A STUDY OF STUDENTS' INQUIRY-BASED I-SEARCH LEARNING EXPERIENCES

by

JING LIN

(Under the Direction of Julie I. Tallman)

ABSTRACT

Inquiry-based learning has triggered interest among educational researchers and practitioners for a long time, for it is a promising teaching and learning method that makes learning more meaningful and conducive to higher-order thinking and active knowledge construction. Inquiry-based learning is not easy to adopt, because it emphasizes that students construct their own knowledge through actively engaging in their learning process. Therefore, most students feel challenged by this learning approach. A precondition to solving this problem is to have substantive knowledge about students' inquiry-based learning experiences, which is lacking in the relevant literature.

My study was designed to fill this gap in the literature by providing rich descriptions of students' inquiry-based learning experiences under a specific inquiry model, I-Search. Five research questions were investigated: (a) How do students choose their I-Search topics? (b) How do students generate their I-Search questions? (c) How do students explore information related to their I-Search topics? (d) How do students respond to their collected information? (e) How do students present their I-Search findings? A generic qualitative approach for this study was employed. Six students volunteered to participate in the study. In-depth interviews and

documents created by participants were the main data sources. An abduction, a combination of inductive and deductive analysis approach, was used for data analysis.

The study found that students were able to use various strategies to determine their I-Search topics. They also utilized multiple methods to generate their essential questions and sub-questions. In addition, they employed different ways and criteria to explore relevant information and made various responses to their collected information. Individual and contextual issues and two-step methods influenced the format and content of participants' final products. The findings also showed that multiple instructional interventions were needed to support students' learning along different I-Search stages. Finally, the study suggested a series of specific scaffolds that could be provided to support successful inquiry-based I-Search learning. Further research directions were also discussed in this study.

INDEX WORDS: Inquiry-based learning, Inquiry, I-Search, Students' learning experiences

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DEDICATION

To my parents, for their love and pride

To my husband, Jiannan, for his endless love and support

To my little baby, Michael, for filling my life with laughter

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CHAPTER 1 INTRODUCTION

Background

Inquiry-based learning has triggered interest among educational researchers and practitioners for a long time, for it is a promising teaching and learning method that makes learning more meaningful and conducive to higher-order thinking and active knowledge construction (Edelson, Gordin, & Pea, 1999). As a learning and teaching process, it usually begins with posing a problem or question, followed by generating and pursuing strategies for investigating, collaborating, reflecting, and justifying the solutions to the problem or answers to the question, and communicating the conclusions (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998; Kuhn, Black, Keselman, & Kaplan, 2000; Levstik & Barton, 2005; Sandoval, 2005).

Inquiry-based methods of teaching and learning can be traced back to Socrates, who used probing methods in his teaching to cultivate his students' inquisitiveness. Early in the last century, Dewey pursued and widely promulgated the same tenet in the progressive education movement. He (1948) stated:

> Inquiry is emancipated. It is encouraged to attend to every fact that is relevant to defining the problem or need, and to follow up every suggestion that promises a clue. The barriers to free inquiry are so many and so solid that mankind is to be congratulated that the very act of investigation is capable of itself becoming a delightful and absorbing pursuit, capable of enlisting on its side man's sporting instincts. (p. 146)

Since the middle of the last century and since the1990s, inquiry-based learning has again become a central theme of discussion among educational researchers (Supovitz, Mayer, & Kahle, 2000).

Why is inquiry-based learning so important to people? First, the development of people's understanding of how people learn has contributed to the espousal of inquiry-based learning. For a long time, people have realized that learning is a complex meaning-making process involving multiple constructs operations on cognition and situated in social and cultural contexts, rather than just a stimulus-response system (Gredler, 1997). In this regard, a learner should be an active knowledge constructor, instead of a passive receptor of knowledge transmitted from authority. A passive learner often ends up with mainly memorized "facts and formulates," instead of a developed understanding of discipline knowledge. To solve the problem, an alternative learning approach grounded on modern learning theories must be adopted. The current view of inquiry-based learning is grounded in constructivism, which emphasizes active knowledge production by inviting students to play an active role in developing their knowledge through proposing questions, identifying assumptions, observing, using critical and logical thinking, considering alternative explanations, experimenting, testing hypotheses, and communicating findings (Chinn & Malhotra, 2002; Linn, 2000). The results of such a learning approach are the construction of new knowledge and higher-order thinking skills (Edelson, Gordin, & Pea, 1999). Therefore, inquiry-based learning, grounded on constructivism, is one promising method eliciting widespread enthusiasm among people (Edelson, 2001; Zuckerman, Chudinova, & Khavkin, 1998).

Second, today's increasingly fast-paced society generates the need for students to master intellectual skills fostered by inquiry-based learning (Thier & Daviss, 2001). Generally speaking, today's students are in an information intensive and rapidly changing society in which they

always encounter new problems and information. Living in such an environment, it is no longer possible for students to grasp all the skills and knowledge in school, which they are expected to apply to their future lives. On the contrary, students must have well-rounded inquiry skills to support analyzing problems, scrutinizing information, making rational decision, actively seeking and creating new knowledge, appreciating divergent points of view, and independently and collaboratively reasoning on complex political and social issues. In this regard, inquiry-based learning, which can foster intellectual skills of problem solving, reasoning, reflecting, and judging, is critical for them to have productive and fulfilling lives in today's society.

Third, reports of the positive influence of inquiry-based learning from multiple research programs have given evidence to support the importance of inquiry-based learning. For example, research indicates that engaging in inquiry can improve students' learning in their disciplines (Krajcik, Blumenfeld, Marx, & Soloway, 2000; Meyerson & Secules, 2001). Learning through inquiry will increase students' ability to apply what they learn to new situations, therefore helping them to understand scientific knowledge. It can also reduce the discrepancy in learning between genders and races (White & Frederiksen, 1998). Supovitz, Mayer and Kahle (2000) emphasize that inquiry can significantly improve students' performance in mathematics and sciences. In addition, Blumberg (2000) argues that inquiry can nurture critical thinking and information-processing skills. He finds that inquiry enables students to be active library users and tends to improve their self-regulated learning abilities. In short, inquiry-based learning enables students to be more reflective, self-regulated investigators who are capable of justifying their own learning processes and viewing inquiry process as a way to know the world (Windschitl, 2000). These types of reports support the idea that inquiry-based learning is a valuable method for educational researchers and practitioners.

