences between primary aides, student teachers, practicum students, secretaries, nurses, or teachers at this school were difficult to discern. I considered it a strength of the school program that we all shared a highly professional demeanor. Affection and concern for all students was evident in our daily interactions with students. The principal acted as a true instructional leader here, supporting her staff often with encouragement and help. Chosen by the nearby university as a professional development site, there were opportunities for professional development and technology implementation in addition to those provided by the school district. The teachers ranged in experience from first-year novices to thirty-year veterans. Many of them were willing to collaborate with me to plan instructional units, although in practice it was typically difficult to find the time to do so.

Parental Involvement

The Parent Teacher Association helps to organize a large volunteer pool, and parents help in classrooms, on field trips, during lunch, and in the library. The "library moms" assist in tasks such as shelving, circulating, and processing books, filing catalogs, and helping children find materials. However, parent volunteers were not used in the data collection or as support for students in this study. Parents spend a good deal of time communicating with teachers about students' performances, problems, and successes. The staff plans activities throughout the school year to display students' work and involve parents in the life of the school. School policy is formulated and enforced by the Site Based Decision-Making Council (SBDM); two of the members are parents of children at Cabin Creek.

The Library

While I worked as the Cabin Creek librarian, it was my goal to make the library a comfortable, inviting space for children, housed with high quality print and multimedia resources. The library occupies a prominent position in the school, close to the front doors and principal's office, with classrooms all around. Large, curved walls and columns form a central circular space within the square shaped library. The white ceiling looks more like the top of a merry-go-round viewed from atop a carousel horse. Outdoors it looks like the turret of a castle. The turret dome is metal, and on rainy days the falling rain creates a pleasant, relaxing sound. The indirect lighting emanates from the center of the turret and reflects off the subtle mauve and periwinkle colored walls, adding to the enveloping architectural effect. The pink and blue banners draped around the edge of the turret proclaim, "READ" and "SUCCEED."

The furnishings are comfortable. A fish tank, soft chairs, some big cushions, a map stand, a dictionary stand, four stand-alone bookcases and the circulation desk surround the central display case and eight wooden tables with small wooden chairs. Four of the rounded walls contain indentations that create smaller, 3' x 8' bookcases, whose backgrounds serve occasionally as bulletin boards and showcases for new materials. Cozy nooks, located in the space defined by the circular center and the square perimeter each contain a particular genre of literature. The bookcase tops are inhabited by Curious George, a green dinosaur, and other furry creatures that attract the children's eyes and make the shelving areas seem more like a child's reading room than a library collection. Well-worn footpaths in the medium gray, low-pile carpet

are defined by eleven years of wear patterns that snake around the shelves, the tables, to the circulation desk and out the two doors that lead to the classroom areas.

Use of the Library at Cabin Creek

Patrons of the Cabin Creek Library are students, staff, and, on occasion, parents. Students come to the library for regularly scheduled classes focusing on information skills and research. Primary aides and student teachers bring in small groups of children for instruction. Teachers accompany their class to the library for extra times during the week to check out books or to read stories. Teachers also check out books for special themes or topics they are working on in class or to survey the new resources or books available. Individual groups of students independently come to look for information or to use the computer programs. Occasionally parents come in looking for books for their children or for personal information. In addition, parents, students, and staff use the library space for various meetings during the week, such as the PTA (Parents Teachers Association), the SBDM (Site-Based Decision Making), and pre-service teacher conferences. Along with parent volunteers, Student Library Assistants also help with library tasks. The school district provides a half-time library clerk, who is also a Cabin Creek parent. She assists in the library with circulation, cataloging, shelving, and with helping children find materials.

Figure 3.8: Map of Cabin Creek Library from the Research Buddy.

In Chapter Four, I reiterate the purpose and research questions for the study. I also describe the site and participant selection, the data collection procedures and the qualitative analytic methods used in the dissertation study.

Chapter Four

Methodology

The purpose of this dissertation is to conduct an investigation of fifth grade students' perceptions of performing research, of their actual performance using the Research Buddy on-line assistant, and to explore dimensions of mentoring related to students' use of the program. The initial impetus for the study evolved from the review of previous studies in information-seeking, mentoring, and using an on-line environment, as well as my personal experiences as a school library media specialist. Refinement of procedures and research questions for this dissertation study were distilled from the exploratory study detailed in Chapter Three.

To reiterate, the research questions addressed in this study are:

1. How do students use the Research Buddy for information problem-solving skills? Does on-line guidance occur? What human mentoring will be required?
2. Do students' perceptions of the research process differ from their actual process, and if so, how?
3. Will students report and/or demonstrate they have learned new research skills because of the Research Buddy? What might they be?
4. Do students' perceptions of the Research Buddy differ from their actual use of this tool, and if so, how?

The study used qualitative data collection and participant observation techniques to investigate the articulated questions. In the following sections, I describe the site and participant selection, the data collection forms, tools, and procedures, and conclude with the methods used to frame the qualitative analysis of these study data.

Procedures

Site Selection

The Cabin Creek Elementary School Library was both a purposive (Mendenall, et al., 1989) and convenience choice site for my study, as I was Cabin Creek's librarian. Access was not problematic; I readily got permission from the district, principal, and classroom teachers. The site also provided access to the age range of participants I wished to study and had the requisite technology and support to carry out the study design. While there are several methodological drawbacks to conducting self-site studies (discussed in detail later in this chapter), there were several advantages to using the Cabin Creek site. First, I was familiar with the library resources and the school technology. Given the numerous problems and potential technology failures that were inevitable when researching technology, my knowledge and management of the school web site enabled me to monitor the availability of on-line resources for students. I was in the library daily, providing an important element of continuity in the study, both for students and for on-

going data collection. For example, the students could come in to work on any day, giving them more opportunities to do their research. I was available to both observe and assist as needed. In addition, I knew the students relatively well, and they were familiar with me, a condition that had, again, both positive and negative aspects. On one hand, there was little need to establish relationships and contact. On the other hand, as I report later in Chapter Six, for some students, familiarity colored their ability to speak candidly about their work with the Research Buddy. In a complex, naturalistic data collection situation such as the one defined by this study, the Cabin Creek site provided, on balance, more advantages than disadvantages to carry out data collection and contextualize the analysis of actual students' work with an on-line research tool.

Selection of Participants

Student participants were volunteers. I chose fifth graders because at their developmental level, Kuhlthau (1988c) suggests that they can begin to combine information from several sources, learn a procedure for organizing information, and learn to cite sources. During the last week of January 1999, I began the self-selection process by telling the fifth grade classes about the project during their regular library instruction time. Several students asked questions, and those who were interested took home parental consent and student assent forms (Appendix D, p. 137). As they returned their forms, I announced that we would have a meeting to discuss participation in the project. Twelve girls and three boys attended three separate small-group meetings, where I carefully outlined what the study was about, and what they would be expected to do. In accordance with the University's Internal Review Board procedure, I required a parent consent form and an additional student assent form.

Of the fifteen students, two of the boys did not return, one girl dropped out in the first month of the study, and two girls did not participate in the research portion of the study, leaving ten full-study participants. The remaining group was diverse in ethnicity and range of reading levels. My initial plan was to select two or three students for an in-depth study, with at least weekly interviews and several planned observations. However, because of the students' enthusiasm, I included them all.

I called the participant volunteers the Research Club, and selected six of them as a subsample to receive more intense observation and interviews. This decision was opportunistic in that I reasoned I would be able to foreground the selected interview group data within the larger sample to check for patterns in performance and use of the Research Buddy. The subsample of six students came in for weekly interviews. The students chosen for the subsample included both genders, a diversity of ethnicities (Indian, European American, and African American), and both ways of working individually and working cooperatively.

There are possible biases introduced in self-selection, such as the possibility of attracting only one gender, socio-economic level, race, or high-achievers, or those with a strong interest in computers or reading. Students who did not like me probably would not be interested, eliminating some likely prospects. In this instance, one male volunteered, and six of the female volunteers were already involved in extracurricular activities I advised. All but one student had a computer in their home. However, the group contained a wide range of reading and achievement levels, with varied ethnicities. Self-selection also may have resulted in adding an extra-curricular atmosphere to the study, as students chose to “belong,” and I did call them the Research Club.

Forms and Data Collection Instruments

Perception questionnaires, interviews, log files, informal observations, field notes, a research agenda checklist, student journals, student projects, and student evaluations comprised the data collection instruments for this study.

Perception Questionnaire

The Perception Questionnaire is a thirty-six item checklist (yes, no, or sometimes) which was developed to investigate students' ideas about their information search process and their self-regulatory skills. This questionnaire was compiled and modified from earlier ones used by Kuhlthau, Turock, George, and Belvin (1990) and Yang (1991) in their work on information-seeking and self-regulatory skills. The modifications I made included choosing questions related to doing research, and then categorizing the questions appropriate to mentoring, information-seeking skills, information-using skills, critical thinking, and persistence. For example, in the using information skills category I used the question from Kuhlthau et al. (1990), "I take detailed notes from every source of information I look at." Also, in the using information skills category, from Yang's (1991) questionnaire I borrowed the question, "When reading, I try to connect the things I am reading about with what I already know." I used the perception questionnaire to ascertain changes in the children's perceptions of mentoring, information-seeking, and metacognitive behaviors by noting changes in students' responses from the first administration at the beginning of the study to the last administration at the completion of the study. The complete Perception Questionnaire is located in Appendix E, p. 140.

Interviews

I conducted an initial and a final interview for all ten selected participants. The six-student subsample interviewed weekly. The initial interview explored what the students understood about doing research. Interview questions focused on students' knowledge about finding information in a library, using computer resources, and using a process to do research. One of the questions I asked was, "What kind of help do you need when doing a research project?" The weekly interviews of the student subsample dealt with mentoring, research skills, and critical thinking. The final interview helped to identify changes in perceptions of doing research and using mentoring. All of the Interview protocols appear in Appendix F, p. 142.

Log Files

At the end of each session with the Research Buddy, students learned to run a log file using Secret Agent (Ariel Communications Limited, 1998) and save it to a floppy disk. The commercially available web-tracking utility logged the Research Buddy pages viewed by the students, as well as other web sites visited during the session. Computer tracking utilities have been used to triangulate qualitative data collection in studies of actual use of complex interactive computer programs (Gay & Mazur, 1993; Trumble, Gay, & Mazur, 1992; Jaynes, Mazur, & Lio, 2002). A word processor macro organized the log files, resulting in an inventory of web pages listed chronologically by time. I used the resulting logs (example shown in Appendix G, p. 143) to help make sense of comments students made in relation to their program use, and to track how much of the program students were using as well as how long they spent per page.

Student Journals

Student instructions included keeping journal and a *Big* 6 time-line. In the journal, students were to note what they did that day for the project, along with their reflections (see Appendix H, p. 144, for a scanned page of Nita's journal). The time-line was a running line at the bottom of each journal page, where students would note the date of the entry and the stage of *Big6* they were currently using in order to help me see how their project progressed. The Research Buddy included pages that provided journal-writing prompts–metacognitive reflection questions intended to help students think about their search process. Along with the prompts, I asked students to record their perceptions, ideas, and activities in their journals. Comments in a journal can often be more private, and I wanted to give students the opportunity to write things in their journal that they might not say aloud to me.

Research Notebook: Documenting Student Products and Processes

I requested that students keep their research work in a blue folder we called the "research notebook." The students chose their topics to research, and chose the way they wanted to present their information. Additionally, they could choose to author a web page, either for their own personal use or as their final presentation. All but one student chose to do a web page for their presentation. However students decided to present their information, they were asked to keep their journal, their notes, their computer diskette, pencils, printouts, or anything else related to their project in their research notebooks. From students' projects and notebooks, I could evaluate how well they followed the Synthesis and Evaluation steps of *Big6*. The format of the notebook was a pocket-folder that contained a calendar, the project guidelines (see Appendix I, p. 145), a progress chart, journal requirements, and blank journal pages. On the calendar, we wrote down appointments for library work and student interviews. The project guidelines were included to help students remember what they should have completed by a certain time, and to help them remember how to do some of the procedures.

Research Buddy Progress Chart

To help students with the organization of their projects, I gave them a Research Buddy Progress Chart to keep in their research notebooks (Appendix J, p. 147). The Progress Chart was a graphic organizer that charted assignments allowing space to the right to place a star. Students received a star for each step on the chart they finished regardless of the order in which they finished them. Each star was worth one Book Fair Buck, which students could spend at the Spring Book Fair. At the end of the project, I received five of the notebooks. Those I received aided in the evaluation their research projects and helped me to explore dimensions of their research process, for example, how the students handled note taking and task definition. I also used their progress charts to track completed activities.

Student Evaluations

After school was out in May 1999, I developed a final evaluation form (Appendix K, p. 149) to administer to the six participants who used the Research Buddy to complete a project. In part, I wanted to determine if students would say the same thing about the Research Buddy two months after their final interview. The evaluation used a Likert scale, containing statements

that helped me clarify what I had read in the data. The survey contained questions such as, "The Research Buddy helped me ask questions about my topic."

Field Notes and Observations

Because I was a participant observer during this study, I included informal observations throughout the study in my field notes directly after I returned home from school in the afternoons. Additionally, I would carry a notebook with me during the day to jot down what was happening, or note pertinent student comments. Occasionally I used a mini-tape recorder for reflections during the drive home, or to document an event that occurred during the school day. These tapes were transcribed the same day whenever possible. I used the field notes to contextualize and elaborate on data from the student interviews and journals. Using the constellation of data, I was able to articulate each student's individual progress, which I could then compare to his or her perception of their progress. Field notes also provided an anchor at the end of hectic school days. As I expected the students to do in their journals, I often asked myself questions and reflected on my own progress.

Research Agenda Checklist

In order to manage the research study, I kept a research agenda checklist (Appendix L, p. 150) for organization. This checklist helped me to track twenty of the activities the students completed. It contains such events as First Interview, OPAC lesson, and Final Interview.

The Research Process: Procedures for the Study and Activities

I conducted limited instruction with the entire fifth grade in the fall of 1998 about the *Big6* information problem-solving process. In the spring of 1999, although students could cite familiarity with *Big6*, few of them could formally use it or explain what it meant. I taught all fifth grade classes short lessons on the OPAC (On-line Public Access Catalog), *SIRS* and the Internet, but never reviewed the Research Buddy with any students except for the Research Club participants.

Prior Instruction in Use of Hypertext Tools for Study Participants

Since prior research (Jacobson et al., 1996; Jonassen as cited by McKnight et al., 1996; Rouet et al., 1996) and the exploratory Research Buddy study (described in Chapter 3) highlighted the need for hypertext literacy, the research participants were offered extensive instruction and practice on the use of the school's hypertext programs. These hypertext-based programs included the Internet, *Comptons Interactive Encyclopedia, SIRS* (an on-line magazine index), and the OPAC (On-line Public Access Catalog). During the first month, students scheduled appointments with me for instruction and then came into the library as often as possible to become familiar with the programs. I suggested at least two visits per week, and many students appeared more often. I provided each student with a manila folder containing lessons on each program. Students looked up subjects from a compiled list (such as black holes and giant pandas) to learn how to locate information in the on-line sources. They also studied the Internet Driver's License manual to learn about the WWW and Internet safety. By the middle of the second month, all but one student had taken the thirteen-item, multiple-choice Internet Driver's License test. Passing this test allowed students to use the Internet in the library without

my direct supervision. I then helped them get an e-mail account through Yahoo (an Internet subject directory and search engine, http://www.yahoo.com), and showed them how to use it to send mail to each other and to me. I kept track of students who completed these preliminary research activities with a checklist (Appendix L, p.150) and the student progress charts (Appendix J, p. 147).

During the second month, students scheduled time with me for library skills instruction and a *Big6* introduction. Some of them also opted to learn to use *Microsoft FrontPage* to author a web page. All of the first two month's instructional sessions were available one-to-one or in small groups. I encouraged small groups, to save time and encourage dialogue among the students. During the last week of the second month, students met together for a thorough introduction to the research project. At this time, I gave them directions and expectations for writing in their journal, drawing the time line, and accessing the Research Buddy.

At the beginning of the third month, students officially began their project. Since there were ten students and only four computers in the library, I hung a daily computer assignment chart on the wall by the circulation desk. The students had worked with me to develop this chart, letting me know which days and which computers they preferred. Students who felt comfortable working on computers in other classrooms scheduled for those machines.

Data Analysis

I kept track of the data on each student by using the pseudonyms they created for themselves at the beginning of the study, although I would eventually rename them as part of my analysis. Students were delighted to choose their own names, and some knew instantly what theirs would be, while others deliberated for several days. I titled computer file names for interviews by pseudonym and date, e.g., *Nita5399* would be Nita's interview on May 3, 1999. For other files, I used the pseudonym, an abbreviation for the data source, and a short date, e.g., *Nitaobs41* would be Nita's observation on April 1, and e.g., *Nitajn223* would be Nita's journal on February 23.

To assist in data analysis, I audiotaped and immediately transcribed all thirty-nine interviews into word-processed documents. I also entered observations and field notes into thirty-one pages of word-processed files, as well as the eight students' journals and eighteen log files I received. Other student documentation included cumulative folder records that contain several years of the children's school data. This data included such information as report cards, health files, reading levels, and occasional pertinent anecdotal remarks by their classroom teachers.

I began looking for patterns and developing assertions within the first month of data recording. As I listened to the tapes, I made note of puzzling student statements so I could ask for clarification during later interviews. Initially, I used codes that denoted the steps of the *Big6*. Later, I added holistic codes such as *doing research, computer experience,* and *mentoring help.*

At the completion of data collection, I created a word-processed document for each student that included their data from perception questionnaires, interviews, observations, e-mail, log files, journals, and projects. Then I used graphic organizers for assistance in assembling assertions (Miles & Huberman, 1994). Types of organizers used were tables, conceptually clustered matrixes and activity records. In one matrix (Appendix M, p. 151), I grouped student responses by first and last interview question to help me see patterns and make comparisons across cases and over time. To compare student perceptions of doing research with their actual activities, I used a two-column table (Appendix N, p. 152). On the left side of the table, I entered

data from various sources that specified perceptions, and on the right side, I placed data of actual student activities. Additionally, I could compare students' process with the amount of practice that they had on the programs before they began their own research with a 15 by 12 table (Appendix O, p. 153). In this table I entered data of students' computer experience, practice on the programs, reading level, use of the Research Buddy, project completion, journal writing, and perceptions of the Research Buddy.

Other matrixes and tables helped me to explore student perceptions of the *Research Buddy*. The tables listed such things as the Research Buddy features students thought were helpful, problematic, or had taught them new skills. I used a matrix about my involvement with mentoring (Appendix P, p. 154). Another matrix (Appendix Q, p. 155) intersected research steps when students used the Research Buddy with whether or not they completed the project and whether they thought they had learned new skills. An additional matrix (Appendix R, p. 156) looked at students' perceptions of the Research Buddy versus their actual use.

I used two activity records (Miles & Huberman, 1994), one to compile the children's collective voices about how they thought they would do a research project, and the other to collect the children's actual research activities (Appendix S, p. 157). These records were hand-drawn webs, complete with many arrows and short descriptions of steps in the research process. Comparing the webs, I saw differences between the two that provided an extra documentation of assertions I made from other types of data.

Participant's statements were edited for the dissertation following APA specifications: two ellipsis points reflected a short pause; three ellipsis points indicate omitted material within a sentence; and four points indicate omissions between two sentences. I used brackets when inserting words not attributed to the participant, and put words emphasized by the speaker in all caps. A perpendicular line in the left margin marks overlapping speech in conversation. Finally, when quoting from the children's journals, I left the words exactly as they had spelled, punctuated, and capitalized them.

Methodological Issues with Data Collection

Computer Malfunction

In qualitative research, reliability and accuracy of methods is important, and care must be taken that data not be invented, misrepresented, or carelessly recorded or analyzed (Mason, 1996). During this phase of my research, I strove to keep snippets of code identified with the correct student, and used many different ways of piecing the data together in order to make meaning from the children's voices. On March 20, 1999, as I was recording notes in my electronic researcher's journal, my computer crashed and corrupted the journal file. I had been performing back-ups of my files weekly, but it was at the end of a harried week, and I lost that week of field notes. I tried to reconstruct them as best I could, taking small comfort in the fact that most of these data were secondary, not primary sources.

Selection of Focus Group Participants

During data collection, I selected a subsample of six students from the total group of ten to study more intently with additional interviews. However, after the data collection ended, I chose to categorize the students into two different groups (Tortoises and Hares) for analysis,

conforming more closely to characteristics I noticed in the ways they performed their research and completed their projects. It was also evident that there was more data for the Tortoises, and they are discussed more extensively in the following chapters. The Tortoises included six students who interviewed more than twice and who finished their projects by using the Research Buddy.

Researcher Bias

In qualitative research, there is a concern that the natural subjectivity of the researcher will shape the research (Marshall & Rossman, 1994). The fact that I was involved in my own research process while the children were embroiled in theirs helped me gain insight into their processes and empathize with their frustrating experiences. The fact that I was an employee at Cabin Creek gave me an opportunity to know the children better than an outside observer, and gave me the ability to more ably describe the environment and context of the study. The fact that I felt strongly about the importance of information literacy and that I was the author of the Research Buddy, of course introduced biases. I strove to be aware of these and how they affected my observations and interpretation of the interviews. However, I constantly questioned my methods and the words that I used with the students, and I looked for discrepancy in the ways they were working, to find out what was different about those cases. Additionally, I checked, re-checked, coded, and re-coded the data; and I used all the different types of data collected to triangulate concepts that emerged.

Problems in Data Collection

A qualitative researcher has two research roles, that of researcher, and that of learner (Glesne & Peshkin, 1992). I made it clear to my students that I wanted them to be involved in the study so I could learn how to be a better teacher/librarian. However, I was still the teacher of their library classes, and one who could help them sometimes, and they perceived me to be an authority. Therefore, the students may not have said what was on their minds, as they would expect me to be the one talking (Glesne & Peshkin, 1992), and probably would want to please me.

Besides the worry that students would say things to please me rather than their real thoughts, the data collection process inadvertently mirrored the look of a busy classroom environment. With so many students involved, there was not enough time to follow up on their work. Without follow-up, students did not complete journals, run log files, or turn in research notebooks–subsequently not providing as rich a data source. Students also did not follow through with the research process I chose. Additionally, there were not enough library computers available, forcing students to work in other, unfamiliar classrooms. More often than not, the computers would be problematic by crashing or responding slowly.

Although I did not plan to mentor students extensively, I noted that because of the activity in the library there was actually little time to act as a mentor. Also, because of class trips, end-of-year assembles, class parties, and concerts, I conducted the final interviews before students presented their projects. In retrospect, interviewing after the presentations may have yielded valuable information. In the end, I had misjudged the logistical problems of collecting data at my own work site. However, in spite of logistical difficulties, data collected gives a rich picture of how the students worked voluntarily for many hours on research topics of their choice.

In the next two chapters, I present the findings for the study. In Chapter Five I articulate profiles of the Research Buddies–the ten students who comprised the Research Club. In Chapter Six I pose the findings related to their perceptions, performance of their research, and use of the on-line Research Buddy.

Chapter Five

The Research Buddies

The Student Research Club: Overview of the Study Participants

The following chapter is a description of the students who participated in this dissertation study. In order to promote a sense of community as well as to expedite announcements to the students, I called our group the Research Club. Once we began using that term, other fifth grade students who were not involved in the study came to me inquiring about being in the club. Fifteen volunteers returned consent and assent forms, but two boys failed to return. Thirteen students began in the preliminary, two-month long instructional activities. One student, Leigh, then dropped out within the first month, citing the mounting pressures of too many school activities. Two additional students, Carmen and Francie, stayed with much of the project, then withdrew during the researching phase, and returned for the presentation party. Thus, ten participants were involved in the complete study.

Demographic Information for Participants

One of the aspects that made this dissertation study so interesting was the fact that, even though the Research Club students were close to the same age, they were unique individuals. Though all were in fifth grade, they possessed a mixture of maturity levels, reading levels, and interests. In the following section, I describe each of the ten study participants.

Nelson.

I named Nelson after Ted Nelson, the man who coined the term hypertext, because this eleven year-old's goal in the project was to make a web page. Nelson was the sole male participant. His grades ranged from A's to C's, inviting teacher comments on his report card such as, "He needs to be more attentive... get assignments in on time... wish he would participate more." He described himself, saying, *"I did last year* [was on the honor roll], *but this year, I just got Hard Worker* [an alternative commendation list]... *I got a check at the bottom like I didn't turn in my work on time" (Nelson3/31#58).* He loved computers, had one at home, and picked up new computer techniques quickly. Nelson had asthma, and while it never seemed to cramp his style when he was roughhousing in the library, he did miss two Research Club meetings because of it. The year of the study his reading level increased from 5.2 to 7.3 (fifth grade, second month to seventh grade, third month). His mother had spoken to me about how pleased she was that he was included in the study and how excited Nelson was to be in the group.

Nita.

Nita, from the Indian name meaning "faithful," was the most dependable student in the Research Club. This was Nita's first year at Cabin Creek, having lived before in Tennessee and Wisconsin. According to her classroom teachers, she was generally eager to participate in discussion, and was a leader and good role model. Nita, born in India, had a reading level of 9.6. As she described herself, *"I get very good grades, and I'm very good in behavior.... I don't study very often... Because every time I'm not studying on the spelling test, I've gotten 100. Every time*

I'm not studying on like a science or social studies test, I've gotten a 100 or 96 or 98 or something like that, so that's why I feel I don't need to study very much." Nita, a soft-spoken child, was the most meticulous of all the research participants. She was careful to write in her journal every time she worked, to come and collect her stars, and to do exactly what she thought she was supposed to do. She was always serious in demeanor, sometimes gracing me with a fleeting smile. One of the youngest students, Nita turned ten just before the study commenced. As a well behaved, "A" student, all her teachers appreciated her. She was involved in the gifted and talented program with Carol and Julie, two other girls in the Research Club. She was always ready to help her classmates, and several times earned extra stars by teaching them some of the lessons she had already completed. Nita would often choose prizes she earned from taking tests in *Accelerated Reader* for her two little brothers instead of for herself. She was in the library more often than any other Research Club member was, even though her mother would not allow her to walk home or let me take her home. Once, her mother came in to see Nita's web site because Nita was so proud of it. Nita had been using the Internet and *FrontPage Express* on her father's office computer.

Lisa.

Lisa was the oldest child of six, had a computer at home, and was well acquainted with the Internet and chat rooms. When Lisa needed information, the computer was the first source she would consult. An average student, her reading level grew from a 3.8 to 4.3 during the year of the study. She was inattentive during library demonstrations and stories. Lisa reported that sometimes she had a hard time determining the main idea in text, and she liked to study in a quiet atmosphere. She was involved occasionally in soccer, Cabin Creek Singers, and was a library assistant. Lisa was the most reserved of the group; I had difficulty drawing her out during interviews. Thus, she became Lisa, for Mona Lisa, another female who is an enigma. A month into the study, Lisa's mother told her that she could not stay late after school any more, and Lisa resorted to coming in before school and during recess. Once she began working with Leah on a web site about friendship, she became visibly interested in the study, and asked about taking her disk home.

Leah.

Leah (a Biblical name meaning, "gazelle"–Leah was so graceful) was an only child and new at Cabin Creek during the fifth grade, making A's and B's. Her teachers thought that she talked too much and that completing work on time was a problem for her. During the year of the study, Leah's reading level increased from 6.3 to 7.2. She and Lisa, who were library assistants, decided about two weeks into the third month to collaborate on a web site. Leah had a computer at home, but no Internet connection. She told me that the previous year when she was doing a project she had to ask for help because then, she *"was not a library assistant and knew nothing about the OPAC or anything."*

Sarah.

Sarah, a Gaelic name meaning "tall," is used to describe the girl who was tall for her age and intensely interested in basketball. Sarah was a serious worker like Nita, but occasionally she spent time socializing with other students in the library rather than working. She enrolled in Cabin Creek twelve weeks after the beginning of school (October, 1998). Sarah's reading level

was fourth grade, second month (4.2), and she made average grades. Her teachers termed her a "talker," and said that she was trying to be "a hood" in that she was associating with older, unsavory students. Despite teacher comments, while Sarah worked on her project for this study, she was usually friendly and acted responsibly. Sarah was a CAP (Creative After-school Program) student, one who stayed for daily after-school childcare, so she was able to work on her project as often as she wanted. Previously she had trouble finding information, stating, *"I get confused."*

Zoe.

Zoe, a library assistant and Student Technology Leadership Program (STLP) member, was often in the library before the project began. Zoe is a Greek name meaning "life," and I chose her for the project because she was so talkative and full of life. She had a perky smile and was a good communicator. Zoe was excited to be in the project, saying, *"most of the stuff I do I'm not really so into it, but I like this."* She was the oldest eleven year-old in the study, with better than average grades and a 6.5 reading level. Cumulative folder annotations from previous teachers proclaimed, "She does not work up to potential... too social." Initially, Zoe was part of the subsample interview group, however, she did not finish her project.

Tacey.

Tacey (from the Latin word taceo meaning "quiet") was a ten-year-old girl with average grades. She had made B's in the fourth grade, and had a few C's on her fifth grade report card. Teachers commented that she was a good worker and a positive role model, although she had trouble with excessive talking. However, Tacey perceived herself as quiet. She said, *"I'm PRETTY quiet. Well, I participate and things, but I'm pretty quiet. I don't talk a lot…. I actually, well, what's that word. I focus…. Everybody's talking around me and* [the teacher] *is... telling them to be quiet. But sometimes I can talk, well, but I don't talk constantly. Like when it's time to talk, when it's a free time to talk I talk. But I focus" (Tacey4/12#94).* She indicated on her perception questionnaire that she was persistent about studying and did not give up even when the work was hard. Tacey read on a fourth grade level. In class, she was never shy about volunteering answers and opinions. She seemed honored to be included in the study. Tacey told me that she had told her mother about this project when I had first introduced it in class. Later she told her mother*, "Mom, you remember the thing with Mrs. Gibson that I told you about before that she's going to pick some students to do research? She picked me" (fn2/3)!*

Cara.

My first impression of Cara was positive. Rarely did she have a frown on her face, and she was kind to other students, often complimenting them on their work. I had initially thought she was extremely congenial, but I came to see that she was often vying for acceptance and appreciation–thus my assignation of "Cara," meaning "friend." Cara, eleven years-old at the time of the study, was larger than most other students. Her loud voice seemed to rise above a crowd despite her best efforts to blend in. Reported by her teachers to be a low-to-average student, Cara began the year with a 2.0 grade level in reading, and by the time the project began, she had climbed to a 3.6. Teachers had documented that Cara often had missing and late assignments and that she talked too much in class. Before coming to Cabin Creek, she had attended school in Chicago and another small Kentucky town. Teachers had recommended Cara for special

education in primary school, which was denied, and then teachers recommended that she be held back for another year. Cara and two siblings lived with her mother and a friend who took care of the children when her mother was working. The other Research Club students usually had rides, or I took them home after school, but Cara always walked. She began the study a little late, having stayed for only five Internet sessions. She did not have as much computer experience as the other Research Club members, as her family did not own a computer. In her March 31, 1999 journal, she wrote, *"I think that being in the Research Club is very cool and I can work on computers."*

Carol.