In summary, the development of learning theories, the demand of current society, and the positive empirical findings in relevant literature support the proposition that inquiry-based learning is important for teaching and learning and worthy of the endeavor to improve it. This was why I devoted myself to the advancement of research on inquiry-based learning in my dissertation.

Problem Statement

Before fully discussing inquiry-based learning, it is important to make it clear that inquiry-based learning is not the only or necessarily the best approach for teaching and learning in all curriculum contexts. Lecture in class does not represent a dreadful teaching image. I argue we need to consider learning goals in different contexts when selecting different pedagogies. Traditional teaching methods may be effective for low-order thinking skills, for example, when recall of facts is the learning objective. But if we focus on designing "an educational activity in which students individually or collectively investigate a set of phenomena - virtual or real - and draw conclusion about it" (Kuhn, Black, Keselman, & Kaplan, 2000, p. 496), inquiry-based learning is a good choice. Broadly speaking, inquiry-based learning is appropriate when the following three types of learning outcomes, individually or collectively, are expected: (a) deep discipline knowledge (Zuckerman, Chudinova, & Khavkin, 1998); (b) higher-order thinking skills or strategies (Kuhn, Black, Keselman, & Kaplan, 2000), including reasoning skills (Chinn & Malhotra, 2002), inquiry skills (White & Frederiksen, 1998), and metacognition (Loh et al., 2001); and (c) adequate motivational beliefs (Blumenfeld et al., 1991; Sandoval, 2005), sometimes called attitude and value (Beyer, 1971) or habit of mind, attitude, and traits of character (Dewey, 1933, 1938).

Despite the positive reports of benefits that students can gain from inquiry-based learning, inquiry-based learning is not easy to adopt, because it is different from traditional learning, in which knowledge is transferred from expert to novice in a teacher-centered, test-driven approach (Beyer, 1994). Inquiry emphasizes that students construct their own knowledge through actively engaging in their learning process. It invites students to search for understanding, express themselves clearly, validate positions, and appreciate uncertainty and multiple perspectives. It requires a qualitative shift in student learning, including a shift in students' beliefs about knowledge and learning and in their specific learning skills (Rice, 1992). Windschitl (2000) described inquiry as "a complex process involving particular habits of thinking, dozens of interrelated sub-skills, and metaknowledge about the inquiry process itself" (p. 85). Researchers suggested that most students felt challenged in this new student-centered, inquiry-based learning approach (e.g. Brown & Campione, 1994).

What challenges are students facing in inquiry-based learning? Parallel to three types of learning outcomes of inquiry-based learning, there are primarily three challenges. First, students are reported to lack adequate knowledge to conduct successful inquiry-based learning. For example, researchers found that students did not have adequate knowledge to generate questions of good quality (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998; Meyerson & Secules, 2001; Zuckerman, Chudinova, & Khavkin, 1998). Second, students don't master relevant skills. There are also reports that some students, ranging from middle school students to adult students, do not know where to locate information, how to evaluate the credibility of the information or how to synthesize information for their inquiry (Change, Sung, & Lee, 2003; Wallace, Kupperman, Krajcik, & Soloway, 2000). Finally, middle and high school students lack high

levels of motivation (Edelson, Gordin, & Pea, 1999) and appropriate beliefs for learning and knowledge (Hancock, Kaput, & Goldsmith, 1992).

How can we solve these problems? Simply speaking, current common practice in this area can be described as follows. Researchers usually start from learning theories to develop an inquiry-based model. The second step is to investigate what it looks like when students carry out their inquiry-based learning under that inquiry model, such as what strategies students employ in their learning, what kinds of supports are needed, etc. The result of this step is a detailed description of students' learning situations. The third step, informed by the second step, is enhanced understanding of learning phenomena, as well as the design of instructional interventions or pedagogical principles which can better scaffold students' inquiry-based learning (see examples, Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998; Linn, 2000; Loh et al., 2001; Wallace, Kupperman, Krajcik, & Soloway, 2000).

The Scope of My Study

I situated my dissertation in the second step. This step is crucial in the chain that bridges the theoretical principles with practice, and, thus, has potential to improve both of them. I am not arguing that designing a new inquiry model based on modern learning theories is not important. On the contrary, it is important. What is at issue is that we have already had a number of inquiry models, such as, Suchman's inquiry model (Suchman, 1962), Krajcik et al.'s project-based inquiry model (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998), White and Frederiksen's inquiry cycle (White & Frederiksen, 1998), Short et al.'s authoring cycle (Short, Harste, & Burke, 1996), Llewellyn's 5E learning cycle (engagement, exploration, explanation, elaboration or extension and evaluation) (Llewellyn, 2002), and Tallman and Joyce's I-Search (Tallman & Joyce, 2006). Compared to the number of inquiry models available, there is relatively little

literature about students' learning experiences under those models (Wachholz, 1994). Krajcik and his colleague (1998) argued for more reports on students' inquiry-based learning attempts; the need still exists today. The lack of rich and deep understanding of students' learning experiences will eventually hinder the development of relevant research, thus holding back the improvement of inquiry-based instruction or inquiry models. For no matter how advanced those inquiry models, those models will eventually be applied in realistic classroom settings and used by students. Without deep understanding of how students learn with those inquiry models, it is impossible for us to know how well the inquiry model can foster meaningful learning and which parts need improvement. In addition, the failure to make inquiry-based learning take root in educational systems in previous movements also teaches us the lesson that it is essential to have enough knowledge about students' learning experiences [for a detailed discussion of this part, please see the following literature review chapter].

I-Search Inquiry Model

More specifically, I narrowed down my investigation to an inquiry model called I-Search. The term I-Search was coined by Ken Macrorie for his college freshman composition class (Macrorie, 1988). Macrorie wanted his students to overcome the traditional, passive way of writing, where they engaged in little original thinking and did not use their personal voices. He proposed an alternative form of writing, "I-Search," in which "a person conducts a search to find out something he needs to know for his own life and writes the story of his adventure" (p. iii). Since its formation, the I-Search process has triggered interest beyond the community of English literacy and has been modified to fit various instructional needs. Currently, the I-Search has also been developed as "one type of inquiry-based research process frequently used in middle and high school classrooms" (Literacy Matters, 2006).

My study investigating students' learning experiences was under Tallman and Joyce's I-Search inquiry model. This model is the combination of Macrorie's (1988) original I-Search model with Maine's thirteen-step research model for middle and high school students. The model consists of several steps: selecting a topic, generating research questions, exploring and responding to relevant information, and presenting findings. Accompanying each step is journal writing where students record reflections about their inquiry-based learning processes and information they collect (Tallman & Joyce, 2006).