Carol was a petite ten-year-old whose bubbly enthusiasm made her a favorite and a leader of the fifth graders. She always had a comment or opinion to offer, but was also kind and supportive of other students' ideas. Her love of helping others was evident, as Research Club students often sought her assistance, and she graciously complied. By the end of the year, Carol was reading on a 9.1 grade level. Carol felt that she was a good, persistent student who was never in trouble except for maybe talking a little. She stated, *"There's a lot of stuff that I don't like to do, but I don't really admit it.. I just go ahead and do it... because I know it will help, but I know.. that I might not like it" (CJ3/31#103).*

As one of two of the first students to return consent and assent letters, Carol worked together with Julie on a project. I called them Carol and Julie because they reminded me so much of Carol Burnett and Julie Andrews, intelligent female entertainers who worked together well as a team, yet had their harried, unorganized moments. Carol and Julie placed in the gifted and talented program at Cabin Creek, and were both straight "A" students. They were excited about being included in the study, especially upon receiving their research notebooks.

Julie.

Quiet Julie often let Carol take the lead in talking or answering my questions, but definitely had her own ideas. She stated that she was a pretty good, persistent student, *"who will sit down and read the stuff but I don't always want to do what it tells you. I don't take, I don't do every single step. But I do most of it" (CJ3/31#97).* She had scarcely turned eleven when we began the study in January, and her reading level was a high 9.9. Both Julie and Carol had younger sisters at Cabin Creek and mothers who volunteered in the library from time to time. Julie and Carol were library assistants, although during the study, they used all their spare time on their project rather than library duties. They worked well together, with Julie's level head bringing the giddy Carol to earth when necessary. High priorities for them were getting things right and being finished on time. Once they were frantic because they had spent too much time in the library working, were late to class, and their teacher told them they could not come back any more.

Sub-Group of Interviewees From the Research Club

In Chapter Four, I explained how I chose to interview the group of ten students once at the beginning of the study and again at the end. In order to garner further insight into students' thought processes, I interviewed six of the students (Nita, Tacey, Zoe, Nelson, Carol, and Julie) two to four additional times in order to more closely follow the research process. I chose these

students for more in-depth interviewing either because of their diverse characteristics or because they were doing their research collaboratively rather than individually. Julie and Carol were doing their project together. Nelson was the lone male. Tacey was African American, and Nita was Indian. I thought Zoe would be a forthcoming informant, as she was talkative. I later decided to include Cara in the interview sub-group because she had the lowest reading level of any student and she required a good deal of face-to-face mentoring. I wanted to explore that further.

The Tortoises and the Hares: Grouping Participants for Analysis

At first, I grouped the Research Club students depending on the number of interviews they received, in order to see if additional time to talk to me as a mentor would help them with their research project. When the study was completed, it became clear that for analysis purposes, I could not compare the two groups, since the number of interviews did not appear to influence whether or not students followed a research process or finished a project. A more significant division was in the way students used the Research Buddy to complete their projects. It made more sense to look at two groups–those who essentially completed the task as assigned (do a project and use the Research Buddy) and those who did not. Thus, the two groups consisted of: 1) the students who finished their projects using the Research Buddy, and 2) the students who either did not finish their project or did not use the Research Buddy.

Because I worked with a clientele that loved stories, I thought that the story of the tortoise and the hare worked well in providing metaphors for how the students proceeded with their research work and used the Research Buddy. This grouping focused on the extent to which students went through the motions of using the Research Buddy cues and tried to apply the techniques of the *Big6*, for example. Thus, if a student log file showed a visit to the "Seed Questions" section of the Research Buddy and the student did in fact produce seed questions, those actions denoted compliance with the *Big6* procedure. I characterized students who finished their projects and used the Research Buddy (or a research process) to do it as the “Tortoises." From the story, I rephrased “slow and steady wins the race” to “working more deliberately with a plan wins the race.” On the other hand, the "Hares" were students who appeared to be on task but were in fact not using the Research Buddy as assigned. Regardless of whether or not they completed a project (two did not) the Hares did not make use of cues or directions from the Research Buddy or use any research process. The motto for the Hares was “poor planning impedes progress to the finish line.”

Table 5.1 shows the members of the Tortoises and the Hares with their participation in the beginning two months of lessons and some elements of the project. A table (Miles & Huberman, 1994) that shows student demographics with completed activities is contained in Appendix O, p. 153. Following Table 5.1, I describe the work of each student group and detail their frustrations and satisfactions.

Table 5.1: Student Participation in the Dissertation Study

	Tortoises						Hares			
Student / Activity	Nita	Tacey	Sarah	Julie	Carol	Cara	Nelson	Leah	Lisa	Zoe
Completed 50% or more of the Training Lessons*	X		X	X	X		X	X	X	X
Research Buddy Log files	5	2	0	2	2	4	2	0	0	1
Seed Questions Developed	X	X	X	X	X	X				
Seed Questions Answered	X	X		X	X					
Inquiry Evident										
Finished Project	X	X	X	X	X	X	X	X	X	

Note. Lessons did not include learning to use the Research Buddy (see Appendix O).

Profiles of the Tortoise's Work

Sarah.

Sarah finished her project accessing the Research Buddy at least twice that I observed, and she completed just two lessons at the beginning. She reported reading the Research Buddy to steps three or four of *Big6*. Basketball season and a death in the family interrupted her work at times. Sarah believed that the Research Buddy taught her about seed questions. She wrote seed questions to frame her topic, but her resulting project, a web site with four pages about the rules of basketball, did not include information that answered those questions. As a CAP student, Sarah could have visited the library often after school to work on her project, but she only came in twice. She did work in the library during recess once, just before the projects were due. Both Sarah and her mother reported that they used their home Internet connection to gather information. Sarah is a Tortoise because she reported using the Research Buddy and she finished her web site, (Figure 5.1) although she did not answer her seed questions or show other documentation of Research Buddy use.

Figure 5.1: Sarah's Home Page.

Nita.

Nita had her topic of India picked out and began working on a web page for it before we officially began the research project. She also finished more introductory lessons (twenty-two) than the other students, and helped to teach some of them. Nita was in the library the most, nearly every day. At one time, Nita was especially tired and frustrated, and I wondered if she was burning out. During the April 1, 1999 interview, when the research study was just beginning, she said*, "At the beginning I thought it was going to be a little bit fun, I still think it's a tiny bit fun now, but it's a little bit hard, too."* This occurred after she had a trying session in the library. I had set up the video camera for an observation, and among other intrusions, Cara and Sarah were working in there, chattering and asking Nita questions. The camera was obviously making her nervous, and she seemed so frustrated, she asked me, *"Do you get bored doing this?"*

Luckily, spring break intervened, and we were out of school for eleven days. When school resumed, Nita was back, working away in the library nearly every day, with no more evidence of burnout problems. I characterized Nita as a Tortoise because she consistently read and took the advice of the Research Buddy, and she finished her project. She gradually became comfortable with interviews, making more eye contact with me and saying in her April 22, 1999 journal entry, *"I'm starting to like interviews…. I think that is because I like to talk."* She did not like to do what she referred to as the *"boring stuff,"* which was reading to highlight her information and type it into the web page, writing, *"Today I found the information that I needed in my information…. I didn't have fun. This has gotten even more boring" (Nitajn4/23).* For her final journal entry of nineteen, she wrote, *"I like doing this research project a lot, especially since I'm doing a web page…. The part I didn't like was typing. The rest of it was fun. I had fun finding my information, too. I had a lot of fun."*

Investigating how Nita said she would research against how she worked through her process, I found that she performed mostly as she had said. Table 5.2 shows part of the matrix I used to compare Nita's perceptions of research with her actual research process. Information in this table shows that Nita felt she had a clear focus before coming to the library, and that she did plan to find specific information about India. It also points out that she took notes the way she stated, by printing out and rewriting. Overall, Nita followed procedures during her work much like she had done before, and her mental model, or schema of performing research changed very little.

Table 5.2: Nita's Perceptions of Research versus Actual Procedures

Help needed	
Perception questionnaire Sometimes asks the librarian for help, talks to others about her topic Sometimes talks to others who know about her topic	**Fn4/1 -** Internet unresponsive, no information in Compton's, questions on creating the web page – asks LOTS of questions, but works alone well for extended periods of time – help with FrontPage moving tables down, making links, adding photos, finding her spot. Asked parents for other ways to find topic in computer – finding a certain book, finding a certain topic, or a certain search engine.
Has a clear focus before beginning	**Jrn3/29** - What do I think I'll get out of it? I will learn about the places in India. 1. What is it that I want to know? (What is my problem?) "I want to know about the special places in India." **Int5/3#3** First.. I would figure out what I wanted to find. What information I wanted to find. And, then.. I'd go find it. And then I would.. do something with it where I could just take it somewhere, like I could print it or copy it, and take notes.
Sometimes writes down page number ## No	**Fn4/14** – writing away at a table – worried about no citations
Taking notes	
Int2/16#2 - I write down all the important stuff, not the whole sentences, but little phrases to help me remember stuff from ….or type them on a computer. I don't copy it I just write little notes.	**Jrn4-12-99** Today, I printed all of my information. It took longer than I though it would. **Jrn4-21-99** Today I found the information I needed in my information. I had a hard time figuring out which information was good and which information wasn't. I didn't have much fun today. **Fn4/26** – re-wrote some of her notes **Fn4/29** – began typing into her page directly from her articles to speed things up **Jrn4-29-99** Today I typed some things on my webpage and I put some of my information in my own words. I didn't have much fun **Int4/29#7** - I've been putting my information in my own words, and I've been typing it on the computer. **Jrn4-30-99** Today I typed, made links, and put information in my own words. I had fun today.

Nita was involved in the Student Technology Leadership Program (STLP) and had worked a little with web pages earlier that year. Her home page (Figure 5.2), *Welcome to Nita's web page!* had links to three places of interest in India, where she was born. It also included an "e-mail me!" link. Her site contained three levels of seven pages, with links that interconnected the levels. Page titles included Bombay, the Taj Mahal, and the Himalayan Mountains. At the presentation, Nita was very self-assured, and her project was the most sophisticated of the lot. Nita's project stimulated many questions from the other students, especially about the fact that she was born in India. Tacey commented, *"It looks like you put a lot of effort into it… I think if I were your teacher I'd give you an A!"*

Figure 5.2: Nita's Home Page.

Carol and Julie.

I describe Carol and Julie together, as these Tortoises worked collaboratively. They were enamored of Lucille Ball, and had decided long before we began the study to do a project about Lucy and to do it together. The girls worked together well, reading the Research Buddy together, and evaluating and inputting information. The fact that they worked cooperatively may have been a factor in their ability to complete a research project.

Their web site (Figure 5.3) included a default page that linked to an introduction, which in turn had links to six other pages: Childlife, Marriage, Children, Careers, Death, and Picture Gallery. Except for Picture Gallery, which was all pictures, each of the other pages included a picture and information about Lucille Ball. Having the Internet in both of their homes, the girls were acquainted with finding information on the WWW. They found most of their pictures from a web site discovered on the WWW. Julie had e-mailed the web master of the site for permission to use some of his pictures, and everyone was excited when she got a reply. The partners independently went to the computer teacher who helped them scan additional pictures from a book and create a file on Carol's disk.

Figure 5.3: Carol's and Julie's Home Page.

The girls were confident in their ability to find and use information, and seldom asked for help. They read the first half of the Research Buddy, creating fifteen seed questions, writing two journal entries, and organizing their information. Most of the help the collaborators requested during their project was for web-building techniques. They got so involved in downloading pictures and making new links that they had saved files everywhere, in the classrooms and the library. Carol used her computer disk most of the time to save files, but sometimes she would inadvertently save them on the computer she used at the time. Other times, she would lose the disk, frantically call her mother at home, and have to save files on the hard drive. Finally, I suggested that we go ahead and upload what they had to the central office server, and they could add changes any time they wanted to. Even on the last day of the project, they were scurrying around, looking for misplaced files.

During the presentation, Carol spoke about the web site and pointed out the features on the television screen while Julie worked at the computer, but in the questioning period, Julie joined Carol to help answer questions. The other students provided positive compliments about this project, and asked many questions about Lucy, Ricky and their children.

Cara.

Cara, compared to the other Research Club students, was at a disadvantage during the project. She made low-to-average grades in school, read below grade level, had no computer at home, and had limited computer experience, yet she finished her project. Thus, she is a Tortoise, as she doggedly continued to try to read and understand the Research Buddy, often soliciting help from other members of the club. The Research Buddy prompted her to create seed questions, write in her journal, and create a bibliography.

Cara struggled hard to do a good job on her project, a web page about lions. She was excited about being in the study, and liked to use the computers. During one of her sessions, she looked for information about lions, the *Titanic*, Prinze, and the Back Street Boys. Once she posted an e-mail to me from the Research Buddy, and said, *"I don't know what to do. What do I do next?"* Several times, it was difficult to get her on task, as she would rather talk with other students. Once I noticed she and Nelson surfing the Internet when they were supposed to be

working. Often I had to tell her step-by-step how to do her lessons, but once she understood, she willingly worked on her own. She finally downloaded a picture of a lion by herself. Cara got other information from a video about lions of the Serengeti. She and Nelson became great friends, and the weekend before her project was due, she met him at his house so he could help her finish her web page. Her one-page web page (Figure 5.4) was attractive, although some of the information on it was suspect, for example, *"How long have lions been alive? 500-700 years."*

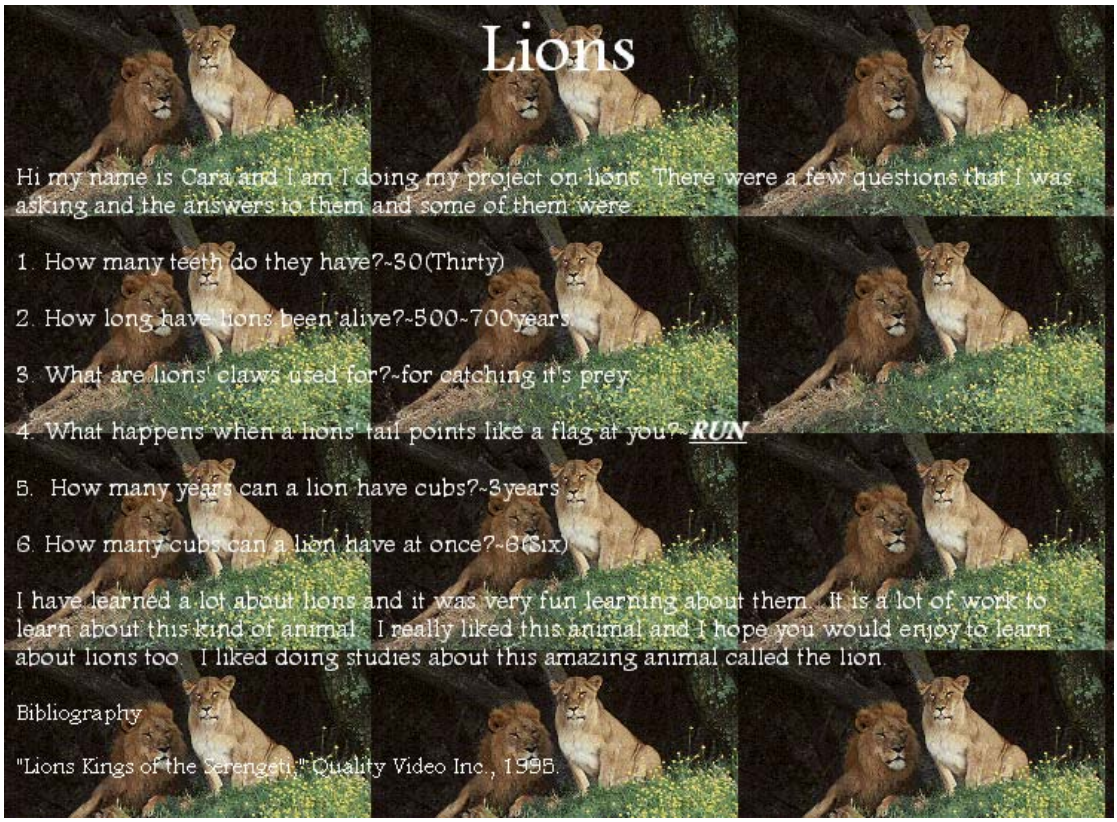


Figure 5.4: Cara's Home Page.

Tacey.

Tacey began the project nearly a month later than the other students, and completed no introductory lessons. Her family had a computer with no Internet connection. A Tortoise, Tacey at first asked for help with choosing a topic. The one other time she asked for help was when she needed a quieter place to work because it would be *"more peaceful."* As Tacey progressed methodically through her project, she was able to organize her responsibilities for the day. She summarized, *"What I did is I'd have one thing to look up like for that day, and the second day I'd have something else to look up. Like, first thing I looked up was where their habitat was. ...I printed that out and, the second day I.. think of something else, like taking care of their cubs" (Tacey5/4#30).*

Although Tacey told me she had been writing down information, and that she would *"probably look over my information and start writing down some information,"* I did not observe

her doing it. Though she had checked out books about bears, she included no material from books in her project. Her project consisted of a collection of printed-out web sites about grizzly bears, with one small paragraph of introduction that she had typed. Regardless, Tacey was very proud of her research folder, once showing me how she had it all organized, with her pictures of grizzly bears in the back pocket. She wrote in her journal four times, so I could tell what she tried to accomplish each time she used the Research Buddy. Log files indicated that Tacey accessed the first three steps of *Big6*. She may not have continued to read because she did not want to synthesize and write, even knowing that those steps would improve her work. She stated that if she had the chance to do her project over, she would, *"Probably write"* (laughs) because *"The information I got from the computer, some of it, I pasted on. And some of it I typed" (Tacey5/4#121).*

Table 5.3 shows a more in-depth comparison of the Tortoises and their work. Four of the six Tortoises formulated and followed through with seed questions, most of them attempted journaling, and all accessed at least half of the *Big6* steps in the Research Buddy. Additionally, all of the Tortoises completed a project. Table 5.4 is a comparison of the Hares' work, and is presented before the discussion about the Hares in order to easily compare it with the Tortoise profiles (Table 5.3).

Table 5.3: Profiles of Tortoise Work

Tortoises						
Student / Activity	Nita	Tacey	Sarah	Julie	Carol	Cara
Introductory lessons	22	2	7	22	19	7
Research Buddy Log files	5	2	0	2	2	4
Seed Questions Answered	X	X		X	X	
Journal Entries	19	5	0	4	5	6
Big6 Steps Accessed						
Task Definition	X	X	X	X	X	X
Information Seeking Strategies	X	X	X	X	X	X
Location and Access	X	X	X	X	X	X
Use of Information	X			X	X	X
Synthesis	X					X
Evaluation						X

Table 5.4: Profiles of Hare Work

Hares				
Student / Activity	Nelson	Lisa	Leah	Zoe
Introductory lessons	10	7	13	11
Research Buddy Log files	2	0	0	1
Seed Questions Answered	0	0	0	0
Journal Entries	1	0	1	2
Big6 Steps Accessed				
Task Definition	X		X	X
Information Seeking Strategies	X			
Location and Access	X			
Use of Information				
Synthesis				X
Evaluation				

Profiles of the Hare's Work

Nelson.

Nelson participated in the introductory lessons, although in January, his writing arm was in a cast. He was reluctant at times to do what I asked, especially during the Internet lessons, saying, *"Do we have to do that?"* He wanted to play games or go into chat rooms. During times when he was working on some of the lessons, he would procrastinate, go to the bathroom, or try to listen to me while I was talking to other students. Earning stars on the progress chart did not appear to entice him as it did some of the others. At first, Nelson was in the library often, as he was close enough to walk or get a quick ride home. Later, when he had difficulty choosing a topic, he began playing basketball after school and did not come into the library as often. Nelson did not like to read or write, saying, *"*[The journal writing is] *not very fun (Nelson4/19#20). ....I don't like writing very much,"* and, *"I don't really like to read" (Nelson4/30#65).* He never had his research notebook with him, and once he wrote a journal entry and just left it lying on the table.

Without choosing to research a topic, Nelson came into the library to work on the school tour web page that he had started for his class. I often encouraged him to read the Research Buddy, even though he saw no need to. He did read about interviews in the Research Buddy, thinking that he would interview different teachers about the history of the school and include that information along with the pictures. Nelson later stated that he had interviewed several teachers, but *"I didn't find any reason to put the teacher's interview in because I didn't really need them for how I started doing it" (Nelson4/30#14).*

He was so interested in working on web pages that he purchased *Microsoft FrontPage* for his home computer, so he could work on his project at home. The only help he requested after he decided to do the tour for his project was technical help with the computer and software. His final project included two web pages (Figure 5.5). The first page was Nelson's Web Page and it included a picture of Cabin Creek and a link to the tour. The Tour of Cabin Creek Elementary School page incorporated five pictures, which he set into tables. One column had the picture and the adjacent column had the information about the picture from Nelson's own knowledge about the school. Nelson is a Hare since he did not use the Research Buddy to complete his web site.

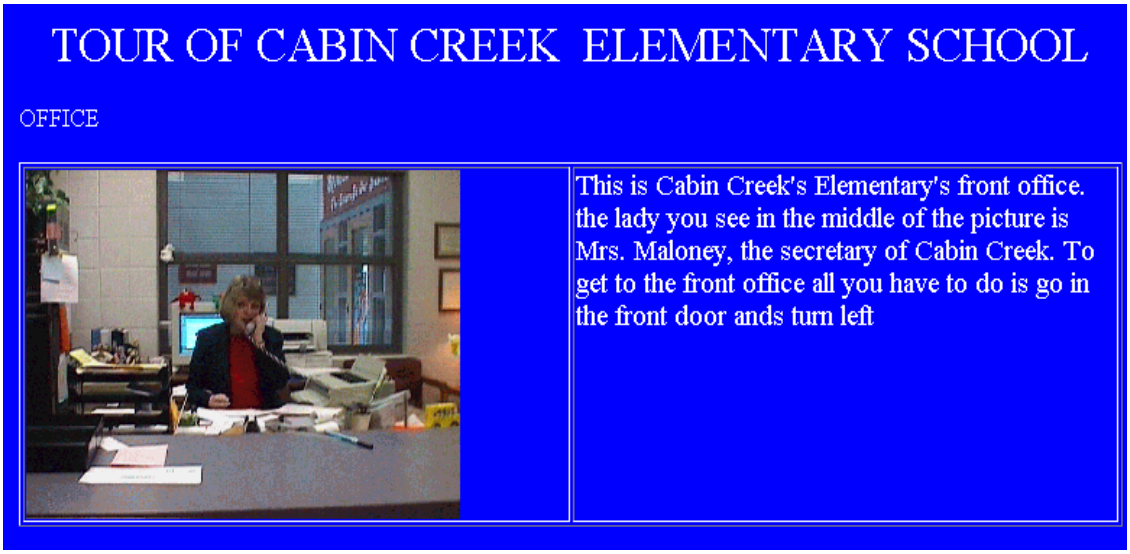


Figure 5.5: School Tour From Nelson's Project.

Leah and Lisa.

Because Leah and Lisa used no information-seeking to complete their web site about friendship, the girls are characterized as Hares. They decided to work together late in the study. Leah, an only child, had the most trouble of all during the project getting to a computer that worked. Sometimes the Internet was down, or there was no other computer available. Other times she worked next to friends with whom she enjoyed conversing. Leah did read part of the Research Buddy, and wrote in her journal, *"I think it is too long to read so I printed out some pages to take home and study because I quickly scemed through it. I will try as much as I can to get it all read."* Her final questionnaire indicated some new attitudes in researching and study habits, although she reported not using the Research Buddy to do her project. The partners obtained my help with the software, but they did not use the Research Buddy.

Lisa reported having good study habits and being persistent on her questionnaire. However, she tried to find information about tornadoes at first, with Nita helping her, but Lisa abandoned that topic. Lisa's and Leah's web site (Figure 5.6) was a home page with links to three other pages about caring for friends, meeting friends, and how to treat friends. They appeared to have a good time experimenting with different backgrounds and writing the text, but Lisa said if she had to do her project over she would do it by herself because *"*[We] *can't agree on a background... I probably wouldn't put our pictures in it" (Lisa5/3#67).* In this instance, working cooperatively had no impact on helping the girls stay focused on the requirements of the research project.

Figure 5.6: Leah's and Lisa's Home Page.

Zoe.

Zoe completed eleven introductory lessons, but missed the introductory meeting because of illness. She at first chose bears for a topic, but then switched to dogs, checking out some books and locating some web sites. During interviews, Zoe always acted enthusiastic and in control of her project. She wrote in her journal twice, and ran no log files for her Research Buddy use.

During interviews, Zoe reported reading about Task Definition, and later told me information that steps five and six contained. She answered the questions in her journal about Information Seeking Strategies. However, the Research Buddy did not appear to direct her into writing seed questions or evaluating her work. Zoe began a web site with links to ten pages, but by the presentation party, only one page included information. The pages contained different backgrounds and titles, and each link back to the home page worked. Perhaps she was too ambitious or was having too much fun with the technology, and ran out of time. Previous teachers had indicated that she did not work up to her potential. On the page where Zoe had written information, it appeared to come from her own knowledge of dogs, rather than informational sources. Zoe is a Hare, as she did not complete her project (Figure 5.7).

Figure 5.7: Zoe's Home Page.

Table 5.4 (see page 55) shows that the Hares used no seed questions, turned in very few journal entries, and accessed little of the Research Buddy. The data from Tables 5.3 and 5.4 highlight the importance of beginning with a focus and with questions when engaging in research work. Data also shows that journaling may have enhanced students' abilities to think about and complete research projects, as the Tortoises had thirty-five more daily entries than the Hares did. Nelson was the only Hare with whom I discussed a topic, and then he chose not to do a research project. Lisa, Leah, and Zoe decided on a topic late in the study. Zoe ran out of time, and Lisa and Leah did not opt to do a research project.

The following table (Table 5.5) displays an overview of the data collected from students, including components of the project, such as timelines and bibliographies. The table lists number of journal entries, log files, interviews, star charts, and perception questionnaires completed by each student, and gives an idea of how diligently each student tried to comply with the research process outlined in the Research Buddy.

Table 5.5: Student Data Sources

Data Sources	Nita	Cara	Carol/Julie	Tacey	Nelson	Sarah	Lisa/Leah	Zoe
Journal entries	19	6	5/4	5	1	0	0/1	2
Seed questions	Yes	Yes	Yes	Yes	No	Yes	No	No
Bibliography with 4 sources	Yes	No	No	No	No	No	No	No
Project	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Project Notebook	Yes	No	Yes	Yes	No	No	No	No
Log files	5	4	2/2	2	2	0	0/0	1
Interviews	5	3	5/6	4	6	2	2/2	4
Timeline	Yes	No	No	No	No	No	No	No
Page explaining how students used information to create their projects	No	No	No/ No	No	No	No	Yes /No	No
Oral presentation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Star Chart Stars Earned	62	27	60/ 54	14	29	11	13/ 21	40
Perception Questionnaires	2	2	2	2	2	2	2	2
Final Survey	Yes	Yes	Yes/ Yes	No	No	Yes	No	No
E-mail	Yes	Yes	Yes/ No	No	No	No	No	No

In the following chapter, the Research Club students' voices are used as I report and analyze what they were thinking and doing as they worked through a research process with on-line assistance and occasional adult mentoring. The initial research questions are addressed, and I introduce additional findings and conclusions by telling the children's research stories using their voices.

Chapter Six

Findings

In order to discuss findings, I begin first with an overview of the Research Club students' activities. Second, I highlight a primary finding by analyzing a poem assembled from student remarks during the interviews, and by presenting Activity Records. Third, I present some problems that are inherent in a self-selected sample with an active participant observer (Wolcott, 1988), and finally, I discuss other findings related to the students' use of the Research Buddy.

Overview of the Research Club Activities

At the beginning of the project, I spoke with students about the study and what they would be required to do. They were to complete a research project about anything they were interested in studying. The students all received a notebook in which they were to keep their journal, timeline, computer log, notes, and computer disk. I also gave them a paper outlining the participation requirements (see Appendix J, p. 147). Along with creating a project, I asked the students to complete a bibliography with at least four different sources. Additionally, if they did not write a paper for the presentation, they were to write one page explaining how they used information to create their project. Students were to do self-evaluation of their projects, but for my own analysis, I set up a rubric and evaluated the projects numerically (unbeknownst to students). Those projects including all required components earned up to fifty points.

Poetic Analysis

For analysis purposes (Coffey & Atkinson, 1996), I used poetry to condense student voices about research. In the initial interviews, I asked students to take me step-by-step through the way they would do a research project, and all of them listed several steps that were similar to my idea of a research project. However, in the midst of the study, Nita noted that reading and typing were not really research, but a research *project*. To clarify students' perceptions, I authored the following poem by rearranging responses of Research Club students to the question, "What do you think it means to do research?" Constructing this poem had an analytical outcome. I found it was clear that to the children, research was the information search only.

The Children's Story of Research

Research is to like, look up something
you're going to the library to look up, if there was a topic or a subject
you're looking up that specific thing
an animal or a person, I think that's what research is.
Look something up
researching something on a topic
to find something out about a topic
it means looking for information and finding it
to search for information about something
looking up things like in other places.
Where you find information in different sources, about a certain topic or thing, or person
in the dictionary or on the Internet or do something like that
on a resource like a computer or in a book to find information
to look into books and find more information about stuff that you need to
to find stuff about your topic and what it's about.
To learn, to present, and to work
to do work, to figure something out.
when somebody finds information.
What you are finding information about, where you will find it, why you have to have it, and how you are going to find it
and then find what you need to know about
you'll find everything right where you needed.
I thought research like was boring, and,
it's funner now
a little funner now
because we know how, and we know how to organize it
and so, we're not all messed up and we get it done quicker, easier.
We got to choose what one we want to do, and our interest, and usually when you get one you don't get to choose something that's fun.
Research means trying to find out what something is
when you start researching you don't really know what to look for first.

Students frequently spoke of research as being a search for something specific. They described the searching process as *"looking up something," "a certain topic," "about something," "about stuff that you need."* They seldom mentioned the questioning or thinking involved in research. The exceptions–*"to figure something out,"* and *"why you have to have it"*–focus attention on the need to think about what one looks for and integrate it into one's own experience, approaches which are more in line with authentic inquiry.