Why did I investigate students' inquiry-based learning under the I-Search model? First, despite the growing recognized importance of the I-Search model (Tallman & Joyce, 2006), and gradually wider adoption in different settings (Zorfass & Dorsen, 2002), including, but not limited to, technology integration (Education Development Center, 2000), writing and research (Tallman & Joyce, 2006), information problem-solving (Duncan & Lockhart, 2000) and social studies (Rubin, 2002), there are few studies on students' I-Search experiences. In fact, I could only find one study conducted by Rubin (2002) with a detailed methodology description in high school social studies. In addition, the I-Search literature itself is biased to focus on the successful students' learning experiences, instead of a variety of students' learning experiences, both positive and negative. Undoubtedly, there is a need for research that can provide not only rich descriptions of students' various learning experiences, but also detailed documentation of methodology through which the research conclusions are made. Second, Tallman and Joyce's I-Search model has unique features compared with other general inquiry models. For example, depending on academic needs, it promotes giving students freedom to select topics based on their own compelling interests. Most other inquiry models begin from question generation within pre-determined learning content (e.g., White & Frederiksen, 1998). Therefore, investigation of

students' I-Search learning experiences has the potential to provide new insights into relevant learning phenomena, thus contributing to current relevant research.

Purpose of the Study and Research Questions

Based on the above discussion, the goal of my study is to provide rich descriptions of students' inquiry-based, I-Search learning experiences, as they engage in the I-Search process (Figure 1.1 shows the relationship between the I-Search model and research questions). More specifically, I pose five research questions for this study:

1. How do students choose their I-Search topics?
2. How do students generate their I-Search questions?
3. How do students explore information related to their I-Search topics?
4. How do students respond to their collected information?
5. How do students present their I-Search findings?

The Implications of My Study

In 1984, the National Academy of Sciences held a conference in direct response to a report entitled, *Nation at Risk* (National Commission on Excellence in Education, 1984), that details the failing of American schools. The conference led to a systemic reform movement in the early 1990s, which aimed to promote reforms that aligned the various components of the educational system, such as standards, assessments, curricula, professional development, and policies around the central tenet of inquiry-based instruction (Supovitz, Mayer, & Kahle, 2000).

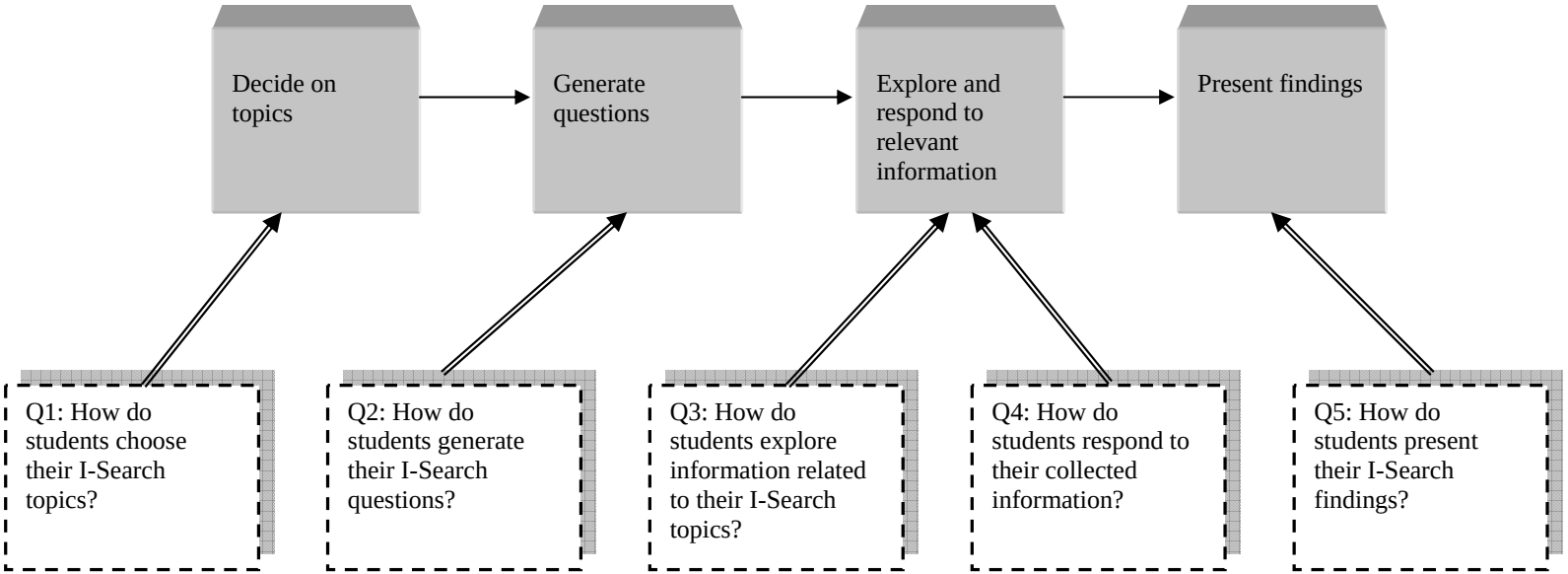

Figure 1.1. Tallman and Joyce's I-Search inquiry model and research questions.

If the movement aims at shifting schools to learner communities, in which students and teachers construct and share their knowledge through inquiry-based instruction, then we need to have substantive knowledge about students' learning experiences under various contexts and inquiry models. My study, exploring students' learning, particularly in the I-Search area, will directly contribute to the relevant literature. My study is not targeted at reporting only students' positive learning experiences, but tries to bring a variety of students' learning experiences to light, whether positive or negative. This will compensate for the weakness in the I-Search literature, as well as enhance people's understanding of complex phenomena in I-Search inquiry-based learning.

In addition, if schools are to prepare students to be active inquirers, one precondition for this goal is that educators have some understanding of how appropriate instructional interventions can be used to support successful inquiry-based learning. My study describes detailed pictures of students' inquiry-based learning processes while they engaged in their learning. Based on the findings, I am refining the Tallman and Joyce (2006) I-Search model(Tallman & Joyce, 2006), which these participants used for their inquiries. I hope to provide a basis for educators to understand when to scaffold students and how to use different instructional approaches for different students. The description provided in this study will form a starting point for designing instructional interventions to improve students' inquiry-based learning. From this perspective, my study has practical implications.

Finally, my study provides a rationale for research methodology design, the context for the study, and detailed description of the procedure of data collection and data analysis. Therefore, this research documentation will provide venues for other researchers and practitioners to judge how the findings in this study can be applied to other contexts, as well as

where they need to improve the design of a similar study if they want to further explore the relevant issue. Thus, my study fills the gap in the current I-Search literature, which lacks methodology documentation, and also provides some basis for further research design and application of I-Search as an inquiry-based learning process.

Terminology

Inquiry-Based Learning: This concept refers to a learning and teaching process, which usually begins with posing a problem or question, followed by generating and pursuing strategies for investigation, collaborating, reflecting, and justifying the solutions to the problem or answers to the question, and communicating the conclusions. The learning outcomes are higher-order thinking skills, an understanding of disciplinary knowledge and adequate attitude and values (Bransford, Brown, & Cocking, 1999; Krajcik, Soloway, Blumenfeld, & Marx, 1998).

Motivational beliefs: I adopt the term used by Pintrich, Marx, and Boyle (1993). Motivational beliefs consist of a list of cognitive constructs related to students' attitudes and values, including goal orientation beliefs (for learning and knowledge), interest and value beliefs, self-efficacy beliefs and control beliefs (Pintrich, Marx, & Boyle, 1993). Due to the scope of my study, I will not further discuss this concept in the literature review, but accept motivation as following this definition.

CHAPTER 2 LITERATURE REVIEW

The purpose of this study was to provide a detailed description of how students carry out their inquiry-based I-Search projects. The goals of this literature review were several. First, it situated the existing literature, as well as the proposed study, in a broader historical and scholarly literature context. Second, it synthesized the key themes which emerged from the literature, informing us about what had been known and had not been known and what it meant. Finally, the literature review rationalized the practical and scholarly significance of the present study in terms of how the study could add to the ongoing discourse of the relevant research.

The materials in this chapter represent a synthesis of literature I have gathered over the last two years. I relied heavily upon *ERIC* and, to a lesser degree, upon other databases, such as *Education Abstract Full Text* and *Social Science Citation Index*. Search terms included “inquiry,” “inquiry-based learning,” “inquiry-based instruction,” and “I-Search.” Bibliographies, suggestions from colleagues and advisors, and course readings often led me to important titles which did not appear in initial searches. Thus, this review was the result of wide reading in many different domains.

Two criteria were used in this literature: relevance and quality. I regarded the following literature as relevant to my study. First, inquiry-based learning has been researched and practiced for more than a hundred years. Therefore, historical and theoretical perspectives about inquiry-based learning are relevant. These perspectives

shape today's view about inquiry-based learning and indicate what is important in this area.

Second, empirical reports related to students' inquiry-based learning experiences within the last 20 years are more relevant than older studies because this section of the literature review aims at referring to today's students, classes and teachers. As we know, student learning involves a wide range of operations, such as students' previous knowledge and experiences related to their time, teaching methods, parents' expectations, learning environments, etc. Recent studies are more relevant for guiding current research.

Third, all available I-Search literature is relevant, because the I-Search is the real focus of my study as the main process for participants' inquiry-based learning. Therefore, I intensively, maybe not exhaustively, reviewed literature about the I-Search research and practice. Reviewing as much literature as I could find helped me form an entire landscape view for I-Search research and practice.

Fourth, eliminated in this review were some problem-based learning studies. Although many inquiry-based learning studies involved ill-defined problems, what I did not include were those that did not use an inquiry approach but involved problem-solving procedures or strategies, such as problem representation, search problem spaces, mean-ends analysis, etc. Also omitted were some project-based articles, when they were not explicitly defined themselves as inquiry approaches. Although it is true that inquiry-based learning often took the form of project-based learning (e.g., Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998), there are many other teaching methods, such as case-based learning, that also take the form of project-based learning. Some project-based learning

may aim at successful accomplishment of projects, while inquiry-based learning does not have to begin with a to-do project; it often starts with a question.

Admittedly, there were many papers with a modest connection to inquiry-based learning that I did not include in this review. But excluding them did not influence the conclusions of this literature review, considering that I had extensively reviewed the most relevant and high quality literature almost to the saturation point; those papers would confirm, instead of change, the conclusions.

The second criterion was quality. I selected high quality papers that contributed significantly to the understanding of the topic. I did not include those that had design flaws or had weak evidence to support their propositions. I cited more papers in science inquiry compared to inquiry in other areas. My rationale was that inquiry-based learning in science has contributed tremendously to our understanding of inquiry-based learning. Many high quality papers were from the science education area. There was no reason to ignore those high quality papers. In addition, inquiry-based learning is emphasized more in science citations than in other areas, and my citations reflect this. However, I did not explore specific science subject matters in depth, such as physics science inquiry, etc. I focused on how those papers contributed to the overall understanding of inquiry-based learning. In this regard, one paper can represent a number of similar papers in science education or social studies, or other areas.

Terms of Inquiry

Although inquiry-based learning is one key theme of the current literature on learning and instruction, the meaning of inquiry, the scope of inquiry, and the components that should be included in inquiry still remain without consensus in the

literature (Etheredge & Rudnitsky, 2003). Inquiry skills, problem skills, critical thinking, and scientific methods are terms whose meanings are included in discussions of inquiry and inquiry-based learning. It should not be surprising considering inquiry-based learning has been discussed in the literature by different people with a variety of theoretical perspectives for more than one hundred years. Thus, clarification of the meaning of inquiry or inquiry-based learning is essential for further serious research in the field.

Three Layers of Meanings

Generally speaking, we understand inquiry on three levels. At the philosophical level, inquiry is a worldview (Alford, 1998; Blachowicz, 1999). At this level, inquiry is a way of looking at the world to develop understandings, including philosophical assumptions, conditions of knowledge, theory, and methodology (Delandshere, 2002).

The second level of inquiry refers to diverse methods through which scientists (including social scientists) research the natural or social world. In this regard, different disciplines have different modes of inquiry, and inquiry is domain specific. For example, inquiry in science emphasizes offering explanations for natural phenomena (National Research Council, 1996), while inquiry in history is targeted at analyzing and interpreting historical events (Levstik & Barton, 2005).

At the third level, inquiry refers to a learning and teaching process in which students undertake a set of activities, such as posing questions, identifying problems, investigating, collaborating, justifying the solutions of the problems or answers to the questions, and communicating conclusions in order to construct their knowledge and develop their inquiry skills (Beyer, 1979; Krajcik, Blumenfeld, Marx, Bass, & Fredricks,

1998; Kuhn, Black, Keselman, & Kaplan, 2000; Levstik & Barton, 2005; Sandoval, 2005). My study is focused on the third level of meaning of inquiry.