In their responses to the previous question, the children did not use the word *write*, although they mentioned *find* thirteen times, and *look* eight times. Regardless of what they had read of the Research Buddy, students never felt that the term research meant asking questions, taking notes, writing, thinking about, or evaluating their work. Nita thought the note-taking and writing activities constituted a research *project*, not *research*. Students' initial ideas about doing a

research project did include such things as Tacey's *"taking notes on a sloppy copy,"* having someone *"correct it for punctuation and good spelling,"* and writing a *"final copy very neatly."* Thus, it was evident that students associated those elements of research with the product rather than the process. No student suggested that a research project should begin with questions, and no one voiced the term *inquiry*. A total count of words from all interview questions (see Appendix F, p. 142) showed that the word *write* was cited 93 times, and *question* noted 58 times. *Look* and *find* were mentioned 164 and 163 times respectively. Still, the emphasis seemed to be on the "hunt" aspect of the research process, rather than questioning or synthesizing.

The poem's most telling statement is the last one, *"when you start researching you don't really know what to look for first."* In disciplined inquiry, the beginning question gives structure to the research. In information problem-solving, Task Definition helps researchers clarify their undertaking and decide on a plan. Both defining a task and formulating a question depend on background knowledge, which may involve a fair amount of exploratory reading beforehand. The differences between the Tortoise's and Hare's projects appeared to be a result of the way they began their work, and of their incoming mental models of research. Those who began with a clearer sense of purpose by learning to use seed questions during Task Definition did more work and were able to finish a project, whether or not they answered their initial questions. (Cara asked me if it was cheating to create new questions as she read.) Students whose models of research were more teacher-dependent or teacher-controlled had difficulty beginning and working through the research process. Background reading may not have been a part of their mental models.

Another analysis, the Activity Record (Figures 6.1 and 6.2), supports the assertion I gleaned from the poem, that it is important for students to learn how to focus on their information needs and delineate questions at the beginning of the research process. Because the Tortoises finished projects, I used their perceptions to draw the Activity Records. Viewed together, the Activity Records clearly show an increase of activity at the beginning of the process on the second record (Figure 6.2). Before beginning the project, Tortoises reported using few activities and strategies at the beginning of a research process, such as "get a topic," "brainstorm," and "what to find out" (Figure 6.1). Figure 6.2, a picture of the Tortoise perspectives of doing research at the end of the project, shows twice as many strategies in beginning a project. The Tortoises expand their schemas of beginning research by adding "think about it," "choose best topic," "make seed questions," "use key words," and ask "does information answer questions?" Additionally, the second Activity Record shows more use of strategies for organizing and using information during the middle of the process, such as "facts not opinions," "put in data chart," and "highlight information." With the use of the Research Buddy these students learned to spend more time on the beginning research strategies, such as devising questions, using keywords, categorizing what to look up, and thinking more about the topic before proceeding.

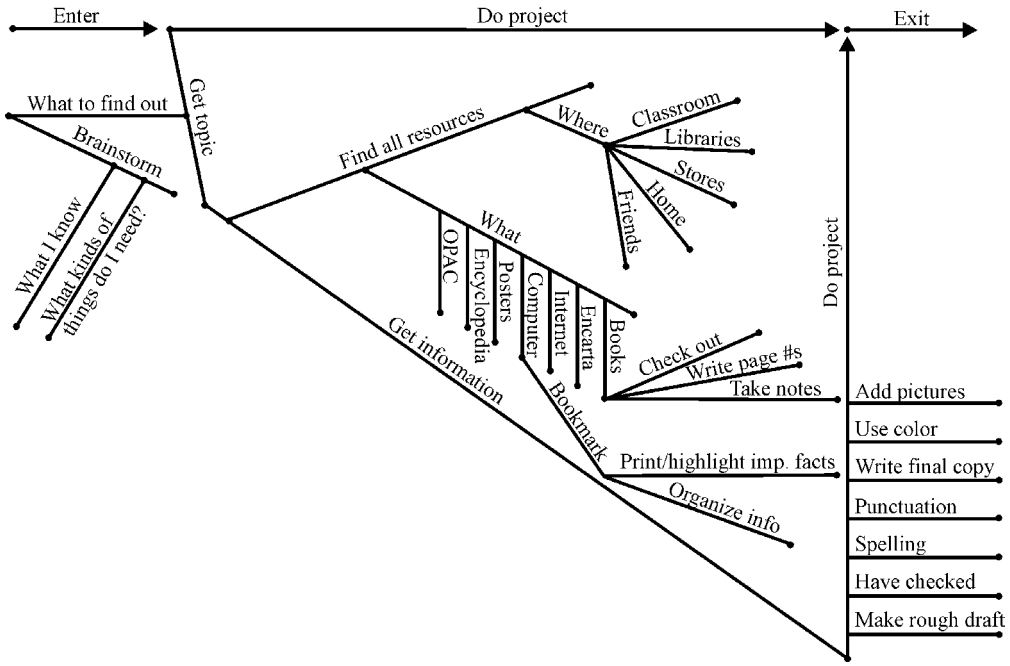


Figure 6.1: How Tacey, Nita, Cara, Sarah, Carol, and Julie Would Have Done a Research Project.

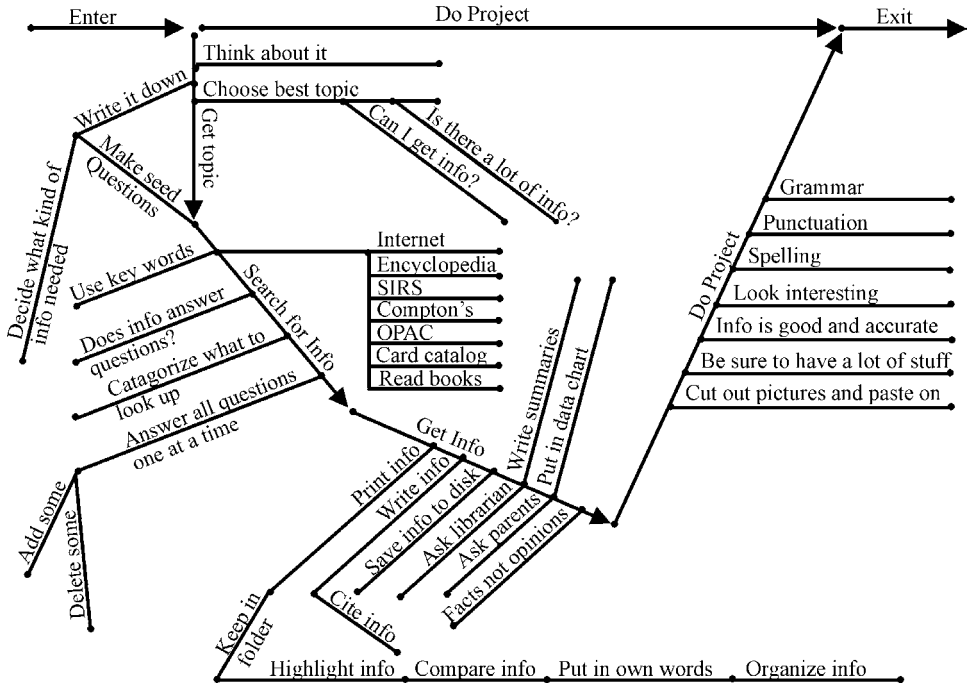


Figure 6.2: How Tacey, Nita, Cara, Sarah, Carol, and Julie Did Their Projects.

Self-Selected Sample and Student Motivation

Any discussion of the findings must be framed by an understanding of the students' purposes for participating in a study that consumed a good deal of their free time over a three-month period. Several of the students appeared simply to want to please me. Cara wrote in her journal on March 26, 1999, *"I like doing this project just to help Mrs. Gibson."* Nita wrote that she was doing the project *"so that Mrs. Gibson can write her paper about what 5th Graders think about the* Research Buddy*, and so that I can learn more."* Several students spent a good deal of time in the library in any case, and this project appealed to them as an opportunity to further participate in library-related activity. Tacey was reportedly happy to be chosen and was particularly excited about choosing her own course of study. For several, the notion of belonging to a club (the Research Club) was exciting. They enjoyed getting research notebooks that they could decorate. Others found the idea of presenting their projects appealing. Zoe wrote, *"We are getting to present this in front of some people and are going to have a pizza party"* and added that she wanted *"to know about bears" (Zoejn3/31).* This latter response, to learn something new, was also a motivator. As Julie noted, *"We got to choose what one* [topic] *we want to do, and our interest, and usually when you get one you don't get to choose something that's fun" (CJ5/3#18).*

Students' Use of the Research Buddy

Conflicting Mental Models

For this study, it is important to understand my view of an "appropriate" use of the Research Buddy, which was quite different from the students' views. Because I strongly believe that information literacy is vital to help obtain life skills and solve problems, I try to teach students the necessary skills to become informationally literate. To do this in a real-world way, students need to use those skills to solve information problems. According to the number of members in the *Big6* Listserv (see http://ericir.syr.edu/Virtual/Listserv_Archives/Big6.shtml for the archives), many teachers do this by guiding their students through a step-by-step research process, such as the *Big6*. With limited time for providing guidance, I designed and depended on the Research Buddy to help students work through a research project. My assumption was that the students would independently read the Research Buddy and take its suggestions to heart.

Drawing from my knowledge about the research process, my idea of an "appropriate" use of the Research Buddy would foster four goals. First, students would read the Research Buddy to learn how to perform elements of research such as devising questions, narrowing topics, searching the OPAC, and taking notes. Second, students would continue reading and re-reading the Research Buddy as they worked on their projects, being sure to complete each step of the *Big6* in order to complete a research process. Third, students would answer the questions posed by the Research Buddy in their research journals in order to help them think about their work–to interact with themselves as they reflected on their own understanding (Wells & Chang-Wells, 1992). Fourth, students would be able to contact me for mentoring through e-mail links contained throughout the Research Buddy*'s* pages. The students' differing view of the research process precluded their use of the Research Buddy, and they did not access most of it. Nita alone completed all the journal questions, and only Cara contacted me through e-mail. Perhaps by thinking they already knew how to do research, the Research Buddy was an unnecessary, cumbersome step that they felt confident to omit.

Additionally, the students' impression of reading was much different from mine. They would read one of the web pages once, and state, *"I read that section,"* whereas I intended "reading" to also include re-reading, reflecting, and synthesizing the material. Contrary to my assumptions, I observed that students did not read the Research Buddy or follow its tenets. I considered that no amount of incentives, encouragement, or prompting would entice the children to learn what I wanted them to learn because one vital thing was missing. The content and context were in place; but an important part of the context for knowledge construction is other people (Winn, 1998). The social negotiation inherent in inquiry teaching was not strong; it did not include time for mentoring, sharing, discussion, or debate.

Without the social interaction, then, students may not have used the Research Buddy due to lack of motivation or self-regulation. Stars and Book Fair Bucks were not motivating to everyone. Standard six of the information literacy standards (AASL & AECT, 1998) stresses the importance of self-regulation, as students strive for excellence in information-seeking and knowledge generation. The Kentucky Benchmarks (2000) for Standard six include questions prompting students to self-regulate, some of which were included in the Research Buddy. Eom and Reiser (2000) found that research suggests self-regulatory skills may affect learning from learner-controlled instruction. According to responses the Research Club students marked on their perception questionnaires, they did need prompts to help them remember to use self-regulation strategies. However, other reasons for non-use of the Research Buddy could just as well have been in the design of the Research Buddy.

As I considered student comments, and noted what parts of the Research Buddy students accessed by their log files (see Appendix G, p. 143), I could see places where Research Buddy needed improvement. For example, the example log file in Appendix G shows that Carol and Julie went directly to the fourth step, Use of Information, and read the seven pages of the Reading for Information section, but they did not return to read the second part of Use of Information, which is Evaluating Information. I discovered that on the last page of the Reading for Information section, there was no direct link back to the beginning of the Use of Information Step. Additionally, information in the Task Definition section did not flow sequentially, so students who read in a linear manner, using the Next and Back buttons, missed pages about question formulation and narrowing a topic. The Task Definition information was included instead as embedded hypertext links, which students chose not to follow. Furthermore, there were only a few pages devoted to the vital processes of formulating questions and narrowing a topic.

The lack of interactive features and feedback in the Research Buddy may have also been a reason for non-use. The addition of information literacy questions, puzzles, or quizzes at regular intervals would allow users to click on choices for answers and obtain immediate feedback. The use of forms with radio buttons or check boxes could supply information and be immediately e-mailed to me at the click of a "submit" button. That way I could respond to students through e-mail or through face-to-face communication, providing feedback, mentoring, and confrontation (suggested by Striping, 1995) from a "live" body.

Few of the students remembered using (or even seeing) the navigation bar at the end of each *Big6* section. This oversight is another indication that students did not read all of each section, and log files indicated one minute or less access time on most pages. Although the Research Club students had two months to learn to use the hypertext-based programs at school, they were not yet hypertext-literate learners. Jonassen (cited by McKnight et al., 1996, p. 629) defines hypertext-literate learners as those who have “developed a useful set of strategies for

navigating and integrating information from hypertext." In this case, the use of a frame or shared border with a stationary navigation area could have been helpful, so students could feel embedded in one place on the Internet. When I asked Tacey if she had learned any new skills because of the Research Buddy, she told me all about the grizzly bear's habitat, thinking she had read about it in the Research Buddy. Leah thought the school OPAC was the Internet. *"I would probably use, if I was looking for a book, I would use the Internet and go on OPAC and find that,"* she stated.

Assuredly, the children's mental models differed with mine. Their ideas of research and reading were less inclusive than were mine, and they were not yet high self-regulators. The study was not designed to include social negotiation, and the Research Buddy did need some improvement in this area as in others.

General Patterns of Research Buddy Use

This section will provide information on general patterns of use of the Research Buddy based on computer log files, interviews, and observation data. Evidence from log files revealed which features of the Research Buddy were accessed by students and the amount of times students visited these features (Table 6.1). Examining the log files alone, I found that five of the six Tortoises and two of the four Hares used the Research Buddy at least once. Including information from interviews, observations, and self-reporting, I can document that all six of the Tortoises and three of the four Hares used the Research Buddy. Table 6.1 shows that Carol, Julie, Cara, Tacey, Nita, Nelson, and Zoe were to some extent trying to follow the precepts of the study by running log files after their sessions with the Research Buddy. The log files show that the parts of the Research Buddy dealing with the first four steps of *Big6* were accessed most often. As the data show, the Hares accessed progressively less and less after the journal pages, and the Tortoises accessed less after the Use of Information step. It is curious to note that the two Hares accessed the journal pages more times than the Tortoises, yet wrote fewer journal entries. Most of the pages listed in Table 6.1 were accessed less than a minute on average, not really long enough to read and reflect upon the information written there. While disappointing to me as author of the Research Buddy, these patterns of use unfortunately echo findings from Wallace and Kupperman (1997), that sixth-grade students want to complete tasks quickly, spending an average of 48 seconds per page (Hirsh, 1999). Altogether, the Research Club students accessed less than one-third of the available Research Buddy content.

Table 6.1: Log File Data for Average Access Time and Number of Hits per Page of Research Buddy

Page Title	Tortoise # Hits	Hare # Hits	Access Time Average (seconds)	Page Title	Tortoise # Hits	Hare # Hits	Access Time Average (seconds)
Program map	0	1	17	Journal p.5	3	2	269
Big6 p.1	11	5	16	Information search p.1	10	2	86
Big6 p.2	11	5	23	Information search p.2	9	2	65
Task definition p.1	10	5	60	Information search p.3	7	1	79
Task definition p.2	10	5	126	List of resources	5	0	41
Task definition p.3	10	4	80	Location & access p.1	9	1	24
Brainstorming p.1	3	2	22	Location & access p.2	7	1	27
Brainstorming p.2	3	2	4	Location & access p.3	9	1	20
Brainstorming p.3	3	1	2	Use of information p.1	9	1	23
Brainstorming p.4	2	0	20	Use of information p.2	9	1	165
Journal p.1	2	3	55	Use of information p.3	6	1	28
Journal p.2	2	3	10	Data chart	1	0	600
Journal p.3	2	3	8	Reading for information pp.1-6	1	0	4
Journal p.4	4	4	130	Synthesis p.1	2	0	2

Note. Data includes log files from five Tortoises and two Hares. Shaded areas are pages dealing with *Big6* steps.

My analysis of log files along with observation and student self-reporting led to seven assertions: 1) students did not think research was information problem solving; 2) Task Definition was a new skill; 3) students tended to combine the second and third steps of the *Big6*; 4) students thought the Research Buddy helped with organization; 5) students thought the

Research Buddy helped with bibliographies, but did not use the evaluation step; 6) students were apprehensive about reading the Research Buddy; and 7) often students felt there was no need for the Research Buddy. In the following section each of the seven assertions appears as a subheading. Within each subheading, I elaborate on the particular assertion as a detail of the overall patterns of use for the Research Buddy, and relate it to specific activities of students' work on their projects with me or with each other. The last subheading in this section is about the possibility of future use of the Research Buddy by the Research Club.

Research is not information problem-solving.

The students brought a set of expectations about school research into their engagement with the Research Buddy. Gagné et al. (1992) state that learning is greatly influenced by material that has been previously learned and stored in memory. Largely, the students knew what they were "supposed" to say about doing research: find a topic, find information, take notes, and write it up. As Nelson explained, research involved trying *"to do what the teacher said to do"* and *"writing down notes on a piece of paper and then I'd put it on my project and, in my own words, and in a longer form."* Leah described her process, *"First I would have to know what I was researching. Then I would go to the library or go downstairs to my computer and look on the Internet or in the dictionary. Then I would write down my information, or copy it off of the computer and put it in my own words. And then, turn it in."* Indeed, as students mapped out how they would conduct a research project, it became clear that they did not really conceive of research as answering questions so much as following a formula for finding facts and reporting them in their own words. Thus, Sarah discusses writing down *"all my information"* and *"then I'd head it with the book name. And then I'd put my name on the bottom, and then the date. And then… I'd change it into my own words."* Zoe added that one of the elements of writing the facts in your own words was *"finding… some kind of poster board or do a book report, and, then present it."*

Thus, while there is little evidence in the students' responses that previous research assignments in school had prepared them to organize their work around compelling questions, there are traces of procedural instructions. However, most of the students could decide if a fact was pertinent, or if they had enough information, so perhaps they had questions in mind. Students had learned to *"summarize or highlight"* what is important, *"get on the computer and look up what I'm researching about,"* and *"if I didn't have enough* [information]*, just go back and get some more."* This conception of "school research" remained powerful throughout the project and may have gotten in the way of students participating in the kind of sustained, disciplined inquiry described by Levstik and Barton (1997) and Levstik and Smith (1996), and assumed by the Research Buddy. Interesting, too, the finding that students could recite these procedures but did not necessarily follow them. For instance, late in the study Nelson provided an extensive explanation of how to conduct research:

> First I would go to the library, and then I would go to the OPAC. And look up, and try to find the book… that subject, and, if I couldn't, if I got all the information out of the book and I needed more I'd get on the Internet, and if I got all I needed there, I would go to *Compton's Interactive Encyclopedia* (Nelson2/8#11)…. I would get my information and write down notes on a piece of paper and then I'd put it on my project and, in my own words, and in a longer form (#27).

Despite reciting these procedures, however, I never observed Nelson using them. He did not formulate a research topic or search for information, although his log files indicated that he did access the sections of the Research Buddy that dealt with these issues. Lisa, Leah, and Zoe (the other Hares) echoed this pattern. All four students mentioned that they should write down notes, yet none of them did. All but Nelson mentioned writing a paper, but again, none did. Some of them mentioned checking out books, but only Zoe did. Neither did the Hares formulate seed questions about their topics. Overall, then, this group of students used the Research Buddy very little, if at all, during the study. For those Hares who completed a project, it appeared as though their information came from their prior knowledge about a topic. Nelson described what he knew about Cabin Creek, and Leah and Lisa wrote about their notions of friendship. It is possible that those students followed a research process without using the Research Buddy, but the projects do not show evidence of such work.

The Tortoises, who did use seed questions, mostly used the Research Buddy to support their initial mental models of research, ignoring those steps that did not fit their conceptions of the process. In her interviews, Tacey described how she would do research, *"I get a pencil and paper then I go through books and the computer and find out some information about it" (Tacey3/10#6).* In her journal, Tacey wrote out her answers to the Research Buddy*'s* questions for Task Definition, and then used the questions to organize the way she did her search. After this initial use of the Research Buddy, Tacey did not continue to use it for other parts of the research process. She did not mention synthesizing or evaluating her work as a part of research (suggested in steps five and six in the Research Buddy). Tacey filled her notebook with printouts from the Internet, but included no evidence of synthesis in her own writing. However, Tacey packed her presentation with facts and enthusiasm for her topic. As she turned the pages of her folder for the audience, she related many things that she had learned about grizzly bears, showing that some synthesis had occurred.

Combing data from log files, observations, and interviews I could infer that students did not equate research with the total set of skills that librarians typically term "information problem-solving." According to log files (Table 6.1, p. 69) or self-reporting, all six Tortoises accessed pages of the Research Buddy, and five of them turned in log files. Three of the four Hares reported Research Buddy use, and two turned in log files. Like the Hares, four of the Tortoises also said they would take notes and two did not. However, I observed that two other Tortoises printed information from the computers, and one of them then highlighted or reworded that information directly into their projects.

The most striking difference in the way that the Tortoises and the Hares used the program was how they worked with their topics by using seed questions. For example, Tacey, a Tortoise, organized her search for information each day by seed question. On Monday, she would look for what grizzly bears ate. Tuesday, she would research their habitat. Julie and Carol used seed questions to organize the format of their web site. They had a page for Lucille Ball's children, and one for her death that related to their specific seed questions for those topics. Overall, the Tortoise's use of on-line assistance paralleled their impoverished mental models of school research; they used the Research Buddy mostly for the first four steps of the *Big6*. Task Definition coincided with the students' model of *"getting a topic."* Information Search Strategies and Location and Access corresponded with *"find information,"* and Use of Information was interpreted by the students as their idea of *"writing it up"* (Table 6.2, p. 73).

Except for Zoe, the Hares did not formulate seed questions, or use the Research Buddy as much as the Tortoises. It was difficult to determine what parts of the Research Buddy the Hares accessed, as they turned in so few log files, were observed less, and self-reported less use of the Research Buddy. I discovered more about the Hares, Zoe and Nelson, because they had more interviews than did Lisa and Leah. I found that Zoe's questions about bears were fact-based ones, as were the Tortoises. However, her final, unfinished project was about dogs. Zoe self-reported that she had taken notes, written in her journal, and read the Research Buddy, but did not turn in notes and could not tell me about parts of the Research Buddy she had read. She had definite ideas about how she would organize her information and decide when she had enough. Zoe turned in one session of log files and Nelson turned in two. Nelson accessed twenty-three pages of the Research Buddy and showed me a list of interview questions that he planned to use with the Cabin Creek teachers to garner historical information about the school. He later reported that he had interviewed three teachers, but he decided not to use that information in his project. He read about bibliographies and could tell me what they were, but did not need to write one. Neither Leah nor Lisa turned in any log file sessions. Leah read a *"little bit"* of the Research Buddy and printed off some pages. At the conclusion of the project, Lisa still insisted that someone would need to give her a topic, and said she could not remember how much of the Research Buddy she read.

Table 6.2: *Big6* Steps Accessed in the Research Buddy by Date

Filename	Nita (T)	Cara (T)	C&J (T)	Tacey (T)	Nelson (H)	Zoe (H)	Student Mental Model of Research Steps Corresponding to *Big6* Steps
Task Definition *Big6* Step 1 (includes journal)	3/29 3/30 3/31 4/13 4/14	3/31 4/19 4/30	3/29	3/29	3/29 4/15	3/31	Get a Topic
Information Search Strategies *Big6* Step 2	3/29 3/30 4/13	4/19 4/30	3/29	3/29	3/29 4/15		Find Information
Location & Access *Big6* Step 3	3/30 4/13	4/19 4/30	3/29		4/15		Find Information
Use of Information *Big6* Step 4	3/29 3/31 4/14	4/19 4/30	3/29 4/12				Write it up
Synthesis *Big6* Step 5	4/14	4/30					
Evaluation *Big6* Step 6							
Student Reading Level	9.6	3.6	9.1/ 8.6	4.2	7.3	6.5	

Note. (T) after the student name denotes Tortoise; (H) denotes Hare.

From the beginning, few of the students felt that they would need help during the writing part of their projects, and few of them progressed to that point in the Research Buddy. Nita mentioned, *"What I'm doing right now, I don't think it's research" (Nita5/3#8).* The reading, highlighting, digesting, and typing of information onto her web page was *"just typing."* As the Research Buddy was there to help the students do research (my definition), they may not have used it as much for this part of their projects because writing and thinking is not research (their definition). Thus, log files show two accesses for Synthesis by Tortoises, and none for Hares.

Finally, going the furthest in the Research Buddy, Cara (a Tortoise) opened one page of step six to read about evaluation.

Levstik and Smith (1996) state that much of the research about children and inquiry emphasizes skill development rather than using inquiry to answer questions and solve problems. They argue that inquiry is more complex than teaching generic research skills, and that is it learned in interaction with others. Up to the present study, the Research Club students were using some step-by-step procedures, perhaps never having experienced the process of inquiry within a community of learners. They, like the third grade students in the Levstik and Smith study, perceived research as a text-based search for information.

Alternatively, Kuhlthau (1995) found in her research that a student's understanding of the process of research through guided self-awareness substantially increased his or her confidence and competence in learning from information. Despite the metacognitive journal prompts that were included for self-awareness, the Research Buddy did not provide enough impetus for a fifth-grade student to independently work through and complete an information problem-solving project. The Research Buddy, like a cognitive tool (Jonassen & Reeves, 1996), relies on learners to supply the planning, decision-making, and self-regulation necessary to promote reflection, discussion, and collaborative problem-solving. The Research Buddy could merely instruct and suggest, not provide user motivation and attention.

Task definition is a new skill.

Within students' prior mental models of research, they did not mention beginning with a question or choosing and defining a topic on their own. Burdick (1998) states that the key to preventing information *aliteracy* is making sure that students know when they have a need for information. Yet, at the beginning of the study, several students reported that they depended on the teacher to give them a topic and to tell them what to find. Burdened with her mental model of teacher-controlled school research, Cara said, *"First, like, if it was my teacher or you, I would ask for my information... maybe the teachers might give it to me early, as in, maybe that day" (Cara3/24#13).* Julie agreed, *"I have to know like… what my project's about and what kind of things I need, that my teacher probably tells me usually" (Julie2/8#15).* Lisa, Leah, and Nelson also said that someone would have to tell them what to do. Tacey was happy finally to get to choose a topic of her own, stating, *"I never get to pick what I want to learn, and I don't have time to do it on my own" (fn4/12).*

Although the students in this dissertation study were free to choose their own topics, they did not think Task Definition was part of the research process because they had rarely, if ever, done that step for themselves. Only Carol had included one strategy of Task Definition in her initial description of research. *"First I'll see what I know about the topic.. like jot down brainstorm," (Carol2/8#6).* In their last interview, Carol and Julie considered narrowing a topic by thinking about possible resources. Julie told me, *"First, I would, figure out which would be the best topic to do and how much information I could probably get on it, and where I could get this" (CJ5/3#26).* The girls were participating in the collaborative sense-making described by Wells and Chang-Wells (1992), as they solved problems by selecting what they judged to be relevant from what they already knew.

Additionally, the Research Club students very likely did not have previous practice in imitating well-formulated questions modeled by knowledgeable teachers. In an effective mentoring or tutoring situation, the mentor or tutor must correct a learner in a fashion that eventually causes the learner to oversee his or her own corrective functioning (Bruner, 1966).

Finally, without taking time to gain knowledge about their topics with some background reading, the students may not have known enough about the knowledge domain to ask insightful questions. Another reason that the Research Club students may have had difficulty in developing lines of questioning is because they did not have the opportunity to converse with content experts, as did students in the Martinello (1998) study. Inquiry is very recursive, as students investigate a domain to gain insight into the overall topic (Stripling, 1995). Strategies included in the Research Buddy for categorizing students' existing knowledge were the Cabin Creek Four-Column Method, KWL chart (What I **K**now, What I **W**ant to Know, and What I **L**earned), concept maps, and other graphic organizers, yet students visited none of those pages according to student log files.

The Task Definition section in the Research Buddy provided students with an opportunity to devise insightful questions about their topics. By following hypertext links on the Task Definition pages, students could access information on brainstorming ideas and formulating open-ended seed questions. Open-ended questions are those that one cannot answer using a simple yes or no response. They may prompt students to look beyond facts, to expand on information. However, only one page in the Research Buddy was devoted to formulating open-ended questions, and Tacey and Nita were the only students who evidenced accessing it. Tacey included "why" and "how" questions in her journal, *"I'm going to see what ther habitat, What they eat, how they sleep, why they hybernat, and other important things about them, How they take care of their cubs."* Nita brainstormed in her journal entry for Task Definition, writing a few open-ended seed questions: *"I need to make a Web page about the different places to see in India. I need current facts & pictures. Taj Mahal, Agra, New Delhi, Jungle. Who built the Taj Mahal? Why did he build it. What is the Taj Mahal? When was it built? How was it built? (What was used?) I also need to find the seed question answers for the other special places in India."*

Cara demonstrated a tendency to frame questions that would support disciplined inquiry. In her initial interview, when I asked Cara about the kind of information she would seek when doing research, she shared some questions that she might ask about volcanoes, as an example. *"Like, what's in the volcano to make it erupt. Or, when or how the people that study on it would.. study on the volcano and how they know when it's going to erupt or anything like that. And... what the lava's made out of, and things like that."* Yet, Cara's seed questions for her actual project about lions were not as open-ended: *"What baby cubs do once they're grown… and what the male lion's job and what food do they eat, things like that."* Although Cara may have found the answers to her questions about lions, she did not write about them in her project.

Carol and Julie thought that writing the seed questions was a new skill for them, and that it expedited their work. Carol replied to my question about new skills, *"I have to think.. I did learn, maybe like, about answering all those questions."* She said, *"Usually before when I have done this, what I would do is take notes and then from that write the report. I didn't write any questions or anything" (CJ4/14#150).* Julie wrote in her journal, *"I think that the chart for your questions really helps you organize. I feel that this part will make it easier for you to research. The Research Buddy helped me go faster."* Later, Carol told me, *"We probably wouldn't even have thought of making those little questions."* However, their seed questions were targeted toward finding facts, and were not open-ended ones that would spur inquiry. Carol told me about their questions: *"We have a list of maybe fifteen sixteen questions, and if we've answered them all, you know, we've looked at the keywords, like we had, 'When was she* [Lucille Ball] *born,' the key words were WHERE, WHEN, PLACE, and once we've answered all that and filled in the key words, then I think that's it" (CJ4/14#81).*

Sarah informed me that she formulated some questions for her topic after she read to about the third or fourth *Big6* step in the Research Buddy. *"I wrote down questions, like, 'Who is the first coach,' and 'Who made up basketball'" (Sarah5/3#37).* She felt that the Research Buddy was helpful when *"figuring out what to ask for that basketball thing" (Sarah5/3#107).* However, Sarah answered none of those fact-finding seed questions in her final project. At the end of the project, she placed more emphasis on choosing a topic, saying she would, *"find out what I had to do research on."* However, she did not demonstrate the value of beginning with a question.

I observed that some students, struggling to come up with a topic, experienced the uncertainty that Kuhlthau (1988b) found in her students' research. Students are unsure of what the teacher requires and how to proceed (Kuhlthau 1995). Some of the Research Club students who were accustomed to receiving a topic seemed unconcerned with defining a topic or with formulating the questions they would need to ask for a focused investigation. Nelson, Lisa, and Leah evidenced the uncertainty by never finding a topic to research, and Zoe did not finish her project because she changed her topic from bears to dogs late in the study. Tacey needed some guidance in her choice of a topic as well. Actually, Nelson never chose his own topic for his project, even though in his initial interview, he related being confident about getting his own ideas. I attempted to help him choose a topic; he had mentioned Schnauzers as a possibility, but never followed up on it. Instead, he would come into the library to work on the web page, "Tour of the School," that he had started for his class. Rather than lose him as a participant, I suggested then that Nelson use this web page for his project. He eagerly took my suggestion. Nelson may have been a victim of the school research mindset as he reported depending on teachers to give him a topic; but he was also very focused on making the web page. He did not think the Research Buddy was useful, since it did not help him find a topic or do the work on his web page. Perhaps these students had a problem with the completely free choice of a topic. Children have different information needs than adults, and most of them relate to school assignments and other imposed queries rather than self-generated information needs (Walter, 1994 and Gross, 1995 as cited by Hirsh 1999, p. 1266). They were simply not used to defining an information need in the form of a question or even a topic. Also, the Hares did not access enough of the Research Buddy to guide them in this part of the process. Log files indicated that two of the Hares visited the Task Definition section fourteen times, the Brainstorming section five times, and visited none at the section of Research Buddy instruction on graphic organizers and seed questions.

With little use of the Research Buddy and none of my help, Lisa and Leah were not able to complete a research project. Like Nelson, both girls expected teachers to assign topics. Lisa initially decided to look at tornadoes, saying, *"I couldn't find any information on it…. Well, I found a few graphs. Nita helped me with it" (Lisa5/3#38).* Near the end of the project, Lisa and Leah collaborated without working through a research process to create a web site about friendship. Leah said, *"Well I didn't really have any* [problems finding information], *because.. we did something kind of simple, we did friendship, and so we already knew quite a bit for that" (Leah5/3#35).*

Zoe also had difficulty choosing a topic for her project, but once she decided upon dogs, she was unable to narrow her focus. Her log files indicated that she read about Task Definition in the Research Buddy, but she did not show me her questions. On April 15, she told me, *"I'm, going to do a photo album about dogs. And… it's going to have pictures of different types of dogs and I'm going to have a caption for each one to explain it… I'm pretty far on my*

research… I think I've got quite a bit to work with" (Zoe4/15#5). However, her project remained unfinished.

The six Tortoises (Carol, Julie, Nita, Cara, Tacey, and Sarah) completed projects using some on-line assistance to work through the Task Definition process. Since they were looking mostly for answers to factual questions, they felt that they experienced success by reading the initial Task Definition pages without accessing the pages about questioning or narrowing a focus. Log files indicate that Tortoises accessed the Task Definition pages thirty times and the Brainstorming pages eleven times. I did not mentor them through this process; instead, I checked to see that they completed each step on the progress chart. Carol and Julie were excited about doing their research, using their seed questions to organize the rest of their process. All the projects would have shown more reflection, and possibly have been more exciting for the students if mentoring had been provided during the Task Definition stage to help them devise more thoughtful questions (as did the mentors in the Martinello et al., 1996 study), rather than the fact-gathering ones they chose.

Apparently, the Research Buddy influenced Nita's perception of Task Definition. On her beginning perception questionnaire, Nita indicated that she had a clear focus before coming to the library, although in her first interview, she stressed finding resources, saying, *"First, I would... find out all the resources there are that I could use. Then, I would use each one to get information on a topic" (Nita2/16#6).* In her last interview, after she worked through Task Definition with on-line assistance, she included it in her description about the research process. *"First.. I would figure out what I wanted to find" (Nita5/3#16).* Cara's view of Task Definition did not change over the course of the study, although she had used the Research Buddy and had written some seed questions of her own about her topic. In Cara's last interview, she described doing a research project, with no elaboration on Task Definition. *"Number one I would go to the library. See, because that's where books and things* [are] *for information" (Cara5/3#19).* One unfocused, undirected project did nothing to change her school research approach.

Combination of information seeking strategies and location and access.

Research Club students tended to combine the second and third step of *Big6* into one step. In *Big6*, the second step of Information Seeking Strategies is a "planning" step, where possible sources of information are identified and evaluated for appropriateness. The third step of Location and Access is a "doing" step, where students search for and find a source, and then access the information within the source. Research Club students who planned their searches by following the *Big6* step of Information Seeking Strategies used more sources and created better presentations, although they still depended on a relatively low number of sources. Nita did not like the writing the Research Buddy required for Location and Access. In her journal she wrote, *"Today I read about Location & Access. I thought it was fun, but I didn't like writing. The Research Buddy helped me by telling me what to do with the list I made last time" (March 30).* Few elementary students have the skills to conduct an investigation entirely on their own (Levstik & Barton, 1997), and teaching them a process can provide them with structure. The Information Seeking Strategies step helps students structure their investigations by making a plan.

However, some Research Club students envisioned the Information Seeking Strategies step and the Use of Information step iteratively as one step. Students would think of a source and then look for information in that source. If the information were inadequate, the students would

look for another source. Tacey looked in the school library for books about bears, later admitting that they were not good sources:

> Sometimes like, when I'd look in books for grizzly bears, it'd say grizzly bears in the contents, or whatever it's called, and… when I'd go to that page, it's just like kid stuff, like grizzly bears are wild animals or something like that. It doesn't have a lot of information.... I went to the public library and got some grizzly bear books (Tacey5/4#63).

Also, Tacey wrote, *"Today I found some books about bears. I've used the computers and books. I found lots of information on Grizzly bears. I still need more information so keep on researching" (Taceyjn4/14).* Initially, Nita said, *"First, I would... find out all the resources there are that I could use" (Nita2/16#6).* She suggested that she would use the encyclopedia, the Internet, or the encyclopedia in the computer, *"but there has to be a CD for it."* However, at the end of the project, Nita told me, *"I think I wouldn't have done everything in that order and I might not have done maybe one of the Big6 steps…. figuring out where the information that I needed is. I probably would have left that one out…. because to me probably… I wouldn't think about that very much, I would just find it, where I just, don't know, or just thought of it first, and just keep finding it in other sources."* Leah was concerned that not all the information she needed would be in one source, as Moore (1995) and Kuhlthau (1995) found in their students. In hoping to find it in one source only, the students limit themselves to one point of view and fewer opportunities for synthesis.

Research Club Students may have been doing one step instead of two for resource selection and acquisition because they only conceived of a few possible sources–those that they were already familiar with using, or those they felt would be the easiest to use. Nita, Carol, and Julie were the only three students who accessed the Research Buddy*'s* list of possible sources. Nita was the only one who accessed the page about finding information within a reference source. Possibly, because students had not used an integrated research process earlier, they believed that thinking about what sources to use and going to find them were one simultaneous action. However, when students are first learning how to do research, it helps to think consciously about choosing or locating sources in order to begin a search with a plan. With no preparation, students could miss a valuable source, depend more on others for assistance, and waste time.

The Research Club students' idea of source selection and access as one action parallels Kuhlthau's (1995, 1998b) Collection Stage of research (see Figure 1, p. 3). However, Kuhlthau's students worked with identifying and locating sources throughout the previous Formulation Stage, so were already familiar with repeating that for the Collection Stage. For the Research Club students, knowing about a source was synonymous with knowing where it was or how to find it. When any of the Research Club students described how to do a research project, they would *"go find information"* without mentioning what kind of information they were going to go find. With further questioning, students would name different sources and tell how to locate each one. Cara had problems in earlier projects with *"barely finding enough information,"* although she could name a number of places to look. *"Well maybe I might find it in the computer, the library, at my school or a public library, and, or maybe I'd try to find it, who knows, anywhere" (Cara3/24#25).* During initial interviews, Carol and Julie mentioned using sources such as

Yahoo (an Internet search engine), *World Book Encyclopedia*, newspapers, or *Encarta*. Carol said, *"And then.. I'll go to the library or.. the school library or the public library, and find some books on the topic if I can, and then.. I'll look on the Internet or Encarta or encyclopedia" (Carol2/8#6).* Carol marked in the July final survey that the Research Buddy assisted her in thinking of places and sources for information, and in helping her locate that information, but Julie did not think it was helpful for location. The partners had some good sources in mind, but were limited in their abilities to use them.

Organization.

Students thought the biggest strength of on-line assistance was helping them stay organized. Tacey said, *"It's helped me a lot... I wouldn't know the Big6, I wouldn't know... how to do my journal, I wouldn't know a lot of things if the Research Buddy wasn't on the computer... I'd probably be lost" (Tacey4/12#79).* Carol, Julie, and Tacey used the seed questions to organize the rest of their research. Tacey said in an interview,

> What I did is I'd have one thing to look up like for that day, and the second day I'd have something else to look up. Like, first thing I looked up was where their habitat was. And so. That's the first thing I looked up and I printed that out and, the second day I.. think of something else, like taking care of their cubs (Tacey5/4#30).

The journal pages were popular since several of the students mentioned using them and printing them out. Doing research, which comprises an ill-structured environment, requires metacognitive skills such as evaluating, synthesizing, and analyzing (Spiro et al., 1992) that the journal provided. I felt that a journal was necessary, especially due to the lack of available adult mentoring. In July, Sarah still thought that the Research Buddy had helped her find and organize information, and she checked on the final survey that it was fun to use. Nita, in her March 30 journal entry, mentioned, *"I didn't like writing."* However, Nita stated that the on-line assistance gave her a regimen: *"I wouldn't have done everything in that order" (Nita5/3#164).*

Bibliographies and evaluation.

Bibliographies were a new concept for these fifth grade researchers. When Carol read about bibliographies in the Research Buddy, she exclaimed, *"Mrs. Gibson, we have a big problem. We have all this information but we didn't write down where we got it. Does that mean we have to go back and find it all" (fn4/12)?* Nita encountered the same problem, but she did not think she had learned new skills. Nita alone voluntarily wrote a bibliography and used the Research Buddy to guide her writing. She remonstrated, *"But I probably won't be able to remember all of it" (Nita4/15#46).* Nita was also the only student to complete her journal and timeline as requested. She printed out the Research Buddy*'s* journal pages, pasting them in her research notebook and then writing in her answers by hand. Her overall impression of the Research Buddy was unenthusiastic. She said,

> Most of it that I read just told me about some of the steps to do, it didn't told [sic] me what to do, it just told me about it. But sometimes it told me what to do, but it didn't help me DO it that much (Nita5/3#69).

No students used the Research Buddy for the Evaluation step, although Cara's log files indicated that she accessed one Evaluation page. When I suggested to Nita that she read that part so she could be thinking about it, she said, *"But I haven't done my project yet.... Does that matter, if I do it" (Nita4/15#71)?* Nita agreed in the final survey that on-line assistance had helped her ask questions about her topic, make a bibliography, and think about her project with journal questions. These were all things that she did complete and most likely had never done before. Although she spent more time in the library than the other students (eighteen visits), Nita did not take advantage of all the information that the Research Buddy had to offer. Her April 21 journal entry led me to believe that she could have used some help with evaluating information: *"Today I found the information I needed in my information. I had a hard time figuring out which information was good and which information wasn't. I didn't have much fun today."*

I believe that Nita would have turned in an acceptable project even without the Research Buddy. However, I thought that she used the Research Buddy effectively for Task Definition, Information Seeking Strategies, Use of Information, and Synthesis. She wrote out questions for her topic, considered different sources, photocopied and highlighted information, wrote a bibliography, and wrote in her journal. These activities were clearly the result of the prompts in the Research Buddy.

Reading was a problem.

Several students were apprehensive about the amount of reading they might have to do for the project, and for a couple of students, the Research Buddy*'s* reading level may have been a barrier to successful work. In an interview, Nelson stated, *"I just really don't like reading, and I'd probably ask my dad before I went to the Research Buddy and if he didn't know I'd probably go to the Research Buddy which probably would be very unlikely" (Nelson4/30#73).* Leah lamented having to read on-line assistance. She wrote in her journal (4/13), *"I think the Research Buddy is easy to use but I don't like it because I don't like to read. I think it is too long to read so I printed out some pages to take home and study. I will try as much as I can to get it all read."* She showed me the printed pages for Task Definition and Information Seeking Strategies, but did not run a log file.

Even Nita and Carol, students with high reading levels, were apprehensive about the Research Buddy in the beginning. Carol wrote in her journal, *"I thought that* [the Research Buddy] *would be a lot of reading, but it was actually kind of neat" (Carol3/29).* From Nita's journal, March 26:

> Today, Mrs. Gibson taught us about the Research Buddy and the *Big Six*. Before Mrs. Gibson gave us the lesson, I thought it was going to be hard and scary and I didn't know where to start. Now I think I know where to start. It's probably either reading the pages in the Research Buddy or Step #1 in the *Big Six*. I think it will be easy if I know what to do. I hope it is optional to read the pages in the Research Buddy because I don't like to read long pages of information, especially when they have big words in them that I have trouble understanding.

Nita was apprehensive about many things, including how hard this project was going to be and how much she was going to have to do. She thought the Research Buddy was going to be hard to read, with long pages. Later, she broke through those apprehension boundaries, writing in her journal, *"Today I read the part in the Research Buddy about Task Definition. It wasn't long, so I didn't get bored. The Research Buddy helped me by telling me exactly what to do and it told me about brainstorming."* Surprised by its brevity, Nita did not find it hard or scary.

Although students exhibited a reluctance to read, their reading levels did not appear to influence whether or not a project was completed. Nor did the reading levels have any bearing on how much of the Research Buddy the children read (of course, none of them read much of it). For example, Cara, with a 3.6 grade reading level read more pages than Leah did, and Leah's reading level was 7.2. The average reading level was 6.55 for the Tortoises and 6.325 for the Hares, which is not much difference, but the Tortoises read more parts of the Research Buddy. Also, five of the six Tortoises completed a project following the prescribed protocol; none of the Hares did (see Table 6.3).

Table 6.3: Reading Levels versus Project Completion Using a Research Process

Student	Nita	Cara	Carol/Julie	Tacey	Sarah	Nelson	Leah/ Lisa	Zoe
Reading Level	9.6	3.6	9.1/8.6	4.2	4.2	7.3	7.2/ 4.3	6.5
Project Completed	Yes	Yes	Yes	Yes	Yes	No	No	No

Cara, whose reading scores were below fourth grade level, had the most visible trouble with reading. She read and re-read the Research Buddy. Her log files show that she accessed the Research Buddy at least three different days, more than anyone except Nita. She spent time trying to understand it, *"So I can get it in my brain" (Cara4/19#61).* Part of Cara's problem was her reading level, but another part of it was her party instinct. If other students were present, she generally would talk or play. Once I went to check on Cara while she was working in another classroom, and she and Lisa were sharing drinks and candy with the teacher.

According to her journal entries, Cara used the Research Buddy for Information Seeking Strategies and for her journal. She showed me her list of questions from the Task Definition section, and she had written a list of sources that she would use in her journal. Cara thought the strategies from the Research Buddy were so helpful that she reported using them in other classes, but she could not articulate what those strategies were. Cara had read the Use of Information pages twice in the Research Buddy, which could have helped her take notes from a video about lions that I allowed her to take home. She said that she was going to read steps five and six in the Research Buddy, and her log files indicated that she did access all of the Synthesis section and one page of the Evaluation section. Although she accessed the Research Buddy*'s* pages more than once on different days, her log files indicated less than one minute spent on most of them– not a lot of time to read or contemplate. I helped her write her bibliography, and Nelson helped

her make her web page. Cara did not contact me about creating evaluation rubrics for her project, as the Research Buddy suggested.

Cara, a Tortoise, admitted to having a hard time with the language: *"Well, the way that I would say it is… showed me what to do. And, trying to explain to me what to do in my project.. I try to read it over and over to understand it... but I'm the type of person can't understand much" (Cara5/3#153).* On April 1, I observed Cara having a terrible time with her project, moaning, *"I'm dumb, I'm dumb."* I encouraged her to find her help from the Research Buddy, as I did not want to become her Research Buddy. She continued to struggle with reading it, but still asked, *"What do I do next?"* The girls around her tried to help by asking her if she had read this part yet, or done that part. She broke down in tears, crying, *"This is hard. I'm having a bad day."* Later, I asked her about how she had used the Research Buddy that week. Cara stated, *"I gotta read the last two* [*Big6* steps] *five through six, and then might go back to the other four and read through them so I can get it in my brain" (Cara4/19#60).* At the end of the study, Cara explained, *"*[I] *read it, but sometimes I'd get confused, but I just gotta read it over and over until it's clear in my mind" (Cara5/3#111).* Finally, Cara clarified her problem:

> I'm the type of person whose needs explaining…. it sounds like someone smart, like Carol, she could understand it because she's real good at understanding things. I just need to understand it. Put it in student words. Kids. Just like grownups (Cara5/3#120).

It was simply too hard for her to read and comprehend, especially when she depended so much on social interaction for her learning. Two months after the project, she noted on the final survey that the on-line assistance had helped her get the most important information out of what she found. Cara also noted that the on-line assistance and the journal writing helped her organize her information, evaluate her project, and think about her project.

Worried about Cara and the non-use of the Research Buddy by others, I asked Carol and Julie if they thought the Research Buddy was too hard. Both of these above-average readers replied in the negative, and Carol continued, *"People might not want to do it, but it's not too hard" (CJ3/31#82).* I had to admire Cara's determination. She had checked on her perception questionnaire both times that when work was hard for her, she would give up or study only the easy parts. However, Cara did not give up; she kept working on her project. She kept trying to read and understand the Research Buddy, and she finished her project when students with higher reading scores did not. She was noticeably proud of her project at the presentation party.

No need for it.

There were times when the students felt that they just did not need the Research Buddy for their work, and thus did not follow certain links or read certain pages. Log file entries certainly proved this point, as students turned in very few. Nelson never thought he needed it. He did not like to read, but demonstrated an affinity for the computer–it took him a few seconds to understand how to save information to a disk. Nelson was very interested in web pages, and came in often to work on them and to take pictures with the digital camera. He began using on-line assistance by reading about interviews, thinking that he would interview different teachers about the history of the school and include that information along with the pictures. He stated that he had interviewed several teachers, but *"I didn't find any reason to put the teacher's*

interview in because I didn't really need them for how I started doing it" (Nelson4/30#14). Nelson, who read about twelve percent of the Research Buddy according to his log files, *"really didn't need it at all"* for his project, the tour of the school. Neither did he think he had learned new skills. Once, Nelson used the index to find out about bibliographies after I asked him to write one. He asked, *"What is a bibliography?"* I told him to see if he could find out in the Research Buddy. Nelson did find that and read it, but having nothing to cite, he did not write a bibliography. I also observed him another day reading about interviews, but those days he did not run log files.

Lisa did not think the Research Buddy was useful, and did not report or show evidence of using it. Just out of curiosity, at completion of the study, I asked her if she would have done this project differently if it had been for a grade. She responded quickly, *"Uh, HUH... I would have looked a lot of places for the information" (Lisa5/3#51).* Lisa may have said these perplexing statements because I represented an authority figure rather than a co-learner. It is likely that Lisa still needed many external prompts to complete schoolwork, not yet being self-regulated enough to do it on her own. Paris and Byrnes (1989) state that, as children get older, their effort depends more on external data such as teacher praise and behavior. Lisa may not have perceived her work in this study as real school work, and it is also very possible that, with no help in devising a good question, Lisa had no compelling interest in any topic. Additionally, lack of feedback can decrease motivation for mindful learning (Langer, 1997), and Lisa was not getting feedback from the Research Buddy or me. Lisa and Leah did not need or use the Research Buddy for their project, as they required no research to write about friendship.

Carol and Julie had their own unique way to organize their work, and eschewed using the Research Buddy*'s* suggestions.

> Carol: We're working on the things that [the Research Buddy] tells us to do. And we didn't use the data chart, because it was kind of confusing, and then because we're just writing out on plain paper, the things that we
>
> Julie: The boxes are a little small to write. I wrote a whole summary down about Desi Arnaz and that would never fit in the box (CJ4/14#91).

The girls chose not to follow links in the Research Buddy, including those about graphic organizers, reference works, surveys, half the journal pages, and evaluation. Carol said, *"There were like two* [links] *that we didn't, but we didn't think they would help us" (CJ3/31#46).* A possible reason for any of the Research Club members to discontinue reading the Research Buddy was because it was something extra to do and slowed them down.

Future use.

One would think that the students' tendency to use the Research Buddy again would depend upon its perceived value. With so few students able to articulate what they had learned or feeling that they did not need on-line assistance, I was surprised that nearly all of them said they would use the Research Buddy again. Students felt that the Research Buddy might help them for social studies or science projects, for class work, or for reports later in middle school. Even Nelson, who said he would not have used the Research Buddy for this project unless he had to,

stated that he would probably use it in middle school. Sarah thought the Research Buddy might be handy at home, and she thought she might use it again if *"I'm doing research in class or something, I might use it, if I need to find some information at home" (Sarah5/3#112).* Lisa said she would use it if it were to stay on the Internet, *"Because it could help me with like projects, that I'm doing."* Nita alone would not use it again, and her data revealed that she read more of the Research Buddy than other students did (still, less than thirty-six percent). Although she stated several times that she followed the Research Buddy*'s* instructions, and that it helped her with the steps to do a project, Nita thought it needed more examples and needed to be procedural. *"If it had told me about making a web page and that kind of stuff" (Nita5/3#122)*, she remonstrated. Nita was frustrated when she needed help authoring web pages, and she could not find procedural instructions in the Research Buddy. Perhaps the other students, having read less of the Research Buddy, felt that they may have missed something that could have helped them do better. More likely, they were being kind to the author. In an e-mail message dated May 13, 2002, Carol admitted using the Research Buddy again once in sixth grade and once in seventh grade, but she could not remember how she used it.

I also asked the students if they thought the Research Buddy was helpful for their work. The six students who used it thought they would not have done as well, citing either that they would have *"have no clue what to do,"* or would have done their project similar to earlier ones (previous models that did not begin with questions). They would not have known to do the seed questions, nor would they have learned about new sources. Julie thought that the on-line assistance helped her go faster and complete her project on time. Nita decided that she would not have followed a process like the *Big6*. Zoe and Sarah said that they acquired their idea about doing a web page from the Research Buddy.

Nita, Carol, Julie, Cara, and Sarah returned the summer survey (Appendix K, p. 149), with positive perceptions about the Research Buddy*'s* ability to help them do research. The students marked the majority of their answers in the "Agree" and "Strongly Agree" columns. They thought that the Research Buddy helped them to ask questions about their topics, think of places and sources to find information, organize their information, make a bibliography, think about their projects with the questions for journal writing, and learn new skills.

In view of the data gathered, it appeared that students used the Research Buddy mostly for Task Definition, Information Search Strategies, and Location and Access, less for Use of Information and Synthesis, and not at all for Evaluation. The Tortoises, who used the Research Buddy the most, wrote seed questions about their topics and were mostly able to use those questions to keep themselves organized and on task during the rest of their process. They consciously thought about and noted in their journals the sources they were going to use, getting some new ideas from the Research Buddy. Students did not do extra clicking to explore hypertext links in the Research Buddy, but read only the parts they felt they needed.

Mentoring is a Must With On-Line Tools

A number of researchers (Burdick, 1998; Kuhlthau, 1988b; Levstik & Barton, 1997; Levstik & Smith, 1996; Martinello et al., 1996; Moore, 1995; Wells & Chang-Wells, 1992) have deemed mentoring to be important to children during inquiry. Additionally, Jacobson et al. (1996) admit a need for support from the social environment when using hypertext. In this dissertation study, Research Club students sought mentoring help from friends, parents, or the librarian. Throughout the study, I was reluctant to act as a counselor to students for two reasons. First, it was rare that I ever had an opportunity to mentor a student in my regular workday.

Second, I did not want to be so available that students would depend on me rather than on the Research Buddy, as I inferred from the exploratory study. Therefore, there were many times during the study that I would direct students back to the Research Buddy when they actually needed to talk and get some human direction, advice, and feedback. However, I stepped in to be a guide much more than I had anticipated.

Carol and Julie were discouraged at one point because they could not find information about Lucille Ball's children. *"They didn't have much on her children. And we just couldn't, she, Lucille Ball, they, we don't have that many biographies on that kind of stuff,"* Julie moaned, and Carol added, *"There's none in the library."* At this point in their research, the girls had come to me with their problem, and I was able to help them. However, not all the students would ask for help, nor would they look for help in the pages of the Research Buddy. It was apparent that human intervention was needed. At times, parents were inadvertent mentors. Nelson reported having problems in earlier research projects with finding information. He asked his father, *"Dad, I can't find this topic that I'm looking for. Would you help me find it?"* When Nita could not find information on New Delhi, she first looked for another resource. On the suggestion of her parents, she dropped the subject of New Delhi and chose Bombay instead. She explained, *"I asked my parents if there was any other way I could find something about this topic in the computer" (Nita2/16#92).* Sarah elicited help from her mother for Internet searching about basketball.

Problems that led students to request help in their earlier school projects were not finding enough or any information, having gaps in their information, forgetting where they found information, not knowing correct spelling, and not knowing sources or how to find them. In her initial interview, Nita said, *"I need help with… maybe getting to a certain search engine on the computer and the Internet, and, I might need help finding a certain book."* The manner of help Julie thought she would need was, *"Where to find the information and what places I should look" (Julie2/8#58)*, and Carol said, *"And I might go to* [librarians or teachers] *and see if they have any extra things to add. If they have any ideas" (Carol2/8#77).* Zoe mentioned spelling problems: *"If you couldn't* [get] *the correct spelling of a word, you couldn't find it in the dictionary.. so I've had trouble with stuff like that."* Nelson described having gaps in his information*: "Like I'd have a little bit of information and then I wouldn't have, it's like, I could say this happened in 1726 and I wouldn't have anything else until 1750… lost years that I couldn't find or something."* Tacey 's problem was *"not writing down what page number in the book or what.. if I used the Internet or the encyclopedia or the dictionary, I don't know what I used."*

Alone, none of the students were able to address the first information literacy standard (AASL & AECT, 1998, see Appendix A, p. 107) more than partially by formulating questions based on information needs, identifying potential sources, and developing and using successful strategies for locating information. Moore (1995) found the same need for help in her study with sixth graders. The Research Buddy could handle some of these problems, but many problems called for the diagnosis and suggested solutions that an experienced researcher could give.

However, the Research Club students' comments about getting help showed that they had some capacity for self-regulation, using the skill of self-assessing, as Yang (1991) suggests. They realized that they needed to ask for help from friends, teachers, parents, and librarians when they could not find something by themselves. The more independent students would give up when unsuccessful, or try another way before they sought help. During the project, help that students said they would request tended to be just what they requested, such as finding books or places on the Internet to search. Overall, the Tortoises acted more responsibly towards their work,

corroborating Eom's and Reiser's (2000) belief that self-regulated students are likely to engage in a learning task regardless of the type of instructional condition they are in; consequently, students who are not as self-regulated are likely to be frustrated.

Nita, who read the most of the Research Buddy (forty-two of the 117 total pages), occasionally requested short-answer help from me, but most of the time it was for computer-related questions about the web authoring software. Most of the questions from Carol, Julie, Nelson, Sarah, Zoe, Lisa, and Leah were also about writing web pages. Tacey emanated confidence throughout the project, only asking a question at the beginning about choosing a topic. She *"knew how to do* [research]*."* Overall, students first went to computers to find information, reporting that it was an infallible source. Lisa stated that she sometimes could not find information because it was not in the computer, and only then would she ask someone for assistance.

Of all the students, Cara elicited the most mentoring. She was not shy about asking questions, but they were never specific. Often she asked, *"What do I do next?"* In keeping with my decision to do minimal mentoring, I repeatedly told her to look in the Research Buddy for answers. Eventually, Cara needed my mentoring to help her structure her work, although I essentially gave her instructions from the Research Buddy. Her behavior was consistent with her reported dependence on her teachers for direction. Cara's comprehension strategies were to read and re-read material, and ask others for help.

Since I did not plan to mentor students extensively, I wondered if the mentoring that could occur during interviews might affect student work in some manner. However, that did not always seem to be the case. Nelson had six interviews, but finished a project that was not based on research. Zoe, with four interviews, chose a topic late and did not finish a project. Alternatively, Tacey, who had four interviews, finished her project by partially following the Research Buddy*'s* advice, as did Cara with only three interviews. Except for Zoe and Nelson, the students who had three or more interviews earned more points for their projects.

To compare the interviews and mentoring information, I listed each student's interview and project information along with their reading levels and how often they were in the library (Table 6.4, sorted by number of interviews). The Study Score is my assessment of the projects according to both the presentation of the projects and the process the students followed, using a five-point rubric (the children did not see it). The rubric and each student's assessment are located in Appendix T, p. 159.

Table 6.4: Interview Table

Student	Reading Level	Number of Interviews	Often in library?	Project completed	Study Score
Nelson (H)	7.3	6	In beginning	Yes	8
Carol/ Julie (T)	9.1 / 8.6	5/6	Towards end	Yes	17
Nita (T)	9.6	5	Yes	Yes	20
Tacey (T)	4.2	4	Yes	Yes	15
Zoe (H)	6.5	4	No	No	6
Cara (T)	3.6	3	Yes	Yes	14
Sarah (T)	4.2	2	No	Yes	9
Leah/ Lisa (H)	7.2 / 4.3	2/2	No	Yes	8

Note. (T) after the student name denotes Tortoise; (H) denotes Hare.