Three Aspects or Constructs of Inquiry

As a learning and teaching process, inquiry is a complex process involving unifying multiple constructs: knowledge, inquiry skills and attitude. As early as the 1930s, Dewey (1933) advocated unifying attitudes (such as open-mindedness, whole-heartedness and responsibility) and inquiry thinking skills for attaining the aim of education. Later, Beyer (1979) conceptualized inquiry as consisting of three components: knowledge, process, and attitudes. As a process, inquiry entailed a set of inquiry thinking skills, such as analyzing data, constructing a hypothesis, locating data, and applying a conclusion to a new setting, etc.

The unifying of these components was also emphasized recently by science standards from several different perspectives. For example, AAAS (American Association for the Advancement of Science, 1989) collectively defined value, attitude and skills as habits of mind in the scientific inquiry. Later, *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993) and *National Science Education Standards* (National Research Council, 1996) both explicitly emphasized the importance for students to coordinate knowledge and skills to develop their understanding of science in their inquiry-based learning process. In summary, people have long recognized the indispensable three components involved in the inquiry-based learning process: knowledge, skills, and attitudes. Ignoring any of these will result in the failure of inquiry-based learning.

Three Learning Outcomes

Associated with the three components of inquiry are three learning outcomes to be attained through inquiry-based learning. They are developing (a) deep discipline knowledge (Zuckerman, Chudinova, & Khavkin, 1998); (b) higher-order thinking skills or strategies (Kuhn, Black, Keselman, & Kaplan, 2000), including reasoning skills (Chinn & Malhotra, 2002), inquiry skills (White & Frederiksen, 1998), and metacognition (Loh et al., 2001), etc.; and (c) adequate attitude (Beyer, 1971; Blumenfeld et al., 1991; Dewey, 1933, 1938; Sandoval, 2005). Take the *National Science Education Standards* (National Research Council, 1996) as an example. The *Standards* clearly addressed these three goals for scientific inquiry-based learning. Developing "understanding of scientific concepts" (p. 105) and "understanding of the nature of science" (p. 105) are goals related to developing discipline knowledge. Developing "skills necessary to become independent inquirers about the natural world" (p. 105) is the goal for skills. Developing "the dispositions to use skills, abilities, and attitudes associated with science" (p. 105) is the goal for attitude.

Three Dimensions of Inquiry

Inquiry-based learning embraces multifaceted activities. Basically, these activities can be classified into three dimensions: physical, psychological, and social dimensions. Physical dimension means that inquiry-based learning entails some hands-on activities, such as performing experiments, interviewing experts, or searching for a book. Psychological dimension means that the students' inquiry-based learning involves a wide range of mental activities, such as analysis, critical thinking, judgment, and reflection, etc. Sometimes, these are called minds-on activities (National Research Council, 1996).

Social dimension means the students' inquiry-based learning always occurs in social and cultural contexts. For example, selecting an important question, pursuing one's investigation, and reporting research findings for ongoing discourse actually reflect the practices in authentic professional communities (Azmitia & Crowley, 2001; Hawkins & Pea, 1987; Levstik & Barton, 2005).

Over-emphasizing one dimension while ignoring the others will lead to a misinterpretation of inquiry-based learning. Rudolph critiqued the trend of ignoring minds-on activity in inquiry (Rudolph, 2005). He said the hands-on, activity-oriented, scientific inquiries, "which are an increasingly common part of the school experience, were fundamentally different from the kinds of things scientists do – science being more about constructing ideas than things" (p. 804). In short, inquiry-based instruction must consider and balance these three dimensional activities (National Research Council, 1996).

Inquiry and Problem Solving

Determined by the time and context, sometimes these two terms are interchangeable. Take social studies as an example. In the new curriculum movement, people refer more often to *inquiry* than to *problem-solving*. But since systemic reform, people prefer the term *problem solving*, or treat both terms as interchangeable (Beyer, 1994).

However, some researchers insist there are different nuances and implications embedded in these two terms. Llewellyn (2002) argued that problem-solving sought solutions to a problem, while inquiry involved "students in observing and exploring a particular phenomenon to raise worthy questions of interest. In inquiry situations, the

process of seeking answers to questions usually results in expanding students' understanding of a concept" (p. 87). Rice (1992) also believed that use of the term inquiry instead of problem solving "shifted the emphasis from immediate utility to the process of acquiring a deeper understanding and intellectual skills, independent of practice effects" (p. 229). Plowright and Watkins (2004) proposed that not differentiating between these two terms implied that a workable solution was equal to developing new, fully "research-based understanding and practice" (p. 187).

Types of Inquiry

According to Lisa Martin-Hansen (2002), inquiry can be classified into (a) full or open inquiry, referring to a type of inquiry in which students had full control of their inquiry from problem identification to findings presentation; (b) structured inquiry or directed inquiry, referring to a type of inquiry in which the teacher took full control of the process and students had to follow the instruction in a cookbook manner, (c) guided inquiry, referring to a type of inquiry in which various instructional interventions were used to scaffold students' learning, while at the same time, keeping the process student-centered. The distinction among these types of inquiry was neither clear-cut nor qualitative; rather, it was a matter of degree. Open inquiry and structured inquiry were two end points on a continuum with guided inquiry in between. According to previous and current research, inquiry-based learning is very challenging. Most students, from elementary school age to adults, need guidance to accomplish successfully their inquiry tasks (Change, Sung, & Lee, 2003; Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998; Zuckerman, Chudinova, & Khavkin, 1998). For this reason, most inquiry-based learning should be guided.

Inquiry Models

Designing an inquiry model is one method for guiding students through the complicated inquiry-based learning process. There are many different types of inquiry models designed for different purposes. Dewey's reflective thinking model is one early and influential model (Dewey, 1933). His model consisted of (a) experiencing a perplexed, troubled, uncompleted or confused situation; (b) constructing a tentative interpretation for a possible solution to the given situation; (c) defining and clarifying the problem by careful examination and analysis of its conditions; (d) transforming conjectures into hypotheses; (e) reasoning to bring elements in ideas or suggestions into a coherent whole; (f) testing the hypotheses through action; and finally (g) experiencing a post-reflective phase with a "unified, resolved situation" (Dewey, 1933, p. 106). There are many other inquiry models, such as Beyer's (1971) inquiry model for social studies and Short's (1996) Authoring Cycle. In the next section, I will discuss them in more detail. Although these inquiry models differ from each other, they share many common features. First, they are all influenced by people's understanding of learning phenomena. Second, most inquiry models are also domain specific. Third, most inquiry models confirm that the inquiry process is not just a single act, but consists of a number of intellectual operations. Finally, these models also indicate that inquiry is a non-linear process, containing a back and forth or cyclical process.