The Tortoises had the most complete projects as shown by higher scores, but were not the only students with frequent interviews. What is also evident from Table 6.4 is that the Tortoises with higher scores were also those who frequented the library. The interviews were a time when I could discuss problems with students and offer advice. Students who had more interviews could have received more of that help, but most of the advice I shared occurred outside of interviews. Therefore, students who worked on the library computers had more opportunities to ask questions face-to-face. For example, when Tacey was wondering about different topics, I asked her about her interests. When Carol and Julie could not find Lucille's children, I provided reference books for them to peruse. I showed Carol, Julie, and Nita how to relocate the web sites that they forgot to cite, and I supplied Nita with suggestions for highlighting information on computer printouts. For some questions, I was able to refer students to the Research Buddy. Zoe, Lisa, and Leah always worked in other classrooms, and asked no research-related questions. Thus, it was not interview time as much as time in the library when I was available that determined the amount of mentoring the students received from me and the quality of student projects.

This need for teacher involvement during inquiry parallels findings from other studies (Martinello et al., 1996; Moore, 1995). I did some prompting during the interviews, but I also reminded students to read the Research Buddy whenever I saw them. I noted that the students were more likely to ask questions when I seemed most accessible to them. When I told them that they could use the telephone to call me from the classrooms, it rang constantly. Kuhlthau (1988a) found that the percentage of users who consult librarians is small. Sandlian (1995) reports that children in her study rarely asked for help. Accordingly, the Research Club students felt that they would ask for help from a librarian in finding materials, but after that step they were largely independent, or thought with false confidence that the research was “done.”

I had few occasions to talk to the other Hares, other than Nelson and Zoe, who were interviewed six and four times. Because there were more students than library computers, we set

up a schedule so students would know when to use a specific library computer. What actually occurred was that some students arrived more often than they indicated, creating a need for more computers. Thus, Zoe, Leah, Lisa, Cara, Carol, and Julie voluntarily worked most often on computers in other classrooms. Working in a remote location may have had an impact on Leah and Lisa, who never developed a research topic. This situation may have affected the likelihood of Zoe finishing her project, although she was interviewed four times. Cara, Carol, and Julie spent hours on the library computers during the last two weeks of the study and were in closer contact with me. Yet, Tacey, who worked mostly in the library for the entire study, rarely asked questions. For most of these students, mentoring had to start where on-line guidance left them perplexed and unsure of what do to next, and the mentoring needed to be invasive. Students needed the support from a community of learners that they did not have.

Students who are following a school research model may not feel that they need much assistance from adults, as they are not engaging in work that creates a need for an apprenticeship (Levstik & Barton, 1997) with an experienced researcher. Additionally, their mental models of research had been proceduralized, as students recognized the similarities of research projects that they had been asked to do in previous classwork. Paris and Byrnes (1989) state that as students classify tasks, they transfer habitual procedures for economy of effort and cognitive accuracy. None of the students delved deeply enough into the Research Buddy, nor were they mentored by expert adults in order to create exciting questions and follow through with a meaningful learning experience to add to their mental models.

The Technology Impediment

Technology, seen as a boon to society, was often an obstacle for Research Club students. One obstacle was the way that students perceived information from computers, and a second obstacle was computer malfunction. As in other investigations (Breivik & Senn, 1998; Burdick, 1998; Dalrymple, 1991; Large et al., 1998), students in this study believed that computer information was fast, easy, and beyond reproach. Cara said, *"If there's nothing good on the Internet I'd look in books."* Nelson thought his work would be good if the information were *"easy to find."* Carol and Julie discussed web sites, saying, *"It's easy because you don't.. in a report you have to read all the way back over it to find that spot, but all you have to do it press BACK, up here."* Zoe wrote in her first journal entry, *"I chose computers.. because they are easy to work with and have alot of information for me."* Nita wrote, *"The Internet has everything in it."* Lisa would not look any place else. Additionally, I winced to see the students take electronic information as gospel. This perception of the infallibility and ease of using computer information prevented students from doing the reading and evaluation necessary to invoke new mental models.

In all data gathered from this study, students mentioned books 130 times versus mentioning a computer or the Internet 168 times. However, from my observation of their actual process, students used books in a total of five cases to look up information about dogs, bears, lions, India, and Lucille Ball. The students did not use any computer tools, e.g., OPAC, *Comptons, SIRS*, or Internet, unless they had to, knew how to, or perceived them as useful or easy. Students who had completed earlier lessons about Cabin Creek's computer resources were observed or reported using the OPAC, *SIRS, Compton's*, or the Internet. Sarah finished lessons on the Internet, and reported using only the Internet. Conversely, Tacey, with no lessons on the Internet, thought she would find most of her useful information there. She said, *"Yeah it has a lot of information, and like, there's not a main book called grizzly bears."* All students cited the

Internet as one of the first places they would go to find information, and it was frequently the first choice. Overall, five of the students reported relying on only computer resources for their information.

For web searching, Kafai and Bates (1997) found that fourth grade and younger children were quick to assume everything they found on the Internet, as in books, was correct just because it was there. Tacey wrote in her March 29, 1999, journal: *"I need to use books, Computer, incyclaidia, My Brain things I already know, and maybe Enternet.... The 2 I think is the best is books, and Computer because they have alote of information."* Tacey just printed out information, read it, and included it in her notebook without synthesizing it into written form. Without checking the authority of a site, Nita, Carol, and Julie used information from the Internet in their projects. Nita evaluated her information by how well it met her needs. *"I just read it and see if I can use it, and if I can't, just don't use it then."* Carol and Julie discussed how they would evaluate information:

> Julie: We.. compare it to other information that we have found.
>
> Carol: Yeah, like if we have one thing from the World Book and one thing from the Internet, if they don't match, we don't
>
> Julie: Look farther.. we use the one from the World Book
>
> Carol: Because it's copyrighted, and
>
> Julie: It's more likely to have the true information
>
> Carol: Because that's checked and, you know what I mean?
>
> Researcher: Edited?
>
> Carol: Yeah. So we usually go with that, and if they're both different and one from the Internet, both from the Internet, we probably won't use either one and keep looking to find the answers.
>
> Julie: You get it out… I've looked at like, ten sites or so, and I laid all my information out in front of me and compared it all. I guess that's how I thought it up (CJ4/14#73).

Carol and Julie had begun to address the second information literacy standard of evaluating information critically and competently (AASL & AECT, 1998).

The finding that students do not evaluate electronic information corroborates studies (Hirsh, 1999; Howe, 1998; Small & Ferreira, 1994) that found children do not effectively or efficiently use electronic sources without instruction. The few preliminary Internet lessons that Research Club students completed did not cover evaluating information. The seduction of technology may increase information aliteracy (the ability to locate, evaluate and use information without the desire) because it allows students to get information and use it without reading it, much less understanding it (Burdick, 1998). Technology also creates the tendency to copy at will

(Large et al., 1998), and not practice ethical behavior concerning information and information technology, one of the nine information literacy standards (AASL & AECT, 1998). I intervened with an impromptu copyright lesson when Carol and Julie found a site containing Lucille Ball pictures that they wanted to use. We were able to find the web master's e-mail address, and Julie e-mailed for permission to copy some of the pictures onto their web site.

Because of their belief that computer information was infallible, students were also easily frustrated when the computers could not produce the information they sought. Nita changed part of her project saying, *"Well, on Compton's once, I typed in New Delhi, because that's one of my questions, and.. it didn't work, for the computer, it couldn't read Delhi, it suggested different words that didn't have anything to do with it."* Lisa stopped trying to do research about tornadoes when the Internet produced nothing she wanted. Nita and Lisa were not devising efficient searches, nor were they evaluating the quality of the information they found.

A second obstacle of computer failure or unavailability occurred often enough that some of the students spent an inordinate amount of time looking for lost files and graphics or were discouraged from continuing to work. Computer problems alone were probably the determining factor in Leah's failure to carry out a research project. Nearly every afternoon she chose to work, her assigned computer would not work, the lab would be closed for wiring, other teachers would be using their computers, or the Internet would be down. She would sigh, grin, and say, *"Well, I'll look at it from home."* Carol and Julie were so involved in downloading pictures and making new links that they saved files everywhere, in the classrooms and the library. Carol used her computer disk most of the time to save files, but sometimes she would inadvertently save them on the computer she used at the time. Carol emphatically stated, *"We've SAVED it. Like, today, I promise you, I KNOW I saved it. And it erased it,"* and Julie wailed, *"Because, because, part of it we'd done like a long time ago, we didn't TOUCH it and it erased it."*

Clearly, technical organization and technology issues impeded students' progress in many ways during this study. At times, I felt as though I was running a computer help desk, because the students using classroom computers would telephone about technical problems. Computers would freeze or crash, information would be saved in unobserved locations, the printer would not print, the URL did not "go" where it was supposed to, and files were lost. The Internet at best is an imprecise search mechanism, and it is not always a fast source. Nita, discouraged at one point, said, *"Nothing works. Like on the Internet today, it didn't work as fast as I wanted it to."* In addition, because of e-mail problems, Research Club students were not able to get off-site mentoring. Most of the computers students used could not send e-mail, and not all students were able to obtain an e-mail account. The only e-mail question I received was from Cara, who asked, *"What do I do next?"* With such a situation, it was impossible for the students to get the maximum use of the technology possible.

Student Enjoyment and Cooperative Work

Regardless of computer malfunctions or frustrating experiences, students reported having fun on this research project. I rarely saw a long face; giggles were the norm. Fun for Carol and Julie consisted of adding hyperlinks to their web pages, finding interesting information, knowing how to organize the information with their topic questions, using a web site to organize their work, choosing what they were going to do, and being together. Carol said, *"It's funner now" (CJ5/3#11). It's time-consuming, but it's fun"* [laughs] *(CJ4/14#162).* Cara's idea of fun included learning new things, with people who took time to help her learn them. *"Well, it's kind of fun. I'm learning new things on this. Whenever I ask for help, the teacher or students, they teach me*

things like helping me about it, and it's kind of fun" (Cara3/24#90). She liked searching on Internet Explorer and putting things on her disk, although she thought *"it was kind of hard" (Carajn3/29).* Zoe thought web pages were fun because she could *"put them on the Internet" (Zoe5/4#130).* Nita also chose to do a web page for her presentation because she thought it would be a *"fun way to do it" (Nitajn4/14).* She delighted in making the links, seeing how pretty the pages looked, and even enjoyed later interviews. In her April 30 journal entry, Nita wrote, *"Today I typed, made links, and put information in my own words. I had fun today."* In her final journal entry, she stated, *"I had fun finding my information, too. I had a lot of fun."* For Sarah, the fun was *"Choosing my title, and finding out all the information and facts about it" (Sarah5/3#53).* Tacey enjoyed finding the information about her bears: *"I knew a lot about them, but I've found a lot more information and it's fun! I like it" (Tacey4/12#23).* However, when I asked Nelson's opinion of on-line assistance, he said, *"I think it's fun and boring because, I think it's fun when there's something I haven't learned already, but I just think it's pretty boring when I'm reading something that I already know" (Nelson4/19#59).*

Part of students' enjoyment stemmed from a new use of technology and the recognition it would bring by presenting it and having others see it on the Internet. Another part came from students' freedom in choosing what they wanted to study, and creating something about it. Finally, it was satisfying to work together and have a sense of belonging as members of the Research Club.

Julie and Carol entered the study prepared to work cooperatively. Later, Lisa and Leah decided to work together, and often the members of the Research Club would help one another. Nelson helped Cara write her web page. Zoe helped Cara learn how to use the Internet. Nita helped Lisa try to find information on the Internet. Without formally planning it, the students created an informal community of learners by themselves.

I believe the cooperative work helped Julie and Carol in working through a research process, as they planned together from the beginning. They read the Research Buddy together, created their web site together, and most of the time collected information together. More than once, I observed that they debated ideas and shared information. When Leah and Lisa finally decided to work together, I did not think they would have time to finish. I believe their cooperative work helped them to finish a project, although not following the stipulations of the study. However, if they had decided to work together at the inception of the study, they may well have stayed on track with a research process.

Information Literacy Standards: Not There Yet…

The least that can be reported is that, generally, the students were working towards only the first of the National Information Literacy Standards (AASL & AECT, 1998). They were beginning to learn how to access information efficiently and effectively, but were emphasizing accessing, that is, getting to information. Yet, within this standard, students struggled with developing and recognizing questions, evaluating information, and identifying sources. Few of the students were able to use their information effectively (Standard 3) by notetaking, classifying, and organizing. None of them independently assessed the quality of their work (Standard 6).

Many reasons might explain the fifth grade students' problem with using the Research Buddy and carrying out a research project using all the steps of *Big6*. I conjecture that students may have an institutionalized model of research because they have not been instructed and scaffolded through a process of inquiry that had real meaning in their lives. Perhaps students are

getting much of their research skills experience on their own, from friends, or from parents who may not always know what to do. Perhaps disciplined inquiry is not happening in enough classrooms because teachers and librarians themselves have an institutionalized mental model of research. Work like this is not easy, and it does take time. Nita told me that time was a problem for her because she would scarcely begin to work and then it was time to go (Fn3/31). Maybe our expectations that children can do inquiry are low. Perhaps teachers feel constrained to cover content required for standardized testing, and thus do not make time for inquiry. Finally, the nine Information Literacy Standards are fairly new (1998), and though widely disseminated, the Indicators contained within each standard (including the one about questioning) are available only in the book, *Information Power: Building Partnerships for Learning* (AASL & AECT, 1998). *Information Power* is a book used by proactive library media specialists, containing information about literacy standards, collaboration, information access and delivery, program administration, and ALA (American Library Association) statements and policies. It is a book that busy teachers might not be aware of unless a librarian were available and interested enough (proactive) to disseminate the information it contains. Additionally, the number and minutia of teaching and content standards that teachers are already trying to incorporate are overwhelming. This suggests that it is increasingly more important for the information literacy standards to be clearly written, explicitly emphasizing the most vital criteria.

In conclusion, a summary of the findings from this study are:

A self-selected sample of students affected the findings. For example, with only one male involved, no gender analysis can be performed. The sample was too small to look for issues of cultural diversity or socio-economic factors such as access to technology. In addition, volunteers may come in to a study with motivation factors that may not be present in a random sample.

Students did not think research was an information problem-solving process; they had their own mental models of school research. To the Research Club students, research was only information-seeking.

Students thought Task Definition was a new skill. Students did not say that they previously had ever tried to determine a topic for research or created seed questions.

Students did not use the Research Buddy as I had assumed they might. In fact, students did not really read the Research Buddy for guidance, to get help when they needed it. The small amount of reading done was to find out the next step in their work, and only five of the Tortoises used the Research Buddy in this manner.

Students needed more mentoring than the Research Buddy provided. The Research Buddy was not interactive enough to provide substantive guidance, although it could provide some assistance if users were persistent enough in finding the information. Therefore, the Research Buddy did not function as a "mentor" as designed. The Research Buddy of course could not provide confrontational mentoring, which all students could have used. Human contact was needed in a consistent and invasive manner to help students stay on track and guide them in learning to practice inquiry.

Computer technology often impeded students' activities. Although students perceived the computer technology to be motivational, there were many times when unfocused, ineffective searches or hardware failures were problematic. The use of traditional technology such as pencils, paper, and books may have been quicker and more successful.

Students' enjoyment and objections were evident. Overall, students enjoyed getting to choose and direct their work, and work together. They did not like to read or write, and enjoyed getting to do as little of that as possible.

In the next chapter I consider the findings in view of my own beliefs, reflect on ways that teaching inquiry can be successful, and raise questions about further use and design of the Research Buddy.

Chapter Seven

Implications and Questions

While on this dissertation journey, I unearthed more questions than I answered. First, I review the beginning questions and summarize related findings, then continue by addressing possible reasons underlying the findings. Second, I reflect on a picture of inquiry for elementary students, and suggest a model for its use. Finally, I pose questions where more research may be valuable. The beginning questions for this study were:

1. How do students use the Research Buddy for information problem-solving skills? Does on-line guidance occur? What human mentoring will be required?
2. Do students' perceptions of the research process differ from their actual process, and if so, how?
3. Will students report and/or demonstrate they have learned new research skills because of the Research Buddy? What might they be?
4. Do students' perceptions of the Research Buddy differ from their actual use of this tool, and if so, how?

I found that although students did not use the Research Buddy as much as I planned, it was helpful at times. Eight of the ten students used the Research Buddy primarily for the first three steps of *Big6*, corresponding to their previous research experience, which was found in this study to be limited in terms of conducting inquiry. On-line guidance that was beneficial for a finished project occurred for five of the students, but it was apparent that all students needed support from the social environment as suggested by Jacobson et al. (1996). Students could articulate a procedural research process, but did not always follow the procedures they cited. For example, these fifth graders reported that notetaking was necessary, but few of them took notes. Overall, students agreed that the skill of Task Definition was new, showing that they had rarely begun a research project by focusing or with a meaningful question. Finally, students who reported that the Research Buddy was helpful noted it was helpful primarily for developing the seed questions and for organizing their work.

Findings from this dissertation study suggest that the Research Buddy*'s* on-line guidance, used as it was in relative isolation, will not work to guide fifth graders to do a complete research project, to perform disciplined inquiry, or to solve an information problem. I considered that several things were responsible–my own philosophy of research at the time, the problems that plagued us throughout the process, and the Research Buddy itself.

During the study, I discovered that my own mindset up to the time I began my dissertation was actually a school research model. I had never done anything remotely close to disciplined inquiry, nor seen anything like it in any previous educational experience. As a classroom teacher, I had been guilty of assigning topics for student reports without helping students work through the process of doing those reports. Since I was a content-based teacher (music and mathematics), I was more concerned with teaching the content of the course than in using inquiry to teach students how to think about that content. Therefore, as I developed the Research Buddy, I relied on my mental model of research: choose a topic, find information, synthesize it, and present it (after a self-evaluation which included a spelling, grammar, and clarity check). The research that I wanted the Research Club students to do was consequently

akin to their notions of school research, and disciplined inquiry was not a focus at the beginning of this dissertation. However, it became a focus as I observed students working only to gather facts, refusing to read background information, and taking shortcuts wherever they could. It appeared to me that they were not working towards learning anything meaningful as much as they were working to finish a project; their goal was product-oriented rather than process-oriented.

Part of the problem lies in differences among terms such as "research," "information problem-solving," and "inquiry." While these terms are synonymous in the thesaurus, they often imply very different practices in schools. In the schools where I have taught, research begins with finding information about a topic. The *World Book Dictionary* definition is "hunting for facts or truth about a subject; inquiry; investigation" (Barnhart & Barnhart, 1983). In too many classrooms, when students do research they look for facts about a teacher-assigned topic. Information problem-solving processes, such as *Big6*, are used to give students the mental tools for doing research or inquiry, and can be used whether students begin with a topic or with a question. However, disciplined inquiry begins with questions, and is most effective in a community of learners. That way, students can research and inquire, compose and co-construct meaning together, and present outcomes to others (Wells & Chang-Wells, 1992). Reflective, disciplined inquiry is rooted in what students already know and can do, and gradually moves beyond the known (Levstik & Barton, 1997).

Perhaps the problem comes when the tools of inquiry are substituted for the practice of inquiry. We may need to teach children research skills, but we must embed those skills in disciplined and meaningful inquiry. Indeed, it may be useful to use each term to identify a different part of the process. For inquiry then, which would encompass the whole process, children would identify questions they wish to pursue and then use research as the strategy, including an information problem-solving process, to help answer those questions. Dreher et al. (1997) found that fourth-grade students who learned a research strategy during a project demonstrated improvement to search independently for information and apply what they had learned to a new problem. The information problem-solving process can supply research strategies.

With the failure to link the Research Buddy to purposes beyond research skills, there were a variety of problems endemic to working with children on a voluntary project in a highly scheduled academic environment. It soon became clear that fitting research into busy days was challenging for the students. There were difficulties in tracking student data, as the students would forget to download the log files, to do journal-writing, or to come in for interviews. They also left out parts of the project assignment. Observations were interrupted or abandoned because of distractions that exist in a dynamic library. More significantly, we could not find sufficient meeting times to maintain continuity and contact. Burdick (1998) and Stripling (1995) found that students needed time to complete research work. As the project continued, students became tired and enthusiasm flagged. In addition, we were all frustrated by computers that crashed, or were slow or unavailable.

Finally, students did not use the hypertext links of the Research Buddy. Perhaps using those links would have sparked more engagement with the content. But students were not "exploring," they were trying to "find" specific information on topics. Nelson thought that using the Research Buddy was *"boring"* because it contained material he already knew. Cara found it too hard to comprehend. Moreover, by design, the Research Buddy is to be used individually at a work station. While it did include an e-mail link to the librarian (myself), it did not encourage

children to engage in social negotiation with a community of learners, which is a vital part of inquiry.

What Can We Expect of Children?

I expected that as volunteers, the children would enthusiastically complete whatever I asked them to do. However, they were fifth graders with varied reading levels and an early developmental level of self-directedness and metacognitive thinking. Journaling, as Kuhlthau (1995) suggests, is an effective strategy for developing metacognition, but I found that it must be teacher-directed journaling. At a fifth grade level, most of the self-regulatory strategies expected still must be teacher monitored until students learn what strategies are available, how they are applied, when and why they are effective (Paris & Newman, 1990), and which ones work for them. Nita, Carol, and Julie, who appeared to have the most developed self-regulatory strategies, still needed to improve their time-scheduling and self-monitoring skills, two of the six learning capabilities that Yang (1991) proposes. The three girls were more comfortable with the number of options that the Research Buddy offered, but still did not take time to explore extensively. In fact, this may not have been a failure of self-regulation, but a reflected decision made to bypass the suggestions in the Research Buddy as something they thought they already knew.

The fact that the participants of this study were children kept the importance of having interesting and compelling activities uppermost in their work (the children called it "fun"). The Research Club students had fun engaging with the material they found, and finding answers to their questions. They were pleased to tell other students about their projects, and to learn to do something new on the computer. Students did not enjoy slow or uncooperative computers. Waiting was intolerable, whether for a computer or for my help. Reading the printed information and rewording it was “boring.” Writing in the notebooks or reading the Research Buddy was not as engaging when students had to do it alone. Working around others was attractive, but isolation was not. Again, in a community of literate learners using disciplined inquiry, the "boring" tasks would take on new meaning as they become valuable tools in a student's quest for meaning.

Clearly the fifth grade students had an ingrained sense of what doing school research implied. By fifth grade, students are potentially capable of using many of the strategies (e.g., using reference books, taking notes, writing a bibliography, doing a self-evaluation) independently, once they see them modeled and practice them. However, we should expect children to need help from more experienced researchers (teachers), just as I have needed help and guidance from my chair and committee members during my dissertation work. Sometimes other voices help students turn a corner, get a fresh look, or heed a suggestion about improving. Also, because the social aspect of learning is so important, we should expect students to want to discuss their work with their peers, work together, and exhibit their work when completed.

How Should Disciplined Inquiry Look in a Classroom?

Although this study focused on students doing independent, extra-curricular work, it was evident that these students had learned about doing “school research” in their classrooms. Thus, these findings do have implications for classroom-based inquiry. The need for disciplined inquiry instruction affects instructional strategies and practices in the classroom in a number of ways. Teachers must allow adequate time for the process of inquiry to occur. Students must have the time to delineate a focus question (Moore, 1995), read background material, and construct new mental models. Additionally, teachers must have the time necessary to conference with

students at different points during the process, to offer suggestions, to provide modeling and scaffolding, and to give advice (Jay, 1988; Mancall et al., 1988; Stripling, 1995). It was obvious that this valuable time was not available for the Research Club students.

Elementary classroom teachers are generally responsible for one class, and are with the class often during the day. During their time together, the teacher and students could engage in disciplined inquiry more easily than in an exploratory class that meets once per week, such as the library classes. The classroom teacher, who has set the broad learning goals supportable by inquiry for the year, has the authority to spend more time working on a project that has students delighted and engaged. Further, it is possible that in one class, all students could work together on an inquiry project, as did the 1999 winner of the President's Environmental Youth Award (Thornburg, 2000). This winning class of Kentucky fourth graders completed an inquiry project about environmental problems involved with strip mining on Black Mountain in Harlan, Kentucky.

Teachers are often governed by standards to help them decide what and how to teach. The nine Information Literacy Standards (AASL & AECT, 1998) focus on the tools and strategies of doing research, but embed the most vital part of doing inquiry–question formulation–in an Indicator. In Kentucky, the Benchmarks for the National Information Literacy Standards (Appendix A) are better at defining the need for questioning skills, and are more widely disseminated. But as this study shows, these fifth grade students had not learned and did not learn as part of this project or through the use of the Research Buddy how to ask meaningful questions to begin an inquiry.

People learn best when they know why they are learning and can see what it looks like to learn successfully (Levstik & Barton, 1997). To experience such learning, people need to be involved with others in a community of literate learners. Cara especially would have benefited from such a community, as she was dependent on being with, talking to, and getting assistance from others. She requested help from me and from her fellow Research Club members, and thought that being in the Research Club was *"very cool."* Carol and Julie may have experienced more success with their project because they chose from the beginning to work collaboratively. The girls would take turns reading the paragraphs of the Research Buddy aloud. It was exciting to see Carol and Julie working together, keeping each other on task and talking about their ideas. I would often see the Research Club members working together or discussing their projects, and with the addition of focus interviews and discussions, that venue could have provided a real learning community. A social dimension was important for students to interact with one another in order to help construct new mental models. This study reiterated conclusions in Levstik's and Barton's work (1997), that inquiry demands socially constructed knowledge, including dialog from peers as well as mentoring from experts.

Another aspect of a learning community is access to mentors with whom to co-inquire (Martinello, 1998). Throughout the process the Research Club students had problems, creating many opportunities for mentoring from adults who could have helped them solve those problems. Problem-solving, reflected as Horne's (1990) successful and unsuccessful questioning behavior, certainly seemed to be one area where the Research Club students needed mentoring. Lisa could not find information on tornadoes, Nita gave up on New Delhi, and Nelson lost interest with no focus. Cara and Tacey had trouble getting information from books because the information was not interesting. In a classroom situation, the primary mentor could be the classroom teacher, who purposely plans for mentoring time with students. However, a wise teacher would plan the study to include others as mentors and resources, such as teachers,

administrators, parents or community members, public librarians, and outside experts. Smith (Levstik & Smith, 1996), in her inquiry with third grade students, had her students call the regional weather service for information and took them to the Special Collections room at the public library for historical research.

The Research Club students had no knowledge of disciplined inquiry. They did not think that reading and writing were part of research, did not enjoy it, and had no concept of formulating questions. In an inquiry-learning situation, a mentor needs to intervene at certain points during the students' progress to ask questions and offer guidance. When I compared the students that completed the project as requested–showing evidence of reading the Research Buddy, finishing a presentation, and having other visible documentation of their work–with those who did not, I realize that my intervention was necessary even before students asked for help. Stripling (1995) calls this intervention confrontation. According to the findings in this study, mentoring and confrontation were vital for students to be successful in the information problem-solving process; on-line assistance alone was inadequate. Therefore, students should not attempt to do the information problem-solving process in isolation, even with on-line assistance. Given that inquiry is a very messy (Marshall & Rossman, 1994), social process, the Research Buddy was not enough to initiate or sustain real-world information problem-solving.

Intermediate students need reassurance that they are doing their work correctly (Kuhlthau, 1988b; Stripling, 1995), and often bring it to the teacher to check at small increments. During this check-up time, Stripling (1995) advocates that teachers coach, consult, and provide for peer review and student reflection. Moore (1995, p. 28) suggests, “If we are to improve [students'] abilities in finding and using information, we should make explicit the problem-solving nature of the task and promote the notion that there are many ways of reaching a solution.”

What's a Mentor to DO?

The students' experiences in this study clearly revealed that teachers would do well to spend more time helping students learn to work through the beginning of a research study (Task Definition), which drives the whole research process. Thoughtful learning starts with a student's need to know (Stripling, 1995), so inquiry begins with a question. For the question to be a good one, students need modeling and scaffolding. Kuhlthau (1987) states that assignments should pay particular attention to the earliest stages of the research process, as well as guide students through the completion of a search. The Research Club students' notion of "teacher gives me a topic" created a block that kept school research and true inquiry separated. A number of researchers (Burdick, 1998; Moore, 1995; Martinello et al., 1996; Stripling, 1995) agree that the first step in the inquiry process, that of asking and defining questions, is vital.

Without choosing and defining a topic or question for themselves, students have nothing on which to "pin" the rest of the process, and they do not "own" it. Burdick (1998) found that limiting freedom in topic selection increased reluctance in students. Bruner (1966, p. 96) states, "If we do nothing else, we should somehow give to children a respect for their own powers of thinking, for their power to generate good questions, to come up with interesting informed guesses." Teachers could implement Bruner's suggestion in a large group setting, as they guide students together to devise interesting questions about classroom content. Experts must be available to scaffold students' thinking (Hancock, 1995; Stripling, 1995; Wells & Chang-Wells, 1992) especially when students do not know what kinds of questions to ask. In the studies of Burdick (1998), Moore (1995), and Kuhlthau (1988b), students began by formulating a topic. In

this dissertation study, each Research Club student chose a topic of his or her interest to research. Because of my own inexperience with inquiry, and because students are seldom asked to begin with questions in classroom assignments, I did not require that students begin with a question. However, I hoped to foster the development of focused questions about the students' chosen topics by designing prompts within the Research Buddy that would lead them to ask such questions. A focused, guiding question gives students a framework because it lets them know what they are supposed to learn (Traver, 1998). Martinello (1998) surmises that we must teach children to question effectively, and that higher-order questions develop as children become more knowledgeable of their topics. I did not purposefully lead the Research Club students to determine what prior knowledge they had about their topics before they began, and I did not observe that the students used graphic organizers, as suggested by the Research Buddy, to review their background knowledge about their topics. They were performing as Moore (1995) found in her study of sixth graders, who rarely reviewed what they already knew in order to formulate questions. This study may have looked very different if conducted within a content area that students were studying in the classroom at the time.

I began this study wondering if an examination of children's perceptions during their research would calm the fear that, because my library was not a flexibly accessed library, I would never be able to effectively teach information problem-solving, or to promote information literacy effectively. I was aware that, by myself, I could not have an impact on such student learning. A number of researchers (Shannon, 1996; Tallman & van Deusen, 1995; Van Deusen & Tallman, 1994) have shown that a freely accessible library contributes to students' use of information and to their ability to learn from information. In addition, library skills instruction has been shown more effective when taught as a process combined with classroom content (Dreher et al., 1997; Oliver & Oliver, 1997; Todd, 1995), calling for teacher/librarian collaboration. I considered that one could embed the information problem-solving process within disciplined inquiry, but that it would require much more instructional time. It seemed natural that technology could play a part in solving this problem by providing an "anytime, anyplace" guidance tool such as the Research Buddy.

KERA Academic Expectation 5 specifies for students to use a problem-solving process. Kentucky Benchmarks for the information literacy standards (Appendix A, p. 107) use some of the *Big6* terminology, such as task definition, problem-solving process, and evaluation. The Benchmarks also seek to have the information literacy standards tied to the curriculum, i.e., standard 5: Student appreciates and enjoys literature and other creative expressions of information (in conjunction with reading in the content areas). Additionally, the essential question is a part of standard 1, which states that fifth graders should be in the developing stage of developing essential questions (guiding questions which guide students to analyze, synthesize, and evaluate), making choices, and refining a task. KERA Academic Expectation 5.1 requires students to use critical thinking skills. It is not enough for students to be able to follow a rote process without reflecting upon each step–not if we teachers want the product of our instruction to be students who can perform thoughtful inquiry. Gagné et al. (1992) state that in order for students to learn to think they must be given the opportunities to do so.

Although the students in this study did not become informationally literate, some of them were developing skills addressing information literacy. Most of the Kentucky Benchmarks locate fifth graders at the developing stage. Learning a process to determine a topic, to access information, to evaluate the information and then to use it accurately and creatively (AASL & AECT, 1998) were all parts of Standard 1 that Nita, Carol, and Julie demonstrated. These three

students also learned to practice the eighth information literacy standard (AASL & AECT, 1998) of ethical behavior concerning information when they learned to cite URLs and to request permission to use copyrighted pictures.

The finding that students were using the Research Buddy mostly for the first four steps of the *Big6* (which paralleled their notion that research was the "finding" and not the synthesizing) showed the need for modeling and discussion, especially through the beginning of a research project. To correct such a limited view of research, an instructional link is needed, as Moore (1995) found, between library skills and study skills in order to foster a more sophisticated view of information use. Sandlian (1995) stated that children do better when they have less information to consider. With Sandlian's study in mind, perhaps it would be more effective to combine *Big6* steps two and three into one step of "Search Strategies." Certainly, there is value in using a source where it is located and then, through browsing or other serendipity, finding a new source and simultaneously learning how to use it.

Upon reflection, I thought that the Research Buddy*'s* usefulness was the structure it gave children who needed assistance with information problem-solving at various times during the process. However, from the stories of the Research Club students, I determined that they executed a research process primarily as done in previous classroom assignments. Levstik and Smith (1996) found that the degree of scaffolding required to help children engage in inquiry is fairly extensive, partially because their prior experience with research has misled them about the process and point of inquiry. To build upon these immature mental models, the implications for educators who use *Big6* or other procedural research processes are to: 1) embed the process into authentic, disciplined inquiry; 2) place more emphasis during the beginning of the task on formulating questions and reading for background information; and 3) make certain that there is social negotiation in a community of learners.

The Research Cycle (McKenzie, 1997) was developed to meet the need for a more robust approach to school research that would involve teams of students working on essential questions. This model focuses on beginning with a question (Figure 7.1).

Figure 7.1: The Research Cycle (McKenzie, 1997).

Because the students' mental models of research were already so entrenched, perhaps a different model that appears less linear than McKenzie's or the *Big6* could be useful. Such a model would include steps that were familiar to children with those that promote disciplined inquiry. In a model of the Search Cycle (Jonassen & Colaric, 2000), researchers place reflection in the middle of a circle. On the outside of the circle are steps that are much like those of Marchionini's (1995) information-seeking. However, Jonassen and Colaric are considering that the circle may need to be star-shaped, where searchers stop to reflect after each step. Based on Jonassen's and Colaric's idea, Figure 7.2 is a model I created for disciplined inquiry. This "Star Inquiry" guides students to emphasize formulating questions, to stop and evaluate after each step, and then to forge ahead or revisit a step in the process.

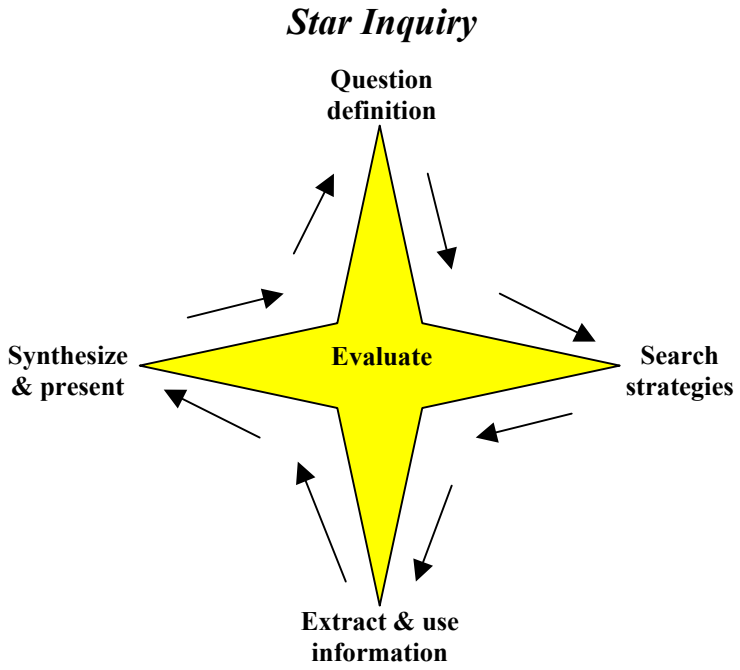


Figure 7.2: Model for an Inquiry Process.

The Role of the School Librarian

School librarians are primarily resources and instructors rather than mentors, chiefly because of the time factor. Nardi and O'Day (1999) state that librarians prepare to be information consultants who are oriented toward quality information service. Because of the influx of technology that enthralls students, information literacy instruction must include increasingly more mentoring and instruction on the use and evaluation of on-line information. Thus, in addition to consulting, librarians must continue to introduce and emphasize the use and evaluation of print resources that are not available on-line. For any source, it is important for users to be able to extract and evaluate the information they find (Moore, 1995; Stripling, 1995). For this reason, students must have more opportunities to find information in all types of sources,

as well as to practice ethical behavior in regard to information and information technology. The Latin maxim, *Scire ubi aliquid invenire possis, ea demum maxima pars eruditionis est* (to know where you can find anything, that in short is the largest part of learning), is even more true in this age of information availability.

For me, it was evident that with or without the Research Buddy, I would not be able to teach information problem-solving skills effectively. Collaborating with classroom teachers and extending the students' resources to persons beyond the school (parents, mentors) are vital to embed these skills in the students' real-life schoolwork. With constraints that a library-teaching schedule imposes, it is more important than ever to find a way for librarians and teachers to work together to foster their students' growth in information literacy. Findings from this dissertation study suggest that we should teach students to perform inquiry with some sort of framework or process, but that teachers and librarians should collaboratively follow students' processes with support and scaffolding through mentoring and social negotiation.

The link between teachers' conceptions of inquiry and how this affects their abilities to mentor students toward information literacy has also been shown in this study. Classroom teachers and librarians, as well as students, may need this mentoring and practice in disciplined inquiry. I certainly needed it. After the study, when I mentioned to one of the fifth grade teachers at Cabin Creek about having students begin with questions, she exclaimed, *"That would be a good way to do it."* Librarians will not do an adequate job of helping children to do inquiry unless there is constant conversation with classroom teachers about what inquiry is and how to engage students in it. We cannot be with the students at every step of the process. Therefore, we must do everything we can to scaffold the students at point of need, and to scaffold the teachers who may not know how to do inquiry themselves.

In order for teachers to teach inquiry, more up-front instructional design is required. This design should include the context of a community of learners (Levstik & Barton, 1997; Wells & Chang-Wells, 1992), including the teacher as coach and role model. More time is also required to do the instructional design, and this would be an excellent opportunity for teacher/librarian collaboration.

Designing On-Line Support Tools for Teachers and Mentors to Support Students' Development of Information Literacy

The preceding suggestions for promoting inquiry and information literacy do not solve the problem of a shortage of time. Part of the reason for the existence of this dissertation study is due to the shortage of time that exists in schools for teacher/librarian collaboration. Esser's (1999) work about elementary teacher-librarians suggests that collaboration is not a product of the "ideal" of taking time to sit down and plan, but of negotiating work relationships with colleagues. This negotiation often happens at the water fountain, in the hall, or after school. Realizing that much of collaboration occurs in this manner, teachers and librarians might use e-mail to initiate contact and carry on collaborative planning.

Since teacher and librarian alike can easily access the Research Buddy, it is possible that a redesigned Research Buddy could become an avenue for promoting collaboration between the classroom and library in the absence of a flexibly scheduled library. For example, the Research Buddy could include interactive forms where teachers could fill in text boxes to let the librarian know what they wanted and when they needed it. Used in isolation, the Research Buddy did not meet the needs that children had during their work. It needed to exist in a community of learners.

With collaborative use, teachers and librarians could build a community of learners by having common goals and planning to be responsible for assessing different parts of the inquiry process that the children complete. It was clear that for the Research Club students, mentoring was necessary to help them be successful with a research process, and there had to be a point where on-line guidance stopped and mentoring started. They were frustrated, they were uninterested, they needed to know next steps, they were burned out, they were bored, they were frantic, and they needed me. Often, they needed me before they knew it.

Further Questions

I wonder if the Tortoises who used seed questions will continue to do that as they complete research projects later in middle school and high school, or if they will experience disciplined inquiry before they enter college. Furthermore, I wonder if they will progress towards the information literacy standards, and most importantly, will they perceive themselves as life-long learners? One year after the completion of the dissertation study, Nita included a copy of a sixth-grade research report on horses in an e-mail message to me (March 19, 2000). It was a very interesting, readable report, but at the bottom, she shared with me, *"P.S. Don't worry, I didn't spend all that time typing this, I just copied it and pasted it."* Did she copy and paste it from her own written report, or from the Internet? If it were the latter, it saddens me that we did not engage in authentic inquiry, as her mental model of research remained so much the same after her work with the Research Buddy.

This study became an investigation focused on the beginning part of the students' research process rather than the latter part. Insights were gathered about the necessity of beginning research work with a clear focus that includes defining the task and questioning, and allowing the students to perform those tasks. Less was learned about the synthesis and evaluation of the students' research process. "Part of the pleasure of doing research stems from one's ability, pleasure, and comfort in writing" (B. Goldstein, personal communication, July 15, 2002). Nita did not like writing, and the other students avoided it. What is it about informational writing, and reading, that students want to avoid?

In order to address the concern about collaboration and the lack of flexible scheduling in schools, the following questions could be investigated.

1) How can we help students ask more interesting questions?

2) How can we help teachers learn how to teach inquiry? Could a teacher/librarian collaboration be feasible if a revised Research Buddy were used as the platform of an inquiry project (a Research Buddy placing more emphasis on inquiry and meaningful questions as a first step with frames, forms, working e-mail links, more suggestions for teacher use in inquiry, and possibly even a threaded discussion board)?

3) Would a re-designed Research Buddy be perceived as useful for the classroom teachers to restructure their instruction of research and critical thinking skills toward disciplined inquiry?

4) What are teachers' perceptions of working with on-line guidance for inquiry, or of working in collaboration with the school librarian?

5) With or without the Research Buddy, could teachers and librarians effectively plan a collaborative inquiry project through e-mail conversation?

6) Why do students have an aversion to reading and writing for research? Does the students' discomfort with reading and writing affect how they want to do research?

Did this dissertation solve my problems as a school librarian? No–but it did answer my questions regarding instruction with on-line guidance and student researching behavior. Helping young students develop information literacy through inquiry is a daunting, but feasible task. Samuel Smiles (1816-1904) stated, "We learn wisdom from failure much more than from success. We often discover what will do by finding out what will not do; and probably he who never made a mistake never made a discovery" (Bartlett, 1919). The primary value of this dissertation study is the discovery that the Research Buddy was not such a "buddy," and would not do, after all. School librarians must continue to investigate ways that will best help our students to become informationally-literate citizens.

Afterword

Technology swiftly changes with a mind-boggling plethora of software and hardware updates. In 1995, I began the doctoral process using the Windows 3.1 platform. That quickly migrated to Windows 95, then Windows 98, and I finished the dissertation via Windows XP. Most of these changes have been beneficial.

Unfortunately, we do not effect beneficial change in education so quickly. Standards and reforms abound and constantly change, primarily confusing and using up the scarce time of well-meaning teachers and media specialists who are concerned about assessment, accountability, and the success of their students. Systematic instructional design already takes a back seat to more pressing activities in a busy day. More than likely, what many teachers would find beneficial would be one quality methods class including pedagogy for disciplined inquiry and instructional design. Perhaps when teachers are given the tools regarding how to teach for such content integration, then the sheer amount of content might not seem so insurmountable.

It is interesting (and sad) that in my teaching experiences following the dissertation study, I have found the same kinds of attitudes about doing "research" in seventh graders and undergraduate college students that I observed in the Research Club of fifth graders. Seventh grade students in my computer applications classes did not want to read information that looked daunting, and did not evaluate web sources for quality information. Later, in my job as an assistant professor in a university instructional technology program, I found that undergraduates conducted "research" in much the same ways as fifth graders at Cabin Creek. Although by this time, I required meaningful questions, students did not spend a lot of time conceiving questions and defining their task. They wondered, *"Why do we need a question?"* The undergraduates were reluctant to use print sources or take hand-written notes. The biggest difference in the college sophomores and the fifth graders was that the majority of the college students followed through the process as assigned; however, they were working for a grade. No matter what age, I have noted that students need thoughtful mentoring and scaffolding during a research process. The availability of well-designed on-line resources is beneficial, as a starting point. However, it is evident that embedding the practice of disciplined inquiry into the curriculum cannot happen too soon.

APPENDICES

APPENDIX A

Benchmarks by Grade Level (http://www.kde.state.ky.us/oet/customer/benchmarks.asp)

The Kentucky Benchmarks are based on the AASL Student Information Literacy Standards. The benchmarks were added by a committee of library media specialists, School District Technical Contacts, and principals. Benchmarks are bulleted and italicized, and the AASL Student Information Literacy Standards and indicators are bolded.

Standard 1 – The student who is information literate accesses information efficiently and effectively.

#1. Recognizes the need for information

- *Grade 3 - students can recognize essential question and make choices; refine task (develop)*
- *Grade 5 - students can develop essential question and make choices and refine task (develop)*
- *Grade 8 - Students can develop essential question, make choices and refine task independently (master)*

#2. Recognizes that accurate and comprehensive information is the basis for intelligent decision making

- *Grade 3 - Evaluate accuracy of curriculum appropriate electronic and print information (introduction)*
- *Grade 5 Evaluate accuracy of curriculum appropriate electronic and print information. (develop)*
- *Grade 8 - Evaluate accuracy of curriculum appropriate electronic and print information (develop)*
- *Grade 12 - Evaluate accuracy of curriculum appropriate electronic and print information (master)*

#3. Formulates questions based on information needs

- *Grade 3 - Recognize questions to ask for accurate task definition (introduction)*
- *Grade 5 - Recognize questions to ask for accurate task definition (develop)*
- *Grade 8 - Recognize questions to ask for accurate task definition (master)*

#4. Identifies a variety of potential sources of information

- *Grade 3 - Print and electronic reference resources that are curriculum appropriate. For example, dictionary, encyclopedia, periodicals, biographical sources, geographical sources, search engines, WWW, almanacs, guidebooks, state and local resources, directories (introduction)*

- *Grade 5 - Print and electronic reference resources that are curriculum appropriate. For example, dictionary, encyclopedia, periodicals, biographical sources, geographical sources, search engines, WWW, almanacs, guidebooks, state and local resources, directories (develop) -- Introduce periodical index and quotation books.*

- *Grade 8 - Print and electronic reference resources that are curriculum appropriate. For example, dictionary, encyclopedia, periodicals, biographical sources, geographical sources, search engines, WWW, almanacs, guidebooks, state and local resources, directories, periodical indexes, quotation books (reinforce) -- Introduce career and post-secondary resources, handbooks, selected government documents, as appropriate to curriculum, bibliographies*

- *Grade 12 - Print and electronic reference resources that are curriculum appropriate. For example, dictionary, encyclopedia, periodicals, biographical sources, geographical sources, search engines, WWW, almanacs, guidebooks, state and local resources, directories, periodical indexes, quotation books, career and post-secondary resources, handbooks, selected government documents, as appropriate to curriculum, bibliographies -- Criticisms, reviews, poetry indexes (I,D,M)*

#5. Develops and uses successful strategies for locating information

- *Grade 3 - Locate resources; determine when technology and/or print resources are useful and select the appropriate resource for the task (introduction)*

- *Grade 5 - Locate resources; determine when technology and/or print resources are useful and select the appropriate resource for the task (develop)*

- *Grade 8 - Locate resources; determine when technology and/or print resources are useful and select the appropriate resource for the task (master)*

Standard 2 – The student who is information literate evaluates information critically and competently.

#1. Determines accuracy, relevance and comprehensiveness

#2. Distinguishes among facts, points of view, and opinion

#3. Identifies inaccurate and misleading information

- *Grade 3 - Research and evaluate the accuracy, relevance, appropriateness, comprehensiveness and bias of electronic information sources concerning real-world problems. (introduction)*

- *Grade 5 - Research and evaluate the accuracy, relevance, appropriateness, comprehensiveness and bias of electronic information sources concerning real-world problems (reinforce)*

- *Grade 8 - Research and evaluate the accuracy, relevance, appropriateness, comprehensiveness and bias of electronic information sources concerning real-world problems (reinforce)*
- *Grade 12 - Research and evaluate the accuracy, relevance, appropriateness, comprehensiveness and bias of electronic information sources concerning real-world problems (master)*

#4. Selects information appropriate to the problem or question at hand.

- *Grade 3 - Selects information appropriate to the problem or question at hand (introduction)*
- *Grade 5 - Selects information appropriate to the problem or question at hand (develop)*
- *Grade 8 - Selects information appropriate to the problem or question at hand (reinforce)*
- *Grade 12 - Selects information appropriate to the problem or question at hand (master)*

Standard 3 – The student who is information literate uses information accurately and creatively.

#1. Organizes information for practical application

- *Grade 3 - Notetaking, classify; and group information, organizing information with electronic tools (e.g. word processors, time lining software, concept mapping, spreadsheets, databases, WWW bookmarks) as related to the task (introduce)*
- *Grade 5 - Notetaking, classify; and group information, organizing information with electronic tools (e.g. word processors, time lining software, concept mapping, spreadsheets, databases, WWW bookmarks) as related to the task (develop)*
- *Grade 8 - Notetaking, classify; and group information, organizing information with electronic tools (e.g. word processors, time lining software, concept mapping, spreadsheets, databases, WWW bookmarks) as related to the task (reinforce)*
- *Grade 12 - Notetaking, classify; and group information, organizing information with electronic tools (e.g. word processors, time lining software, concept mapping, spreadsheets, databases, WWW bookmarks) as related to the task (master)*

#2. Integrates new information into one's own knowledge

- *Grade 3 - Draw conclusion and make connections with real life applications. Redefine task as appropriate (introduction)*
- *Grade 5 - Draw conclusion and make connections with real life applications. Redefine task as appropriate (develop)*
- *Grade 8 - Draw conclusion and make connections with real life applications. Redefine task as appropriate (reinforce)*

- *Grade 12 - Draw conclusion and make connections with real life applications. Redefine task as appropriate (master)*

#3. Applies information in critical thinking and problem solving

#4. Produces and communicates information and ideas in appropriate formats.

- *Grade 3 - Use technology resources for problem solving, communication, and illustration of thoughts, ideas and stories. Create developmentally appropriate multimedia products with support from teachers, family members or student partners. (e.g. presentation software, web page design programs, spreadsheets and databases, videos, scanners, digital cameras) (introduction)*
- *Grade 5 - Use technology resources for problem solving, communication, and illustration of thoughts, ideas and stories. Create developmentally appropriate multimedia products with support from teachers, family members or student partners. (e.g. presentation software, web page design programs, spreadsheets and databases, videos, scanners, digital cameras (develop)*
- *Grade 8 - Use technology resources for problem solving, communication, and illustration of thoughts, ideas and stories. Create developmentally appropriate multimedia products with support from teachers, family members or student partners. (e.g. presentation software, web page design programs, spreadsheets and databases, videos, scanners, digital cameras (reinforce)*
- *Grade 12 - Use technology resources for problem solving, communication, and illustration of thoughts, ideas and stories. Create developmentally appropriate multimedia products with support from teachers, family members or student partners. (e.g. presentation software, web page design programs, spreadsheets and databases, videos, scanners, digital cameras (master)*

Standard 4 – The student who is an independent learner is information literate and pursues information related to personal interests.

#1. Seeks information related to various dimensions of personal well-being, such as career interests, community involvement, health matters, and recreational pursuits

#2. Designs, develops and evaluates information products and solutions related to personal interests

Standard 5 – The student who is an independent learner is information literate and appreciates and enjoys literature and other creative expressions of information (in conjunction with reading in the content areas).

#1. Is a competent and self-motivated reader

- *Grade 3 - Introductory level in all areas with developing and reinforcing on a developmentally appropriate basis*
- *Grade 5 - Developing and reinforcing in all areas with mastery on a developmentally appropriate basis*
- *Grade 8 - Mastery level with continuing reinforcement*
- *Grade 12 - Mastery level*

#2. Derives meaning from information presented creatively in a variety of sources

- *Fiction*
    - *Genre (Historical, Realistic, Science, Fantasy, Adventure, Mystery)*
    - *Style*
    - *Themes (including Booktalks)*
    - *Authors/ Illustrators (including visits)*
    - *Short Stories*
- *Classic Literature -- Including cultural connections*
    - *Bible stores/myths/legends (including Odysseus)*
    - *Folklore/Fables (e.g. Robin Hood, King Arthur)*
    - *Poetry*
    - *Plays/Opera/Films (Including Shakespeare)*
    - *Jokes/Riddles*
- *Grade 3 - Introductory level in all areas with developing and reinforcing on a developmentally appropriate basis*
- *Grade 5 - Developing and reinforcing in all areas with mastery on a developmentally appropriate basis*
- *Grade 8 - Reinforcing in all areas with mastery on a developmentally appropriate basis*
- *Grade 12 - Mastery level*

#3. Develops creative products in a variety of formats

- *Read aloud -- including model reading*
- *Storytelling*

- *Drama -- including puppetry, creative drama, skits*
- *Book Reporting techniques -- include print and multimedia presentations.*
- *Circulation statistics of the F and/or E; SC; 220s; 290s; 398s; 782s; 793s; 800s.*

- *Grade 3 - Introductory level in all areas with developing and reinforcing on a developmentally appropriate basis*
- *Grade 5 - Developing level in all areas with reinforcing in all areas with mastery on a developmentally appropriate basis*
- *Grade 8 - Reinforcing level in all areas with mastery on a developmentally appropriate basis*
- *Grade 12 - Mastery level*

Standard 6 – The student who is an independent learner is information literate and strives for excellence in information seeking and knowledge generation.

#1. Assesses the quality of the process and products of one's own information seeking

#2. Devises strategies for revising, improving, and updating self-generated knowledge

- *Grade 3 - Revise*
    1. *Have I asked the right question? Did I follow the problem-solving process? Did I match the task definition?*
    2. *Is my product what I defined my task to be?*
    3. *Did I consider electronic and print resources?*
    4. *Did I evaluate information related to my task? Did my product communicate to the audience effectively? (check spelling and grammar, is work visually appealing?) (introduction)*
- *Grade 5 - Revise*
    1. *Have I asked the right question? Did I follow the problem-solving process? Did I match the task definition?*
    2. *Is my product what I defined my task to be?*
    3. *Did I consider electronic and print resources?*
    4. *Did I evaluate information related to my task? Did my product communicate to the audience effectively? (check spelling and grammar, is work visually appealing?) (develop)*

- *Grade 8 - Revise*

    1. *Have I asked the right question? Did I follow the problem-solving process? Did I match the task definition?*
    2. *Is my product what I defined my task to be?*
    3. *Did I consider electronic and print resources?*
    4. *Did I evaluate information related to my task? Did my product communicate to the audience effectively? (check spelling and grammar, is work visually appealing?) (reinforce)*

- *Grade 12 - Revise*

    1. *Have I asked the right question? Did I follow the problem-solving process? Did I match the task definition?*
    2. *Is my product what I defined my task to be?*
    3. *Did I consider electronic and print resources?*
    4. *Did I evaluate information related to my task? Did my product communicate to the audience effectively? (check spelling and grammar, is work visually appealing?) (master)*

Standard 7 – The student who contributes positively to the learning community and to society is information literate and recognizes the importance of information to a democratic society.

#1. Seeks information from diverse sources, contexts, disciplines and cultures

- *Grade 3 - Students locate print and non-print sources; evaluate and collect information from diverse sources, context, disciplines, and cultures when appropriate to time and community. (introduce)*
- *Grade 5 - Students locate print and non-print sources; evaluate and collect information from diverse sources, context, disciplines, and cultures when appropriate to time and community (develop)*
- *Grade 8 - Students locate print and non-print sources; evaluate and collect information from diverse sources, context, disciplines, and cultures when appropriate to time and community (reinforce)*
- *Grade 12 - Students locate print and non-print sources; evaluate and collect information from diverse sources, context, disciplines, and cultures when appropriate to time and community (master)*

#2. Respects the principle of equitable access to information

Standard 8 – The student who contributes positively to the learning community and to society is information literate and practices ethical behavior in regard to information and information technology.

#1. Respects the principles of intellectual freedom

- *Grade 3 - Students understand the ethical, cultural, and societal issues related to information resources, both print and electronic. (ISTE 2A) (introduction)*
- *Grade 5 - Students understand the ethical, cultural, and societal issues related to information resources, both print and electronic. (ISTE 2A) (develop)*
- *Grade 8 - Students understand the ethical, cultural, and societal issues related to information resources, both print and electronic. (ISTE 2A) (reinforce)*
- *Grade 12 - Students understand the ethical, cultural, and societal issues related to information resources, both print and electronic. (ISTE 2A) (master)*

#2. Respects intellectual property rights

- *Grade 3 - Extracts information appropriately and record citations. Apply legal principles and ethical conduct related to information technology related to copyright and plagiarism. Students practice responsible use at technology systems, information and software, (Introduction)*
- *Grade 5 - Extracts information appropriately and record citations. Apply legal principles and ethical conduct related to information technology related to copyright and plagiarism. Students practice responsible use at technology systems, information and software (develop)*
- *Grade 8 - Extracts information appropriately and record citations. Apply legal principles and ethical conduct related to information technology related to copyright and plagiarism. Students practice responsible use at technology systems, information and software (reinforce)*
- *Grade 12 - Extracts information appropriately and record citations. Apply legal principles and ethical conduct related to information technology related to copyright and plagiarism. Students practice responsible use at technology systems, information and software (master)*

#3. Uses information technology responsibly

- *Grade 3 - Use appropriate electronic etiquette. (introduction) Demonstrate understanding of privileges and consequences of Acceptable Use policy. (introduction) Demonstrate understanding that what a student does on a network affects other users. (introduction)*

- *Grade 5 - Use appropriate electronic etiquette. Demonstrate understanding of privileges and consequences of Acceptable Use policy. Demonstrate understanding that what a student does on a network affects other users. (develop)*

- *Grade 8 - Use appropriate electronic etiquette. Demonstrate understanding of privileges and consequences of Acceptable Use policy. Demonstrate understanding that what a student does on a network affects other users. (reinforce EXCEPT UNDERSTANDING THAT WHAT ONE STUDENT DOES ON A NETWORK AFFECTS OTHER USERS. That should be mastered by 8th grade.)*

- *Grade 12 - Use appropriate electronic etiquette. Demonstrate understanding of privileges and consequences of Acceptable Use policy. Demonstrate understanding that what a student does on a network affects other users. (master)*

Standard 9 – The student who contributes positively to the learning community and to society is information literate and participates effectively in groups to pursue and generate information.

#1. Shares knowledge and information with others

See Benchmarks for AASL Standards #3 and #4

- *Grade 3 - e-mail (Keypals) in connection with curriculum, interactive websites school-related activities (e.g. STLP, Beta Club), distance learning (KET Electronic Field Trips) (introduce)*

- *Grade 5 - e-mail (Keypals) in connection with curriculum, interactive websites school-related activities (e.g. STLP, Beta Club), distance learning (KET Electronic Field Trips) (develop)*

- *Grade 8 - e-mail (Keypals) in connection with curriculum, interactive websites school-related activities (e.g. STLP, Beta Club), distance learning (KET Electronic Field Trips) (master)*

#2. Respects others' ideas and background and acknowledges their contributions

See Benchmark for Standard 8, point #2

#3. Collaborates with others, both in person and through technologies, to identify information problems and to seek their solutions

See Benchmarks for Standard 1, plus collaborates with others

#4. Collaborates with others, both in person and through technologies, to design, develop and evaluate information products and solutions

- *Grade 3 - Students use telecommunications to collaborate, publish and interact with peers, experts, and other audiences (introduction)*

- *Grade 5 - Students use telecommunications to collaborate, publish and interact with peers, experts, and other audiences (develop)*
- *Grade 8 - Students use telecommunications to collaborate, publish and interact with peers, experts, and other audiences (develop)*
- *Grade 12 - Students use telecommunications to collaborate, publish and interact with peers, experts, and other audiences (master)*

KEY

INTRODUCED -- Basic components or prerequisites of a skill or concept are covered. Instruction is often in the context of other content; little or no accountability is expected of students.

DEVELOPED -- Skills or concepts are taught more specifically. Instruction may be in the context of other content or in isolation. Students are accountable for some mastery of those skills or concepts but not all of them. This may be a period of building fluency.

REINFORCED -- Skills or concepts that were previously developed are revisited in a different context and over a longer period of time.

MASTERED -- Instruction on skills or concepts is completed and students are expected to demonstrate understanding of all main aspects. Students are expected to maintain mastery over a long period of time.

Comparison of the Kentucky Educational Reform Act (KERA) Goals and Academic Expectations that Address Information Literacy with the Kentucky Grade 5 Benchmarks for the National Information Literacy Standards

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
1. Students are able to use basic communication and mathematics skills for purposes and situations they will encounter throughout their lives.	1.1 Students use research tools to locate sources of information and ideas relevant to a specific need or problem.	Standard 1 – The student who is information literate accesses information efficiently and effectively.	
		Indicator 4. Identifies a variety of potential sources.	Identifies print and electronic reference resources that are curriculum appropriate. For example, dictionary, encyclopedia, periodicals, biographical sources, geographical sources, search engines, WWW, almanacs, guidebooks, state and local resources, directories (develop). Introduce periodical index and quotation books.)
		Indicator 5. Develops and uses successful strategies for locating information	Locates resources; determines when technology and/or print resources are useful and select the appropriate resource for the task (develop)
		Standard 2 - The student who is information literate evaluates information critically and competently	Selects information appropriate to the problem or question at hand (develop)
		Indicator 4. Selects information appropriate to the problem or question at hand.	