Historical and Theoretical Perspectives

Nurturing inquiry is not a new endeavor in the history of education. Dewey, Burner, Piaget, and Vygotsky are all influential figures, who helped shape the perspectives of inquiry-based learning research and practice. Generally speaking,

promoting inquiry-based learning has gone through three major education reform movements in the United States in the 20th Century: the progressive education movement from the 1920s to1930s, the new curriculum movement from late 1950s to the early 1970s, and the third systemic movement, which began in the middle of the 1980s and continues today (Rice, 1992; Supovitz, Mayer, & Kahle, 2000). Many factors contributed to promoting inquiry-based research and practice in these movements. In this section of my literature review, I will briefly discuss the background, learning theories, inquiry models, and projects which significantly shaped the research and practice of inquiry-based learning within each movement.

Progressive Education Movement and Inquiry-Based Learning

Background

At the end of the 19th Century, the United States experienced a rapid urbanization, enormous technological development, and massive immigration. Accompanying such complex, disruptive and contradictory social conditions were economic and political problems, including the growing disparity between the rich and the poor, increased corruption in government, labor unrest and violence throughout the country (Zytowski, 2001). The progressive movement "was largely conceived as a response by the democratic reform movement to the problems and paradoxes evident in the Gilded Age" (Bohan, 2003, p. 74). Therefore, the essential theme for the progressive movement was to seek "both social stability and social uplift" (Cremin, 1961, pp. viii-x). Obviously, the U.S. schooling system could not escape progressivism. The movement, which occurred in education, is often called the progressive education movement or progressive education, reaching its peak in the 1930s. Influenced by the social context at that time, progressive

education emphasized “child-centeredness, social reconstruction, reform, broadened conceptions of citizenship, and studies that emphasize preparation for life” (Bohan, 2003, p. 77).

Dewey’s Theories and Inquiry-Based Learning

John Dewey was one of the prominent educators responsible for the U.S. educational reform in progressive education. He was also regarded as the one who widely promulgated the concept of inquiry in education. The concept of inquiry was an evident focus in his works and had a profound impact on the research on inquiry-based learning at that time (Krajcik, Blumenfeld, Marx, & Soloway, 1994; Supovitz, Mayer, & Kahle, 2000). Hence my discussion in this section focuses on Dewey’s epistemological theory and his propositions of inquiry.

Dewey’s Theory of Knowledge. Dewey defined knowledge as having two inseparable parts, content of knowledge and application of knowledge in the real world. “Knowledge is a perception of those connections of an object which determine its applicability in a given situation ” (Dewey, 1916, p. 396). Separating the two parts might lead to mistakes, such as treating knowledge as something stored in books, which is a content-only approach (Dewey, 1916).

How do people acquire knowledge? Dewey (1916) summarized the answer in his theory of knowledge with two terms: discovery and proof. Generally speaking, discovery involved a process of generating tentative ideas or hypotheses when faced with perplexity. Proof involved a process of verification of the ideas based on the evidence or data associated with the application of the idea (Dewey, 1916). Therefore, the learning

mechanism, from Dewey's point of view, was students' creation of ideas and confirmation of their ideas (Prawat, 1995).

One thing that needs mentioning here was that Dewey often used the terms "ideas," "suggestions," "hypotheses," "perceptions," and "theories" to represent types of knowledge with various degrees of warrant for acceptance and subject to modification and refinement (Prawat, 1995). The method of discovery and proof was a way to transform knowledge from a gross, ungrounded one to a refined, justified one (Dewey, 1916).

Dewey's Theory of Inquiry. Inquiry was proposed by John Dewey in his books *Democracy and Education* (1916) and *How We Think* (1933). In most cases, he used the term "reflective thinking" to mean the same thing as today's meaning of "inquiry". In two places, he explicitly explained the relationship between thinking and inquiry. In *Democracy and Education*, he (1916) stressed the interchangeable meaning of the two terms: "thinking is a process of inquiry, of looking into things, of investigating" (p. 173). In his book *How We Think*, he (1933) said, "reflective thinking impels to inquiry" (p. 7).

In addition, Dewey's meaning of reflection was not the same as today's meaning of reflection, which is "the act of stepping back from one's activity to view actions, objects, system states, or emerging understandings from a different perspective" (Loh et al., 2001, p. 283). The essential meaning of reflection in Dewey's (1916) eyes was "where there is reflection there is suspense" (p. 173). He (1933) proposed that reflective thinking meant that people would not "jump at a conclusion without weighing the grounds on which it rests" (p. 16). In summary, based on the above discussion and careful reading of Dewey's works, and considering the influence that Dewey's reflective

thinking played on later inquiry-based learning research and practice, I thought that Dewey's reflective thinking theory was theory about inquiry, but that he addressed it by another term.

According to Dewey (1933), the essential features of reflective thinking included: (a) sustaining an adequate attitude, such as open-mindedness, whole-heartedness and responsibility; (b) being regulated by a purpose and/or a conclusion which "control the kind of inquiry undertaken" (p. 14); (c) justifying the acceptance of ideas by considering the quality of referent evidence so that the ideas could be grounded on a firm basis; and (d) consisting of consecutively ordered steps.

He also elaborated on the steps that composed reflective inquiry or thinking (Dewey, 1916, 1933). First was experiencing a perplexed, troubled, uncompleted or confused situation, which he called the "*pre*-reflective" phase (Dewey, 1933, p. 106). Second was constructing a conjectural anticipation or tentative interpretation for a possible solution to the given situation, coming from one's prior experience and relevant knowledge. Third was defining and clarifying the problem by careful examination and analysis of its conditions and causes so that "the perplexity is more precisely located" (Dewey, 1933, p. 109). Fourth was elaborating on and modifying conjectures and transforming them into hypotheses. Fifth was reasoning to bring elements in ideas into a coherent whole. Sixth was testing the hypothesis through action, and, finally, the post-reflective phase with a "unified, resolved situation" (Dewey, 1933, p. 106). We can see that Dewey's reflective thinking process was essentially a knowledge acquisition process. This was why inquiry was of central importance in Dewey's theoretical educational offering; he even claimed that learning was to learn reflective thinking (Dewey, 1933).