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
		Standard 7. The student who is information literate recognizes the importance of information to a democratic society. *Indicator 1.* Seeks information from diverse sources, contexts, disciplines and cultures	Locates print and non-print sources; evaluates and collects information from diverse sources, context, disciplines, and cultures when appropriate to time and community (develop)
	1.2 Students construct meaning from a variety of print materials for a variety of purposes through reading.	Standard 2. The student who is information literate evaluates information critically and competently *Indicator 1.* Determines accuracy, relevance and comprehensiveness. *Indicator 2.* Distinguishes among facts, points of view, and opinion. *Indicator 3.* Identifies inaccurate and misleading information–researches and evaluates the accuracy, relevance, comprehensiveness and bias of electronic sources concerning real-world problems.	Researches and evaluates the accuracy, relevance, appropriateness, comprehensiveness and bias of electronic information sources concerning real-world problems (reinforce)

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
		Standard 3. The student who is information literate uses information effectively and creatively. *Indicator 2.* Integrates new information into one's own knowledge *Indicator 3.* Applies information in critical thinking and problem-solving.	Draws conclusions and makes connections with real life applications. Redefines task as appropriate (reinforce)
	1.10 Students organize information through development and use of classification rules and classification systems.		
	1.16 Students use computers and other electronic technology to gather, organize, manipulate, and express information and ideas.	Standard 1. The student who is information literate accesses information efficiently and effectively *Indicator 4.* Identifies a variety of potential sources of information.	Print and electronic reference resources that are curriculum appropriate (develop) – Introduce periodical index and quotation books

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
		Indicator 5. Develops and uses successful strategies for locating information	Locates resources; determines when technology and/or print resources are useful and selects the appropriate resource for the task (develop)
		Standard 3. The student who is information literate uses information effectively and creatively.	Notetaking, classifies and groups information, organizing information with electronic tools as related to the task.
		Indicator 1. Organizes information for practical application	
		Indicator 4. Produces and communicates information and ideas in appropriate formats	Uses technology resources for problem-solving, communication, and illustration of thoughts, ideas, and stories. Creates developmentally appropriate multimedia products with support from teachers, family members or student partners
		Standard 8. Practices ethical behavior in regards to information and information technology.	Extracts information appropriately and records citations. Applies legal principles and ethical conduct related to information technology in the areas of copyright and plagiarism. Students practice responsible use of technology systems, information and software (develop)
		Indicator 2. Respects intellectual property rights	

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
2. Students shall develop their abilities to apply core concepts and principals from mathematics, the sciences, the arts, the humanities, social studies, practical living studies and vocational studies to what they will encounter throughout their lives.	2.1 Students use appropriate and relevant scientific skills to solve specific problems in real-life situations.	Standard 1. The student who is information literate accesses information efficiently and effectively.	Students can develop essential questions, make choices and refine task
		Indicator 1. Recognizes the need for information	
		Indicator 2. Recognizes that accurate and comprehensive information is the basis for intelligent decision making	Evaluates accuracy of curriculum appropriate electronic and print information (develop)
	2.2 Students identify, compare, and contrast patterns and use patterns to understand and interpret past and present events and predict future events.	*Indicator 3*. Formulates questions based on information needs	Recognizes questions to ask for accurate task definition (develop)
		Indicator 4. Identifies a variety of potential sources of information	Print and electronic reference resources that are curriculum appropriate.
		Standard 3. The student who is information literate uses information effectively and creatively.	Notetaking, classify and group information, organize information with electronic tools as related to the task
		Indicator 1. Organizes information for practical application	

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
	2.22 Students create products and make presentations that convey concepts and feelings.	Standard 3. The student who is information literate uses information effectively and creatively. *Indicator 4.* Produces and communicates information and ideas in appropriate formats	Uses technology resources for problem-solving, communication, and illustration of thoughts, ideas, and stories.
		Standard 4. The student who is an independent learner is information literate and pursues information related to personal interests. *Indicator 2.* Designs, develops, and evaluates information products and solutions related to personal interests	Students practice responsible use of technology systems information and software (develop)
		Standard 9. The student who contributes positively to the learning community and to society is information literate and participates effectively in groups to pursue and generate information *Indicator 1.* Shares knowledge and information with others	Uses e-mail in connection with curriculum, interactive websites, school-related activities, distance learning (develop)

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
	2.23 Students analyze their own and others' artistic products and performances.	Standard 6. The student who is an independent learning is information and strives for excellence in information-seeking and knowledge generation. *Indicator 1.* Assesses the quality of the process and products of one's own information-seeking *Indicator 2.* Devises strategies for revising, improving, and updating self-generated knowledge Standard 9. The student who contributes positively to the learning community and to society is information literate and participates effectively in groups to pursue and generate information *Indicator 2.* Respects others' ideas and background and acknowledges their contributions	Revise: Have I asked the right question? Did I follow the problem-solving process? Did I match the task definition? Is my product what I defined my task to be? Did I consider electronic and print resources? Did I evaluate information related to my task? Did my product communicate to the audience effectively? (develop)

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
3. Students shall develop their abilities to become self-sufficient individuals.	3.7 Students demonstrate the ability to learn on one's own.	Standard 6. The student who is an independent learning is information and strives for excellence in information-seeking and knowledge generation. *Indicator 1.* Assesses the quality of the process and products of one's own information-seeking *Indicator 2.* Devises strategies for revising, improving, and updating self-generated knowledge Standard 4. The student who is an independent learner is information literate and pursues information related to personal interests. *Indicator 2.* Designs, develops and evaluates information products and solutions related to personal interests	Revise: Have I asked the right question? Did I follow the problem-solving process? Did I match the task definition? Is my product what I defined my task to be? Did I consider electronic and print resources? Did I evaluate information related to my task? Did my product communicate to the audience effectively?

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
4. Students shall develop their abilities to become responsible members of a family, work group, or community, including demonstrating effectiveness in community services.	4.6 Students demonstrate an open mind to alternative perspectives.	Standard 7. The student who contributes positively to the learning community and to society is information literate and recognizes the importance of information to a democratic society. *Indicator 1.* Seeks information from diverse sources, contexts, disciplines and cultures	Locates print and non-print sources; evaluates and collects information from diverse sources, context, disciplines, and cultures when appropriate to time and community (develop)
5. Students shall develop their abilities to think and solve problems in school situations and in a variety of situations they will encounter in life.	5.1 Students will use critical thinking skills in a variety of situations that will be encountered in life.	Standard 1. The student who is information literate accesses information efficiently and effectively. *Indicator 1*. Recognizes the need for information	Students can develop essential questions and make choices and refine task.
		Indicator 2. Recognizes that accurate and comprehensive information is the basis for intelligent decision making	Evaluates accuracy of curriculum appropriate electronic and print information.
		Indicator 3. Formulates questions based on information needs	Recognize questions to ask for accurate task definition.

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
		Standard 2. The student who is information literate evaluates information critically and competently *Indicator 1.* Determines accuracy, relevance and comprehensiveness. *Indicator 2.* Distinguishes among facts, points of view, and opinion. *Indicator 3.* Identifies inaccurate and misleading information *Indicator 4.* Selects information appropriate to the problem or question at hand Standard 3. The student who is information literate uses information effectively and creatively. *Indicator 3.* Applies information in critical thinking and problem-solving.	Research and evaluate the accuracy, relevance, appropriateness, comprehensiveness and bias of electronic information sources concerning real-world problems (reinforce) (develop)
	5.3 Students create and modify their understanding of a concept through organizing information.	Standard 3. The student who is information literate uses information effectively and creatively. *Indicator 1.* Organizes information for practical application	Notetaking, classify and group information, organizing information with electronic tools as related to the task

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
	5.4 Students use a decision-making process to make informed decisions among options.	*Indicator 2*. Integrates new information into one's own knowledge	Draws conclusion and make connections with real life applications. Redefines task as appropriate.
	5.5 Students use problem-solving processes to develop solutions to relatively complex problems.	Standard 6. The student who is an independent learner is information literate and strives for excellence in information-seeking and knowledge generation. *Indicator 1.* Assess the quality of the process and products of one's own information-seeking *Indicator 2.* Devises strategies for revising, improving, and updating self-generated knowledge	Revise: Have I asked the right question? Did I follow the problem-solving process? Did I match the task definition? Is my product what I defined my task to be? Did I consider electronic and print resources? Did I evaluate information related to my task? Did my product communicate to the audience effectively?

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
6. Students shall develop their abilities to connect and integrate experiences and new knowledge from all subject matter fields with what they have previously learned and build on past learning experiences to acquire new information through various media sources.	6.1 Students address situations (e. g., topics, problems, decisions, products) from multiple perspectives and produce presentation or products that demonstrate a broad understanding and experiences.	Standard 9. The student who contributes positively to the learning community and to society is information literate and participates effectively in groups to pursue and generate information. *Indicator 1.* Shares knowledge and information with others. *Indicator 2.* Respects others' ideas and background and acknowledges their contributions.	Uses e-mail in connection with curriculum interactive websites, school-related activities, distance learning (develop)

KERA Goal	KERA Academic expectation	AASL Information Literacy Standards	Kentucky Grade 5 Benchmarks
	6.2 Students use what they already know to acquire new knowledge, develop new skills, or interpret new experiences. 6.3 Students expand their understanding of existing knowledge (e.g., topic, problem, situation, product) by making connections with new and unfamiliar knowledge, skills,	*Indicator 3.* Collaborates with others, both in person and through technologies, to identify information problems and to seek their solutions *Indicator 4.* Collaborates with others, both in person and through technologies, to design, develop and evaluate information products and solutions. Standard 6. The student who is an independent learner is information literate and strives for excellence in information-seeking and knowledge generation. *Indicator 1.* Assesses the quality of the process and products of one's own information-seeking *Indicator 2.* Devises strategies for revising, improving, and updating self-generated knowledge	Revise: Have I asked the right question? Did I follow the problem-solving process? Did I match the task definition? Is my product what I defined my task to be? Did I consider electronic and print resources? Did I evaluate information related to my task? Did my product communicate to the audience effectively?

Appendix B

Formative Evaluation from Exploratory Study

I completed a formative evaluation of the Research Buddy during a spring 1998 exploratory study, which was also the basis for this dissertation study. In the exploratory study, I investigated how students used the Research Buddy, and what features of the web site needed modification. To structure the formative evaluation, I used the goals from Planning and Conducting Formative Evaluation (Tessmer, 1993). Tessmer's four goals were to identify deficiencies in learning effectiveness, locate ease of use problems, evaluate the efficiency of the instruction, and analyze instructional strengths.

Goal 1: Identifying Deficiencies in Learning Effectiveness

Deficiencies in the learning effectiveness of the Research Buddy, the first goal, indicate where students failed to find the program effective. The Research Buddy must be interesting to the users, have accurate information, and provide some motivation (Tessmer, 1993). First, I found that the page length was a barrier to students' interest in reading the whole web page; too much scrolling was necessary to get all the information (Figure B1).

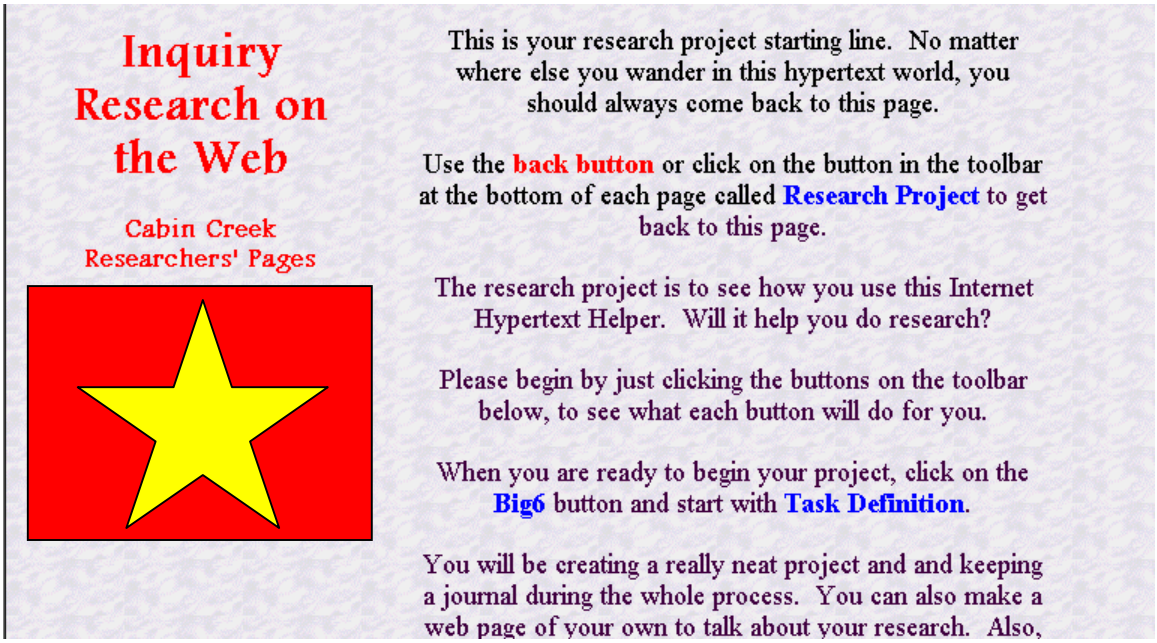


Figure B1: Original Research Buddy Home Page.

Researcher: Did you scroll down the page or did you tend to skip the page?

Student 1: Um, sometimes I scrolled down, sometimes I skipped it (JS3).

Because of that barrier, I changed most of the pages by splitting them into screen-sized sections (Figure B2).

Figure B2: Revised Research Buddy Home Page.

At the bottom of the pages, I added "next" and "back" buttons to help students navigate. On these pages, I deleted the navigation bar at the bottom, to deter students from hopping to another point before they finished reading, but I included the navigation bar on the last page of each section. One student commented, *"*[It is] *easier to, like go from the top of the page to the bottom of the page... one page to the next" (JS3).* But another student said, *"Sometimes you can get lost... you keep going to next and it gets confusing sometimes" (MR3).*

To address motivation and interest, I included several graphics, illustrations, and examples to avoid having so much text all together. I used large fonts so the students would not be discouraged by "little" words. I incorporated links to other pages to provide extra information when students needed it.

The Research Buddy contained accurate information about the research process, yet one student thought she would find actual content about her topic in it. Giselle, a student in the exploratory study, searching for information about Harriett Tubman, said, *"I found... about her mother, and her father. How she escaped slaves, and the tricks that she done."* She thought that she could have done as well without the Research Buddy. As the novice computer-user of the four, Giselle did not understand the difference in the Research Buddy pages and those she found from the Internet.

Goal 2: Locating Ease of Use or Implementation Problems

For Tessmer's second evaluation goal of locating ease of use problems, I needed to find out if the students were able to use the Research Buddy strategies and the hardware and software involved. This proved to be the most important part of the evaluation, as part of the reason for non-use of the Research Buddy was their unfamiliarity with computers, the Internet, and Netscape. One student stated, *"I kind of got lost a little bit, and it was kind of confusing, because some pages were here, and you weren't sure if you had to go this way or this way" (MP3).*

Goal 3: Determining the Efficiency of the Instruction

Determining the efficiency of the instruction analyzed the fit of the time to use the Research Buddy with the students' available time to use it. Overall, the project, which seemed to last a long time, was too short-lived. Students needed time to learn how to use the Research Buddy and other pertinent computer programs. They also needed time to actually use the Research Buddy to help guide them through the process. Therefore, efficiency could not be determined. None of the students actually went through the whole *Big6* process using the Research Buddy. One of the students stated that one of the bad points of using it to work on his project was that it *"took time."* However, this could have been due to his unwillingness to take the necessary time to work at his project. He had said earlier, *"*[Writing] *makes your hand hurt, it makes your head hurt, and it takes a long time" (JS3).*

Goal 4: Determining the Strengths of the Instruction

The final evaluation goal was to determine the strengths of the instruction. Only one student rarely felt lost in the Research Buddy because the student used the navigation bar at the bottom of each page. I used student projects and their perceptions of doing research before and after using the Research Buddy to determine the Research Buddy*'s* effectiveness as a guide. In studying the narratives from each student about how they found and used information before we started and how they did it afterwards, I found that a few new habits were formed, and some old ones were strengthened. The students enjoyed the "hunt" with the computer, were less enthusiastic about using print materials, and dragged their feet during the writing stage. Students considered doing webs and interviews as suggested by the Research Buddy, which they had not used before the study. Students also though the Research Buddy helped them with organization. *"*[It helps] *a little bit ... cause, it makes me more organized" (MP3).* Yet another student did not like the organization, *"I don't like going through all the steps to do a project, I just like doing the project" (MR3).* Other students used printing out articles and highlighting as new strategies.

Appendix C

A Synthesis of the Literature Related to the Design of the Research Buddy

Author(s)	Premise of Study or Article	Elements of Program Design
(Sandlian, 1995)	Children using OPACs have trouble using correct terms to initiate a search, find it hard to sift through the list of hits, have spelling errors, are not familiar with computer procedures, and the Dewey decimal system confuses them.	Provide many opportunities to use the computers before initiating study. Provide special training on OPAC use. Include OPAC searching as part of the Research Buddy. Include information on Dewey Decimal System in the Research Buddy.
(Edmonds et al., 1990)	A librarian's assistance was needed when children used the OPAC; there was no prior instruction given for the OPAC.	Students may e-mail the librarian from any page of the Research Buddy; students are encouraged to contact the librarian personally for help. Provide instruction on the use of the OPAC; include OPAC instruction in the Research Buddy.
(Marchionini & Teague, 1987) (Marchionini, 1988)	Children can learn the basic concepts related to on-line searching, but do not move efficiently through menus, and use the strategy of exhaustion. Freedom to learn is not a sufficient condition to assure effective learning. The learning environment contains problems such as confusion, grandiose expectations, resistance to change, and burnout.	Shorter pages in the Research Buddy with Next and Back buttons to facilitate children's reading of an entire section. Students are directed in the Research Buddy to read the *Big6* systematically. Students are required to reflect through journal questions. Students are encouraged to use the e-mail capability and to contact the researcher as frequently as necessary for help and guidance. Students will be closely monitored; having one or two sessions per week in the library with the researcher.

Author(s)	Premise of Study or Article	Elements of Program Design
(Hill & Hannafin, 1997)	Factors that impact strategies adult learners use in an Open-Ended Learning Environment are metacognitive knowledge, perceived orientation, perceived self-efficacy, system knowledge, and prior knowledge.	The journal section of the Research Buddy is designed to help student reflection (metacognition). Provide instruction on the use of the WWW and other hypertext programs. Provide instruction in library skills. A program map, index, and navigation toolbar on many pages are included in the Research Buddy to keep students oriented.
(Hirsch, 1996) (Hancock, 1995)	Grounding in content is an important aspect of education. Learners cannot acquire information literacy skills independent of content.	Research Buddy includes information on library skills such as location and use. Research Buddy gives multiple suggestions for types of sources.
(Mayer, 1992)	Expertise is a result of knowledge and techniques for problem-solving of one's field.	Prior use of hypertext programs, prior instruction on library skills, and scaffolding included in the Research Buddy for problem-solving.
(Dale, 1996)	What a child does helps them make sense of it.	Research Buddy keeps children directly involved with the journal section and on-line instruction.
(Teague, Rogers, & Tipling, 1994)	Instruction provides cues or directions, the learner participates in the activity, and reinforcement and feedback are provided.	Research Buddy includes directions for use, and reflective questions. Reinforcement and feedback are provided through use of e-mail and interviews.
(McKnight et al., 1996)	Problems with hypertext research include difficulties in controlled experimentation, finding ecologically valid tasks, and describing the process and outcome of learning.	Study will provide a rich description of events, contexts, and participants. Task of doing research is increasingly valid for our information society.

Author(s)	Premise of Study or Article	Elements of Program Design
(Dee-Lucas, 1996; McAleese, 1988; Nielsen & Lyngbaek, 1989; Wenger & Payne, 1994)	Include maps to create structure in hypertext.	Research Buddy includes a program map and an index.
Jonassen cited by McKnight et al., 1996)	A fair evaluation of learning from hypertext can only come from hypertext-literature users with navigation and integration-of-information strategies.	Students will have opportunity to learn how to use the WWW, Encarta, and other on-line hypertext products before inception of study.
(Spyridakis, cited by Wenger & Payne, 1994)	Cues help readers locate and relate information from different locations in a document.	Many hypertext links are provided in the Research Buddy that cross-index one page of information with another.
(Anderson-Inman & Tenny, 1989)	To study for learning, students should manipulate the information, monitor their progress, and take personal responsibility.	Research Buddy is based on the *Big6* information problem-solving process that allows for all these elements of learning.
(Chang & McDaniel, 1995) (Jonassen, 1997) (Wittrock, 1991)	Cognitive complexity impacts search strategies. Hypertext systems can prompt students to monitor their own thinking. Awareness and self-control of learning processes increase achievement.	Journal questions are designed to cause students to reflect on their actions and thinking.
(Jacobson, 1996)	Students who freely chose where to go in hypertext were not successful because of their novice state; students who had the most freedom of choice liked it the least; students who held complex epistemic beliefs benefited.	Pages are designed to scaffold the learners; large sections of information are divided into several pages with Next and Back buttons. Questions are included on the interview to determine what users think about learning.

Author(s)	Premise of Study or Article	Elements of Program Design
(Jonassen & Reeves, 1996)	It is hard to anticipate how individuals will interpret instruction.	Students have opportunity to determine what is important, and to react to and assess what they know through mentoring and through journal entries.
(Gray, 1994)	Students' basic cognitive skills should involve application, comparing and contrasting, and problem-solving.	The *Big6* model for information problem-solving is the basis for the Research Buddy.
(Brown et al., 1989)	Situating learning in a real-life way allows for development of skills.	The Research Buddy can assist students in answering any informational problem they have by helping them with library and information use.
(Horne, 1990)	Problem-solving is reflected as successful and unsuccessful questioning behavior.	Research Buddy prompts users to ask questions, search for answers, and evaluate their tasks.
(Martinello et al., 1996)	Children were paired with adult mentors throughout an inquiry process; using several strategies to help children.	Research Buddy is an on-line guidance system in that it suggests strategies for use, asks the students to think about their actions, and makes the researcher available through e-mail and face-to-face interaction.

Appendix D

Consent and Assent Letters

Consent for Research Study

"What students think about using the Research Buddy for information problem-solving."

Dear Parent or Guardian of _____ (student),

My name is Melissa Gibson, and I am the Cabin Creek Elementary School librarian. I am working on a degree at the University of Kentucky, which requires me to do some research in a school. My research will be conducted under the direction of Dr. Joan Mazur and Dr. Gary Anglin.

I would like for your child to be included in my research. I will be studying what they think about and how they use a program I wrote for the Internet. This program, called the Research Buddy, helps students do information problem-solving (library research).

The following are activities that your child will doing when we can plan times to meet (before, during, or after school once or twice a week):

Some interviews where I ask questions
Some observations where I watch them using the Research Buddy and doing research
Some teaching sessions where I help them learn about the Internet and doing research
Sessions where they work on computer programs to learn how to use them
They will earn an Internet Driver's License
They will work in the library doing research a lot
They will write about what they do in a journal each time they work (this is a lot)
They will create a project or presentation about their research
They may write a web page about their project if they choose

For the three-month study, the research times would be probably twice per week at most, and I would be happy to provide transportation home afterwards. We will work in the library and computer lab. Their teacher has already given permission to allow them out of class at times when they are finished with all other work, or at recess. For their participation, they can earn a star for each 30 minute-work session in the library for their Research Buddy Progress chart. For each star, they earn a Book Fair Buck that they can spend at the book fair in May. We will have a pizza party at the end of the study, where students will present their projects to one another. Finally, students may act as Library Research Assistants to members of their class as they learn new skills dealing with research.

Every effort will be made to maintain confidentiality, so names and pictures will not be used either in discussion or a write-up. Cabin Creek as a school will not be identified, nor will the teachers. Everyone except me will have made-up names. Only I will know who says what in any particular interview or observation, and I will code those with numbers. The only other risk involved could be if inappropriate material is accessed on the Internet. I minimize that risk with the Internet Driver's License, with Cyberpatrol in the lab, and by being present when they use

the Internet in the library. Benefits are many, as they will learn much about doing research in the library which will help them throughout their lives. However, it will involve a lot of work doing research. I will take notes on what they say, and sometimes will use a tape recorder.

If you have any questions about this study or its procedures, you are invited to give me a call at my home, 276-1902. Most evenings I am home after 9:30 p.m. or so. If you have questions about your child's rights as a research subject, you may contact the Research Subjects Office at the University of Kentucky at 323-2446. I am asking 2 to 6 children to be in this study. Participation is entirely voluntary. Also, if at any time your child wants to stop, he or she may choose to do so at any time, with no penalties involved. I appreciate the opportunity of working with your child, and I think that we will have fun with this!

If you agree to allow your child to participate in this study, please sign below and return this letter to me in the library. I will return a copy of this consent form to you. If at all possible, I would like to begin this study next week. Thank you in advance for your time and consideration.

I agree to allow _____ to participate in this research.

_____ parent/guardian signature

_____ parent/guardian signature

_____ Date

I have explained in detail the research procedure in which the subject has consented to participate.

_____ principal investigator

_____ Date

Assent Letter

Assent for Research Study: "What students think about using the Research Buddy for information problem-solving."

I _____(student) have been asked to be in the research study being conducted by Melissa R. Gibson under the direction of Dr. Joan Mazur and Dr. Gary Anglin of the University of Kentucky.

The purpose of the study is to find out what I think about and how I use a program called the Research Buddy, which may help me do information problem-solving (library research).

Activities that I will be asked to do (before, during, or after school once or twice a week) are some interviews and observations where Mrs. Gibson will watch me. There will also be some teaching sessions where I learn about the Internet and about doing research, and some times where I will work on computer programs to learn how to use them. I will earn an Internet Driver's License, will work in the library doing research a lot, and I will write about what I do in a journal each time (this is a lot). Finally, I will create a project or presentation (it might be to write a web page).

I know that this study will last three-months. We will work in the library or computer lab. I can earn a star for each part of the Research Buddy Star Chart I finish. Each star is worth a Book Fair Buck I can spend at the book fair in May. I know there will be a pizza party at the end of the study, where I will present my project to the other students. Also, I can be a Library Research Assistant to help other students in the library.

Mrs. Gibson will never use my name when she is talking or writing about this study. The one dangerous thing that could happen is seeing bad things on the Internet, but she is going to be very careful about that. I know that this is really going to be a lot of work, but I will learn a lot about how to do research in a library, and will really feel good about it when I'm finished. Mrs. Gibson will take notes on what I say and sometimes use a tape recorder.

If I have questions about this study, I may call Mrs. Gibson at home, 276-1902. If I have questions about my rights as a research subject, I may call the Research Subjects Office at 323-2446. I am a volunteer, so if I change my mind I may stop doing this study without getting in trouble.

_____

I agree to participate. I will receive a copy of this assent form.

_____ student signature _____ Date

I have explained in detail the research procedure in which the subject has consented to participate.

_____ principal investigator _____ Date

Appendix E

Perception Questionnaire

The Information Search Process/Self-regulatory Skills

Put a check mark in the column that is most like you.

Questions	Yes	No	Some-times
Mentoring			
1. I ask the librarian for help with my research project.			
2. I find it helpful to talk to others about my topic			
3. I talk to people who know about my topic.			
4. I use the help screens on the computer resources.			
Information-seeking Skills			
5. I have a clear focus for my topic before using the library			
6. My thoughts about my topic change as I explore information			
7. I like to find everything I will need first and then read it.			
8. The library has the information I need.			
9. All the sources of information I need are listed in the OPAC.			
10. I make several trips to the library to research a topic.			
11. The information I need is in unexpected places in the library.			
12. I am successful in using the library			
13. I need materials other than books.			
14. A search is completed when I no longer find new information.			
15. A search is completed when I find enough information.			
Using Information Skills			
16. When reading, I try to connect the things I am reading about with what I already know.			
17. I take detailed notes from every source of information I look at.			
18. I make an outline before I write my paper.			
19. When I take notes from my reading, I write down the page numbers where I found the information.			
20. I use the table of contents to help me find information.			
21. I use the index to help me find information.			
22. I use the glossary to find meanings of words I don't know.			
Critical Thinking			
23. I become more interested in a topic as I gather information			
24. When studying, I copy my notes over to help me remember material.			

Questions	Yes	No	Some-times
25. When I study, I put important ideas into my own words.			
26. I use what I have learned from old homework assignments and the textbook to do new assignments.			
27. I ask myself questions to make sure I know the material I have been studying.			
28. When I'm reading, I stop once in a while and go over what I have read.			
29. I study or work where I will not be interrupted.			
30. I turn off the radio and TV so I can concentrate on what I am doing.			
31. It is hard for me to decide what the main ideas are in what I read.			
32. I check over my work to make sure I did it right.			
33. When I am studying a topic, I try to make everything fit together.			
Persistence/Motivation			
34. When work is hard, I either give up or study only the easy parts.			
35. Even when study materials are dull and uninteresting, I keep working until I finish.			
36. I work hard to get a good grade even when I don't like a class.			

Appendix F

Interview Questions

Questions on the beginning interview.

Research process

1. Take me step-by-step through the way you would do a research project.
2. How do you know what kind of information to look for when you start a project?
3. Where do you think you might find useful information for a project?
4. How would you find sources like books, encyclopedias, magazines, and computer resources?

Computer exposure

5. Do you have a computer at home that you get to use? Tell me how you use it.
6. Once you find a good page of information in a book or on the computer, what do you do next? (If you are writing a report or making a presentation.)

Mentoring

7. What are some problems you have had before in finding information? (Perhaps in a research project that you have done before)
8. What kind of help did you have to ask for?
9. What kind of help do you need when you are working on a project?

Questions on weekly interviews. Week 1.

Critical thinking

1. Bring me up to date on your project. How is it going? What are you doing now?
2. Did you have any problems today with your project? How did you solve them?
3. How do you know if the information you found is any good?
4. How do you know when you have enough information?
5. Tell me about some times when you ask yourself questions. When do you do that?
6. When you get finished with your work, what sort of things do you think about it?
7. How would writing down information help you to think about it better?

Questions on weekly interviews. Week 2 – 4.

Presenting information skills

1. Bring me up to date on your project. How is it going? What are you doing now?
2. Did you have any problems today with your project? How did you solve them?
3. When you have finished finding all your information for your project, then what do you do next?
4. How are some ways that you could present the information you learn?
5. Why did you choose to work on this project, and how do you feel about it?