Projects

Dewey's writings became the foundation for progressive reform in education. By 1930, the main approach adopted by various progressive programs was that teachers and students would define a problem and follow the steps suggested by Dewey (Cuban, 1984b). In this approach, students had the chance to co-decide learning content with their teachers. They were encouraged to use their curiosity and other intellectual resources to explore experiences in various settings. The goal was to improve their observational and judgmental abilities. They were trained to think about evidence by looking into various sources of information from life activities and books and they were expected to express their conclusions logically and clearly (Cuban, 1984b).

Numerous administrators, reformers, and teachers joined in the reform in different national and district organizations during the 1920s and 1930s. One of the spotlight programs at that time was the *Eight-Year Study* sponsored by the Progressive Education Association in 1933. By 1934, 30 public and private schools, as well as university laboratories, were involved. Two hundred and forty-eight colleges and universities agreed to suspend their college admission process for those students who participated in the projects (Kridel & Bullough, 2002). "Investigation, experimentation, and discovery were central components of the vision behind the Eight-Year Study" (Kridel & Bullough, 2002, p. 69). To install the progressive practice, those schools refined their school goals to train students in thinking.

What was the effect of the *Eight-Year Study*? A follow-up study examined 1475 pairs of college students. One group of students came from schools which participated in projects, while its counterpart group of students came from traditional schools. The

college records of students in both groups were compared. The result was that students from participating schools were only marginally better than their counterparts. However, by further examining the study design, researchers at that time found there were many factors possibly contributing to the seemingly disappointing result. For example, by 1936 when the evaluation was conducted, some participating schools were just about to start their reforms. Some of the students who were evaluated actually were not influenced by the projects, although their schools were on the list of those participating. In 1936-1937, another research study, called the *Study within Study* (Kridel & Bullough, 2002), was conducted to compare students in the six most experimental and six least experimental schools, as well as other more traditional schools. Comparing students' college records, the 323 students from the reform type of school greatly exceeded their peers in the measures, including academic average, academic honors, levels of curiosity, higher-level thinking skills, and concern for self and others. This illustrated the positive value of the *Eight-Year Study* with inquiry-based learning as the central tenet (Kridel & Bullough, 2002).

Ending of the Progressive Movement

What about the impact of the reform at the national level? By examining 2800 classrooms across the country from 1920s to 1930s, Cuban (1984b) came to the conclusion that progressive practices in elementary school settings had not become a dominant practice. In high schools, even fewer practices had been modified to install reform ideas. The dominant instruction was still teacher-centered. Cuban, in another book (1984a), further pointed out that an estimated 25 percent of elementary teachers had tried out a few ideas associated with progressive education. But only five to ten percent,

mostly elementary school teachers, made efforts to implement the reform in a substantial way. Even in the heyday of the progressive education movement, two-thirds of American classrooms were left untouched by the tenet of reform (Kliebard, 1988).

In a 1938 meeting, Harold Alberty reported very little implementation was actually carried out in schools compared to much talk about the change (Kridel & Bullough, 2002). In conclusion, progressive reform, with inquiry as one of the central tenets, did not take root and disappeared. Educators shifted their attention elsewhere. Although gone, Dewey's proposition of inquiry remained a profound influence on later inquiry-based research and practice. Many of today's inquiry models still maintain the tenet of discovery and proof from Dewey's reflective thinking model, although new terms and labels have been created.

The New Curriculum Movement and Inquiry-Based Learning

Background

In the early 1950s, the U.S. was in a period of social-political crisis. The national racial equality movement took off after the 1954 Supreme Court decision *Brown v. Board of Education*. At the same time, human knowledge was rapidly increasing. Communication and computer technology was transforming the world into a more sophisticated and closely-related system. Education was accused of not being able to provide a curriculum that met the needs of a quickly changing world, and curriculum reform was in its infancy (Senesh, 1981). This social-political crisis was escalated by the successful Sputnik launch by Russia in 1957. U.S. schools were criticized as "second-best" (Eisner, 1970, p. 3). This eventually sparked the second biggest movement in the

history of U.S. education – the new curriculum movement (Eisner, 1970; Kliebard, 1988).

Educational problems were at least partly attributable to the failure of the American school curriculum to reflect the contemporary content and modes of inquiry in the academic disciplines from which the school subject matters were drawn (Bruner, 1960/1977). Therefore, one resolution was to enlist eminent scholars and scientists in different domains to access and redesign the school curriculum. From the later 1950s to the early 1970s, the development and implementation of new curriculum cost millions and millions of dollars and involved numerous scholars, reformers, and educators covering almost every subject matter in school, including science, mathematics, social studies, art, etc. (Eisner, 1970).

Joseph J. Schwab's Structuring of a Discipline

Because the curriculum reformulation primarily tried to align school curriculum with relevant academic disciplines, a central theme of the movement was to explore the fundamental ideas and methods of inquiry in different fields, which were directly relevant to the subjects in the public schools, and then organize the curriculum according to the structure of those disciplines (Ford & Pugno, 1964). *Structure*, defined by the National Committee of the NEA Project on Instruction, meant, "the body of concepts that limit the subject matter and control research about it" (Tanner, 1966, p. 362).

One prominent and influential scholar researching the structure of disciplines and its relation to teaching and learning was Joseph J. Schwab. He (1963) described in detail how three types of discipline structure related to teaching and learning, especially to *enquiry*, or inquiry in today's spelling. The first was the organization of the disciplines,

which determined the arrangement of the curriculum, what to converge and what to set apart and the order for learning different subjects. The second was *syntactical structure* of the disciplines, which concerned what could be warranted as valid knowledge in a discipline and ways to verify it. Syntactical structure was basically an inquiry process. The implication of syntactical structure was that different disciplines had different syntactical structures, thus having different modes for inquiry. School curriculum should reflect the differences. The third was *substantive structure* of the disciplines, which was the conceptual structure of a discipline. The substantive structure consisted of the discipline's conceptions. The substantive structure was revisable, but needed thorough inquiry. Schwab (1963) proposed that particular pieces of discipline knowledge could be "understood properly only in the context of the enquiry that produced them"(p. 24). The implication was that we should not dogmatically teach students knowledge as the final truth. We should teach knowledge "in the light of the enquiry that produced it"(Schwab, 1963, p. 30).