Appendix G

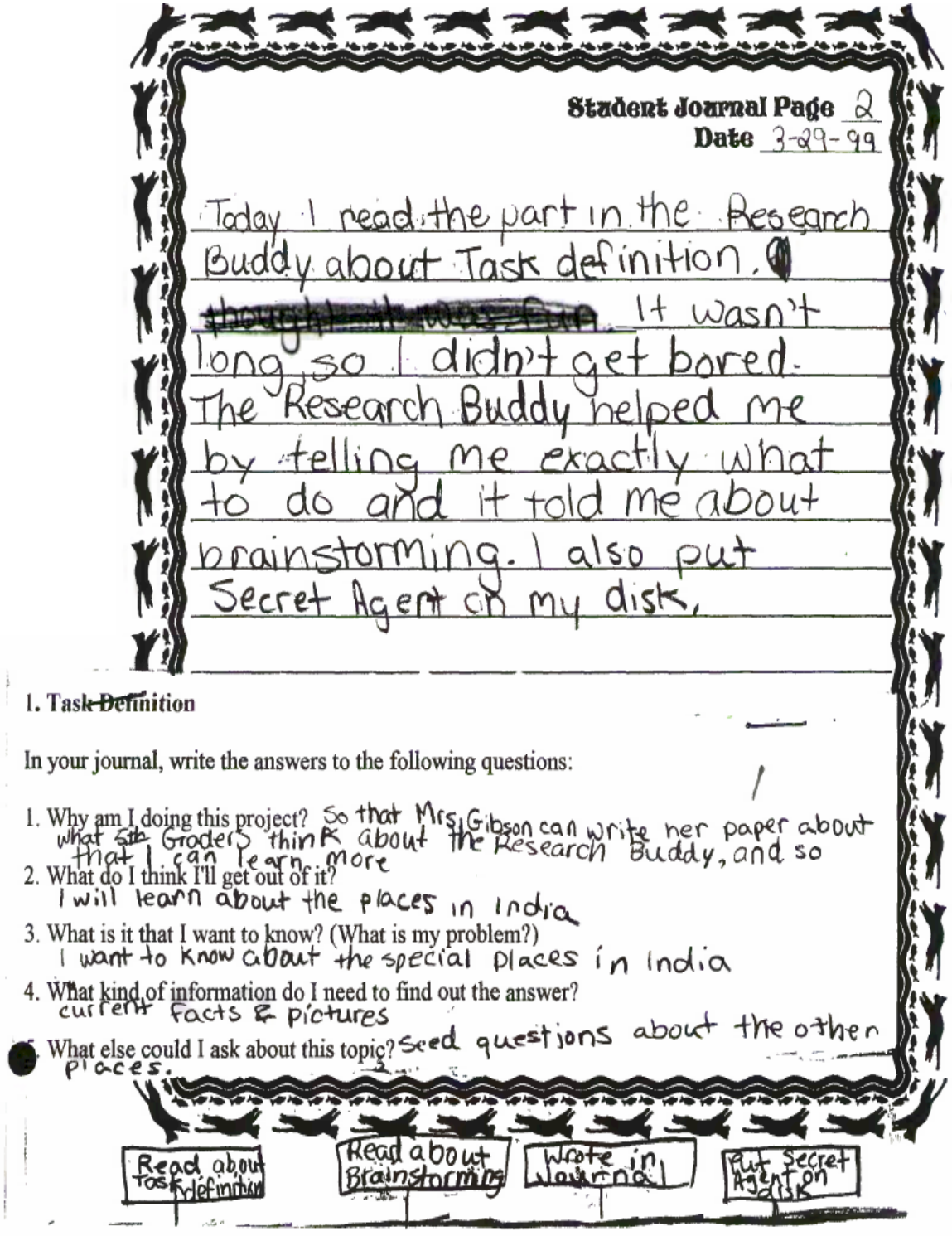
Example of Log Files

Carol & Julie, April 12, 1999

URL	File	Access Date	Access Time
www.cabincreek.centerville.k12.ky.us/	Cabincreek_centerville_k12_ky.htm	04/12/99	14:38:22
www.cabincreek.centerville.k12.ky.us/library/library.htm	Library.htm	04/12/99	14:41:54
www.cabincreek.centerville.k12.ky.us/library/research/research.htm	Research.htm	04/12/99	14:42:30
www.cabincreek.centerville.k12.ky.us/library/research/researc2.htm	Researc2.htm	04/12/99	14:42:36
www.cabincreek.centerville.k12.ky.us/library/research/big6.htm	big6.htm	04/12/99	14:42:42
www.cabincreek.centerville.k12.ky.us/library/research/big6~2.htm	big6~2.htm	04/12/99	14:42:44
www.cabincreek.centerville.k12.ky.us/library/research/redchek2.gif	Redchek2.gif	04/12/99	14:42:45
www.cabincreek.centerville.k12.ky.us/library/research/useof.htm	useof.htm	04/12/99	14:42:50
www.cabincreek.centerville.k12.ky.us/library/research/useof2.htm	useof2.htm	04/12/99	14:43:19
www.cabincreek.centerville.k12.ky.us/library/research/datachrt.htm	Datachrt.htm	04/12/99	14:59:38
www.cabincreek.centerville.k12.ky.us/library/research/read7.htm	read7.htm	04/12/99	15:10:42
www.cabincreek.centerville.k12.ky.us/library/research/read6.htm	read6.htm	04/12/99	15:10:43
www.cabincreek.centerville.k12.ky.us/library/research/read5.htm	read5.htm	04/12/99	15:10:55
www.cabincreek.centerville.k12.ky.us/library/research/read4.htm	read4.htm	04/12/99	15:10:56
www.cabincreek.centerville.k12.ky.us/library/research/read3.htm	read3.htm	04/12/99	15:11:00
www.cabincreek.centerville.k12.ky.us/library/research/read2.htm	read2.htm	04/12/99	15:11:02

Appendix H

Page from Nita's Journal



Student Journal Page 2
Date 3-29-99

Today I read the part in the Research Buddy about Task definition. I thought it was fun. It wasn't long so I didn't get bored. The Research Buddy helped me by telling me exactly what to do and it told me about brainstorming. I also put Secret Agent on my disk.

1. Task ~~Definition~~

In your journal, write the answers to the following questions:

1. Why am I doing this project? So that Mrs. Gibson can write her paper about what 5th Graders think about the Research Buddy, and so that I can learn more
2. What do I think I'll get out of it?
   I will learn about the places in India
3. What is it that I want to know? (What is my problem?)
   I want to know about the special places in India
4. What kind of information do I need to find out the answer?
   current facts & pictures
5. What else could I ask about this topic? Seed questions about the other places.

Read about task definition | Read about Brainstorming | Wrote in Journal | Put Secret Agent on disk

Appendix I

Guidelines and Timeline for Project

Mrs. Gibson's Research Project and YOUR Research Project Guidelines
Things you must do for this project:

1. For the first two months: Explore and learn to use the World Wide Web, *Encarta*, OPAC, and *SIRS*
2. For the last month: Come to the library at least once a week to use the Research Buddy and do research.
3. Create a project presentation from your research. *

Open the Research Buddy.
Read the part that you need for the day's work.
Do any other activities you need to do in the library for the day's work
Copy the browser history file to your floppy disk.
Rename it with today's date (example: 11599.txt)
Spend 10 minutes at the end of your day's work to write in your journal.
Check with Mrs. Gibson before you leave for next appointment time.

Ask for help whenever you need it, but try to use the Research Buddy first.

A. See me in the library
B. Call me at home 276-1902
C. E-mail me from the Research Buddy or mrgibs1@mis.net
D. Ask other people for help (But tell about it in your journal - who you asked and how they helped)

You will mostly be on your own — just like a grown-up - you make your own decisions.

Report to Mrs. Gibson at least once a week for updates and an interview.

JOURNAL INSTRUCTIONS

This is what to write in your journal.
A.
1. What I did today.
What I think about it.
How I feel about it.
How the Research Buddy helped me get my work done.
Draw a timeline at the bottom of the page. **

B. Other times when you finish a *Big6* step, answer all the questions in the Research Buddy after you answer the questions in part A.

*Project Presentation
Your presentation must include:
A bibliography with at least 4 varied sources.
If you do not write a paper for your presentation, include one page which explains how you used the information you found to create your project.

** TIMELINE
This is how to do a timeline:
At the bottom of each page you write in your journal, draw a long line.
Label your line with:
The date
The *Big6* step you used today.

At the end of the project, make one page that has your entire timeline from all of your journal pages.

Research Homepage URL:
(http://www.dwu.edu/cat/rb/default.htm).

Appendix J

Research Buddy Progress Chart

Each time you finish one of the assignments, see Mrs. Gibson for a star to put on it. Each star is worth one Book Fair Buck.

Name	♥
Assent letter	
Beginning Survey	
1st Interview	
World Wide Web lesson/learning time (up to 8)	
SIRS Discoverer lesson/learning time (up to 4)	
Encarta lesson/learning time (up to 4)	
OPAC lesson/learning time (up to 4)	
Location lesson/learning time	
Web page lesson/learning time (optional)	
Big6 lesson/learning time	
I got my Internet Drivers License	
Journal & Timeline lesson/learning time	
I used the Research Buddy, wrote about it in my journal, and copied the browser history file to my disk (up to 8)	
I found at least 4 sources of information for a bibliography and showed them to Mrs. Gibson	
Weekly interview 1	
Weekly interview 2	
Weekly interview 3	
Weekly interview 4	

Research Buddy Progress Chart (continued)

Name	♥
I showed Mrs. Gibson how I organized my information	
I showed Mrs. Gibson how I plan to present the information and met with her to decide on my presentation rubrics	
I evaluated my project with the presentation rubrics that I had created earlier with Mrs. Gibson	
I finished my timeline all on one page	
I presented my research at the pizza/presentation party	
I created a web page about my research (optional)	
I wrote a final summary in my journal about what I thought about using the Research Buddy to do research in the library	
Additional library work visits (worth one star for each quality 30 minute time)	

Appendix K

Student Evaluation Survey

Mark an "X" next to the number that best fits your answer. Please be totally honest about each answer, and think hard before you decide. Be especially careful about the last four, because the words are almost the same, but they mean very different things. Thank you so much for taking the time to do this.

5 - strongly agree
4 - agree
3 - neither agree nor disagree
2 - disagree
1 - strongly disagree

Questions	5	4	3	2	1
1. The Research Buddy helped me choose my topic.			2	1	2
2. *The* Research Buddy helped me ask questions about my topic.	2	1	1	1	
3. The Research Buddy helped me think of places and sources to find information.		3	2		
4. The Research Buddy helped me to find the information in the places (library, home, etc.).	1	1		2	1
5. The Research Buddy helped me to find the information in the sources (books, computers, etc.)		1	1	3	
6. The Research Buddy helped me to get the most important information out of what I found.		2	2	1	
7. The Research Buddy helped me to organize my information.	2	2		1	
8. The Research Buddy helped me to make a bibliography.	1	1	2		1
9. The Research Buddy helped me decide what to do for my project (report, web page, poster, etc.)		1	2	1	1
10. The Research Buddy helped me to evaluate my project.		2	3		
11. The Research Buddy helped me think about my project with the questions for my journal writing.	1	3	1		
12. The Research Buddy was fun to use.	1	3	1		
13. I learned new information about my topic because of this project.	3	2			
14. I learned new information about my topic because of the Research Buddy.			2	3	
15. I learned new skills about doing research because of this project.	1	3	1		
16. I learned new skills about doing research because of the Research Buddy.	2	2	1		

Appendix L

Research Agenda Checklist

Student number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Gatekeeping letters (3)	X	X	X	X	X	X	X	X	X	X	X	X	X
Consent and Assent letters	X	X	X	X	X	X	X	X	X	X	X	X	X
Beginning Questionnaire	X	X	X	X	X	X	X	X	X	X	X	X	X
1st Interview	X	X	X	X	X	X	X	X	X	X	X	X	X
Encarta lesson/learning time		5	4	3	1	0	3	1	0	1	4	1	1
World Wide Web lesson/learning time	6	6	7	3	2	0	2	4	3	5	8	4	4
OPAC lesson/learning time	3	4	2	1	1	0	1	1	0	0	4	1	0
SIRS Discoverer lesson/learning time	0	4	4	4	4	0	5	2	2	0	4	4	0
Location lesson/learning time	1	1	0	1	1	0	0	1	1	0	0	1	1
Big6 lesson/learning time	1	1	1	0	1	1	1	1	0	1	1	1	0
Journal & Timeline lesson/learning time	0	1	1	0	1	1	1	1	0	1	1	1	0
E-mail lesson/learning time	0	2	2	1	0	0	4	0	0	0	1	1	0
Web-page lesson/learning time	4	3	3	1	0	0	0	2	0	0	4	0	0
Internet Drivers License	X	X	X	X		X	X	X	X	X	X	X	
Interview 2-5	3	4	5	0	0	3	1	5	1	2	4	1	1
Saw research questions	X	X	X							X	X		
Meeting for presentation rubrics	0	0	0	0	0	0	0	0	0	0	0	0	0
Student journal perceptions		X	X						X	X		X	
Final project presentation/assessment	X	X	X		X	X	X	X	X	X	X	X	X
Ending Questionnaire	X	X	X		X	X	X	X	X	X	X	X	X

Appendix M

Example of Conceptually Clustered Matrix for Student by Interview Question

When you first start a project, how do you know what kind of information to look for?
Where do you think you might find useful information for a project?
How would you find those sources?

Student	Interview 1 response	Final Interview response
Tacey 3/10	Um, well, …, I gotta find out, like what I'm researching on. And then, uh, can you repeat the? See what I do is I gotta see what kind of information I gotta look up. I gotta ask the teacher, whoever's telling me to research on, I gotta ask them, what certain thing do you want me to find about this thing? Mostly the Internet. Um, Encarta? That's about all. Um, I gotta look up the name of the thing and see what kind of information is on the thing? Um, …, just, …, put the animal name, type the animal name in the computer, and, in books. The thing,.	5/4 Um, well, … what I did is I'd have one thing to look up like for that day, and the second day I'd have something else to look up. Like, first thing I looked up was where their habitat was. And so. That's the first thing I looked up and I printed that out and, the second day I uh, think of something else, like taking care of their cubs. I looked that up. (by categories?) Yeah. Computer. (laughs) Internet. Yeah it has a lot of information, and like, there's not a main book called grizzly bears. It's just bears. There's a couple but most of them are just about bears. (computer's the best?) Yeah. (consider magazines, etc.) No, not really. You don't know where to look up grizzly bears in magazines. Library. Ask the librarian for help.
Tacey 2/16	Um, I would, um, what kind of sources, or what articles? Um, I might look in, …, something about America or the Gulf, or about, …, um, the Civil War there could be an article about the Civil War, or uh, … In … in an encyclopedia. Maybe in the library or in an encyclopedia or on the Internet.	5/3 I don't know. I think because I think because what kind of project I'm doing that might help me. Because if I was doing like, um, something that has, that doesn't have any writing in it and pictures, I would only look for pictures and not words in the computer. The library, and Encyclopedias, almanacs, um, just books with information in them.

Appendix N

Example of Conceptually Clustered Matrix of Student Perceptions versus Actual Process

Student	Perceptions of doing research	Actual research process
Tacey	*Questionnaire* – Sometimes thinks all sources she needs are in OPAC - Sometimes thinks library has everything needed - Information is always where she expects it to be - Needs materials other than books – Search is over when enough information is found ## No Finds everything first and then reads - Talk to people who know about her topic Use the computer help screens - Would go through books and computer to find information second - Looks on Internet, Encarta - Did not have a clear focus before going to library, afterwards, sometimes - Did look on Internet, and books, encyclopedia in classroom Sometimes uses TOC ## Yes Uses index ## No Uses glossary ## No Makes several trips to the library to research - Sometimes takes detailed notes from every source	*Journal* - March 29, 1999 - Today I found what I'm doing my project on. I also learned what to do. What I'm doing my project on is Grizly Bears. I'm doing my project on Grizly Bears I think I'll get a good grade I'm going to see what ther habitat What they eat, how they sleep, why they hybernat, and other important things about them How they take care of their cubs What I did today was look through Research Buddy to do research I think I did good today I'm doing well I feel that I can research more on the topic I have It helped me with my project. I understand what to do I thank the Research Buddy. *Tacey Journal* 3/29/99 I need to use books, Computer, incyclaidia, My Brain things I already know, and maybe Enternet The 2 I thing is the best is books, and Computer Because they have alote of information *Tacey Journal* March 31, 1999 I need to find out the things what they do during the day. What is there habitat. *Tacey Journal* March 31, 1999 Look to see if There are books about Grizzly bears. Look in All Gizly bear books before you answer my questions. Look in encyclopidias. Books, computer, and people of teachers Books and teachers of computers They have the info I need to research my project on. It has so much info on the project

Appendix O

Table for Student Participation and Experience versus Perception of Research Buddy

Student	Home Computer	Home Internet	Experience	Reading Level	Used Research Buddy	Finished project	Wrote in journal	Perception of Research Buddy	Student Lessons or Instructional Sessions Completed						
									Big6 (1)	E-mail (1)	OPAC (4)	*SIRS* (4)	CD-ROM (4)	Internet (8)	Print Reference (1)
Tacey	Yes	No	Yes	4.2	Yes	Yes	Yes	Positive	1	1	0	0	0	0	0
Nita	Yes	No	Yes - STLP	9.6	Yes	Yes	Yes	Neutral	1	1	4	4	4	8	0
Leah	Yes	No	No	7.2	No	Yes	No	Positive	1	1	1	4	1	4	1
Lisa	Yes	Yes	Yes	4.3	No	Yes	No	Negative	0	1	0	2	0	3	1
Cara	No	No	No	3.6	Yes	Yes	Yes	Neutral	1	1	0	0	0	5	0
Julie	Yes	Yes	Yes	8.6	Yes	Yes	Yes	Positive	1	1	2	4	4	7	0
Carol	Yes	Yes	Yes	9.1	Yes	Yes	Yes	Positive	1	1	4	4	5	6	1
Zoe	Yes	No	Yes - STLP	6.5	Yes	No	No	Positive	1	1	3	0	0	6	1
Nelson	Yes	Yes	Yes	7.3	Yes	Yes	No	Negative	1	0	1	2	1	4	1
Sarah	Yes	Yes	No	4.2	Yes	Yes	No	Positive	0	0	0	0	1	4	1

Note. Tortoises are represented with shaded rows; Hares are represented with unshaded rows.

Appendix P

Example of Conceptually Clustered Matrix for Mentoring Intervention

Date	Purpose	Researcher intervention
Fn3/29	Research	They had read steps 1 through 3 and asked what next. I said either read it all or start on Task Definition, or do your research.
Fn3/31	Research	Showed Julie about copyright (downloading pictures) and helped her e-mail for permission and spell words.
Fn4/12	Research	Had not been citing sources, did they have to go back and find them? I said, yes. Julie got a reply from her e-mail.
Fn4/26	Computer	Their scanned pictures did not work and we tried as a jpg file. They were getting in trouble for being in the library so much, and I agreed to talk to their teacher so they could finish their project–very worried about this.
Fn4/28	Computer	Lots of time spent with them the last week making their image links work. They have files spread out all over the place, so I finally just uploaded them to the server so they would be in one place.
4/14Int	Research	Researcher: Okay. Well, there are things I'm going to ask you that kind of are covered in the journal but in case I forget I read your journal. It's kind of a cross index for my project. And also it's supposed to help you think about what you've done. Because the more you think about what you've done, then the more you get better ideas, and that kind of thing.
4/23Int	Research	Researcher: Do you know her children's names? That would help if you knew their names. If you'll get their names and use their names as keywords, I think you'll find a lot. Especially Lucy, her daughter, her daughter's name is also Lucy I think, and she's an actress in her own right. So I'm sure there will be things about her somewhere.
4/28Int	Research	Researcher: Exactly. Actually it's not really meant for you to use from there. It's meant if you wanted to lay out a whole big poster you could. It's just a way to help organize. Any of the things in the Research Buddy are just suggestions to help you. You can do them or you can not. Okay? I think you're doing a good job so far. I think you're where you need to be. You're talking about where you are on your project and the *Big6* are exactly the same. This is good.

Appendix Q

Example of Conceptually Clustered Matrix for Student Perceptions of Research Buddy Use in Learning the Research Process

	Areas of Research Buddy Assistance					
Student/Code	Perception of Research Buddy	New skills	Information Search Strategies	Use of Information	Synthesis	Evaluation
Nita (P)	Fn3/29 -thought it was going to be hard and scary - hoped it was optional to read Research Buddy–helped by telling her exactly what to do and about brainstorming Fn3/30 - thought it was fun, but didn't like writing (list) Fn3/31 - graphic organizer too hard Fn3/31 - #4 was same as #3 - "It didn't help me very	Int4/15#46 - did not think so "But I probably won't remember any of it"	Jn3/29 - read Task Definition Jn3/30 - read Information Search Strategies–helped her make a list of things needed - read Location & Access - helped her by telling what to do with list of things Fn3/30 - read #2 & journaled Jn3/31 - read about Use of information Obs4/1 - Nita told girls she had 25 questions	Int5/3#98 - Just the *Big6* steps, the order that I had to do something in. Did not recall using any of the navigation tools	Jn3/29 - printed out journal questions & wrote answers Jn4/14 - read about synthesis and did bibliography lesson Int4/15#39 - read #5 & wrote bibliography 5/3#92–printed out journal pages	Int4/5 1#71 - Does it matter if I do it?

Note. (P) = project completed, Jn = Journal entry, J = journal writing, Int = Interview, Obs = Observation, Fn = Field notes, #=line number of interview or observation transcript.

Appendix R

Example of Conceptually Clustered Matrix for Student Perceptions of Research Buddy versus Students' Actual Use

Name	Perceptions of Research Buddy	Actual use of Research Buddy
Tacey	Fn4/12 – "Helped me a lot." 4/12#41 - R: How did you use the Research Buddy the last time that you were using it? Tacey: Um, I used it when, uh, on the Internet lesson, like learning about the Internet, getting on it and where I need to go to find the information, do I need to go to Yahooligans or just the search thing or... stuff like that. Researcher: That part's good. Did you read any of the *Big6* stuff? Tacey: Yeah. A lot about it. Researcher: Do you remember how far you got with that? Tacey: I got about to lesson 2 or something.	Fn4/12 – used it for her journaling 5/3/ #86 - Researcher: Anything else? No. Tell me how you did use the Research Buddy during this study. Tacey: I just read it. That's all. Researcher: Okay, you just read it.? Tacey: And for the bibliography, I used the instructions to make the bibliography. Researcher: Did you ever print out any of the pages in the Research Buddy? Tacey: Um, huh. I printed out the journal pages. Researcher: What it helpful at all? Tacey: What? Researcher: The Research Buddy. For the project that you did. Tacey: Yes. Researcher: It was helpful. Can you tell me how it was helpful? Tacey: Just the *Big6* steps, the order that I had to do something in.
Nita	Nita's Journal 3/26/99 Today, Mrs. Gibson taught us about the Research Buddy and the *Big Six*. Before Mrs. Gibson gave us the lesson, I thought it was going to be hard and scary and I didn't know where to start. Now I think I know where to start. It's probably either reading the pages in the Research Buddy or Step #1 in the *Big Six*. I think it will be easy if I know what to do. I hope it is optional to read the pages in	Journal 3-29-99 Today I read the part in the Research Buddy about Task definition. It wasn't long, so I didn't get bored. The Research Buddy helped me by telling me exactly what to do and it told me about brainstorming. Also included a print-out of the journal questions upon which she had written the answers. Journal 3-30-99 Today I read the pages in the Research Buddy about Information Search Strategies. I didn't think or feel anything about it. I just did it.

Appendix S

Activity Record

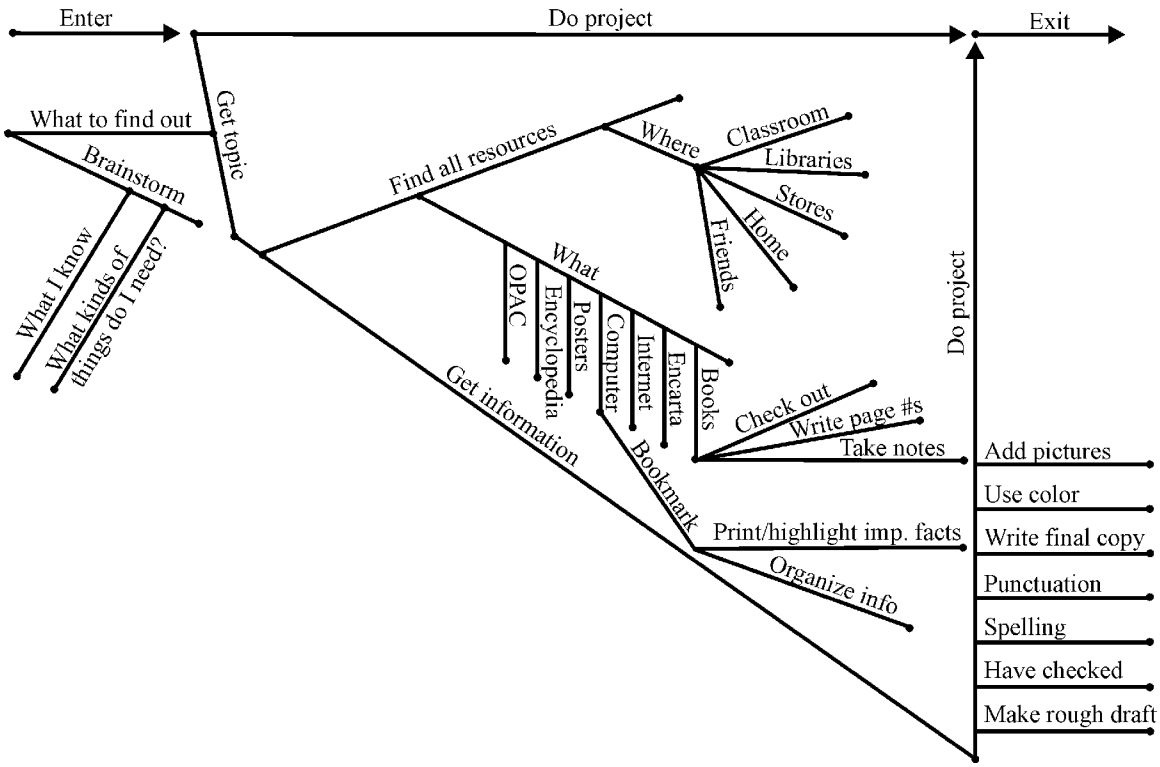


Figure S1: How Tacey, Nita, Cara, Sarah, Carol, and Julie Would Have Done a Research Project.

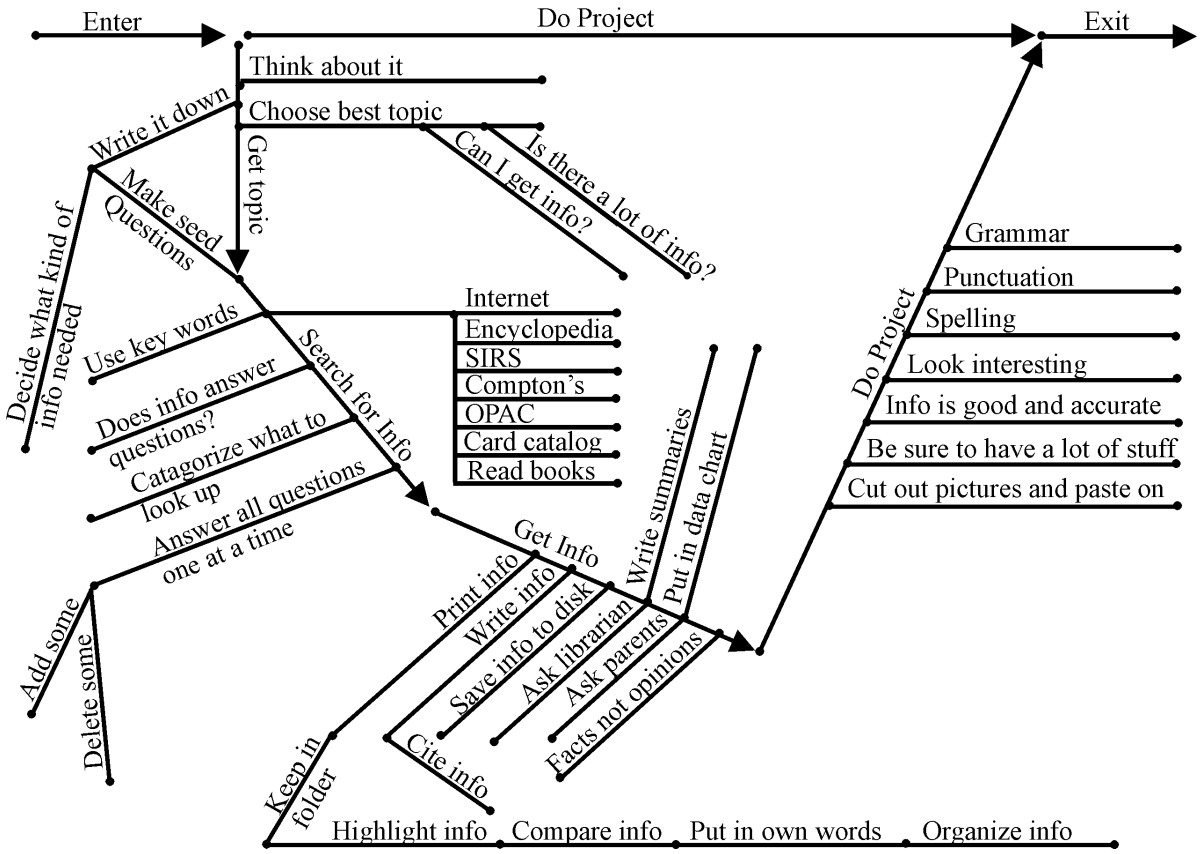


Figure S2: How Tacey, Nita, Cara, Sarah, Carol, and Julie Did Their Projects.

Appendix T

Rubrics for Student Project Evaluation

Points	Topic	Sources	Required documents	Evaluation
5	Addressed question or topic by answering seed questions	Used multiple, appropriate sources	Included all requested documents	Completed work with few or no mistakes
4	Addressed question or topic by answering some seed questions	Used some appropriate sources	Included most requested documents	Completed work with few mistakes
3	Addressed question or topic without using devised seed questions	Used at least one appropriate source	Included at least half of requested documents	Completed work with three to five mistakes
2	Addressed question or topic with no seed questions	Used at least one source	Included at least one requested document	Completed work with more than five mistakes
1	Did not address question or topic	Used no sources	Included no requested documents	Did not complete project

Project Assessments from Rubric

Points	Topic	Sources	Required documents	Evaluation	Total Score
Nita	5	5	5	5	20
Carol/ Julie	5	4	3	5	17
Tacey	5	4	3	3	15
Cara	3	4	4	3	14
Sarah	3	3	1	2	9
Lisa/ Leah	2	1	2	3	8
Nelson	2	1	2	3	8
Zoe	1	2	2	1	6

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