Bruner's Discovery Learning

Of course, inquiry-based learning research and practice was not only influenced by Schwab's theory, but also influenced by other people and their propositions, such as Bruner's discovery learning. Based on the central tenet that curriculum should reflect the structure of a discipline for students to master, Bruner recommended discovery as a learning and teaching method be used in school (Bruner, 1960/1977). Here, Bruner's concept of structure of a discipline was close to Schwab's substantive structure, consisting of fundamental ideas and principles of that discipline. Instead of asking teachers to present the fundamental ideas and principles to students, students should be

provided opportunities to discover those principles and ideas by themselves (Bruner, 1960/1977). He proposed that this discovery process include intuitive thinking for forming a hypothesis and verification of the guess through evidence (Bruner, 1961).

From this, we can see that Bruner's discovery learning was not much different from Dewey's reflective inquiry, but discovery learning emphasized discovery principles and basic ideas or generalizations in a discipline. Discovery learning was very popular at that time, especially in the early period of the movement.

Jean Piaget's Cognitive-Development Theory

Now it is time to discuss Jean Piaget's theory and its impact on inquiry-based research and practice. Jean Piaget described the stages from birth through adolescence related to cognitive development and associated mechanisms in the developmental process (Gredler, 1992). For Piaget, intelligence development was through cognitive development (Gredler, 1992). What made cognitive development happen? Simply speaking, it was equilibration. Basically, equilibration began from disequilibration, which was a state of cognitive contradiction. Piaget explained, "Disequilibria would occur only because no form of thought, at whatever level considered, is capable of simultaneously embracing all of reality or every universe of discourse in a coherent whole" (Piaget, 1985, p. 11). When people encountered such a cognitive state, they tried to reorganize or regulate their prior thinking. It was through these reorganizations that higher levels of cognitive structures and operations were developed to account for the more complex or diverse situations (Piaget, 1985). Piaget proposed two fundamental processes that were components of every cognitive equilibration: assimilation and accommodation (Piaget, 1985). Assimilation was the incorporation of an external element into the subject's

existing internal structure (Piaget, 1985, p. 5). Accommodation was defined as the adjustment of internal structures to some particular characteristics of specific situations (Piaget, 1985). It was these two processes under equilibration that allowed cognitive development to proceed in a coherent and organized fashion.

Piaget's theory had profound impact on inquiry-based learning research and practice at that time. First, discovery learning, which was very popular at that time, was heavily influenced by Piaget's theory, which was self-evident in relevant documents. For example, in *The Process of Education*, Bruner (1960/1977) proposed to arrange adequate conditions to help learners discover principles or concepts in a subject matter to be learned in order to transform students' primitive models of thinking into advanced models capable of sophisticated logic operations. He (1960/1977) admitted that his ideas were directly grounded on Piaget's theory, which aimed to advance students' cognitive structures. Besides this, Piaget's theory emphasized internal mental activity. At that time, people made efforts to conceptualize cognitive activities involved in the process of inquiry. For example, Beyer (1971) detailed cognitive activities involved in each step of the inquiry-based learning process (described later). What's more, because the individual learner was the starting point for Piaget's theory to understanding the learning phenomenon (Cobb, 1994), inquiry-based learning research limited itself to the individual learner; collaborative learning had not become a central theme in inquiry-based research and practice at that time.

Features of Inquiry-Based Learning in the New Curriculum

Besides a heritage of ideas from Dewey's inquiry, inquiry-based learning research and practice at that time had the following new features. First, it emphasized that the

students should engage in a learning process very similar to the inquiry methods utilized by professional scientists, scholars, etc. Second, discovery learning was widely accepted for instruction. And finally, it underscored the individual learner's cognitive activities or skills.

Some Inquiry Models Developed in the New Curriculum Movement

Learning Cycle. In this section, I will discuss some inquiry models developed during the new curriculum movement that illustrated some of the above features. One inquiry model is the *Learning Cycle*. The Learning Cycle in science was first proposed by Atkin and Karplus (Atkinson & Karplus, 1962; cited in Llewellyn 2002). It illustrated the idea that science learning should be consistent with scientists' authentic inquiry practice (Supovitz, Mayer, & Kahle, 2000). Scientists' inquiry processes usually consisted of three phases: (a) exploration or gathering evidence; (b) invention or naming concepts and introducing relationships; and (c) discovery or using concepts, etc., to investigate other phenomena (Edelson, 2001). The Learning Cycle was developed to represent class activities parallel to those of scientists (Edelson, 2001). Basically, in the exploration phase of the Learning Cycle, students engaged in hands-on laboratory work or field trips. In the invention phase, students discussed concepts introduced by the teacher or from their experience. In some Learning Cycles, the term *invention* is replaced by *introduction*. In the discovery phase, students tried to apply what they learned. Some Learning Cycles replace *discover* with *apply* to reflect more accurately the practice in the classroom (Lawson, 1995; Llewellyn, 2002).

Inquiry Model for Social Studies. Beyer (1971) proposed an inquiry model that described the sequential processes for inquiry learning for social studies. The first step

was to define a purpose, be it an answer to a question or a problem, or the need to satisfy curiosity. This involved cognitive activities, including becoming aware of a problem and making it meaningful and manageable. The second step was guessing a tentative answer or solution – hypothesizing. This step included examining available data, looking for relationships and drawing logical inferences and stating a hypothesis. The third step was testing the hypothesis. This step included cognitive activities, such as assembling, arranging, and analyzing evidence to see if the evidence was supportive of the hypothesis. The fourth step was drawing a conclusion. This step asked the inquirers to think about the validity of his or her formerly constructed hypothesis. If he or she determined that the hypothesis was not valid, the inquirer needed to reformulate a new hypothesis and test the new hypothesis. Otherwise, he or she could draw a conclusion and move forward to the final step of applying the conclusion to new data and generalizing. In this step, the inquirer would check whether his or her conclusion was supported by new data. Through modification of his or her conclusion to embrace new data, the inquirer would have more generalized and less specific conclusions (Beyer, 1971).

Beyer's (1971) model was typical at that time. First, the result of his model was a generalized conclusion. This was often advocated by discovery learning. Second, this model enlisted detailed cognitive activities in each step of its model. This reflected the stress on mental activities in inquiry-based learning at that time.

Projects

As in the progressive education movement, a vast amount of money, about 80 million dollars, had been invested to support different reform projects to develop, implement and disseminate to schools new curricula in almost every subject matter.

Although the first project for the new curriculum was started by Max Beberman at the University of Illinois in 1952 in the mathematics area, the most influential projects were launched after 1955; increased funding was especially spent on science and mathematics after the 1957 Sputnik launch. For example, the *Physical Science Study Committee* (PSSC) developed textbooks, laboratory exercises, films and teaching manuals for high school physics curriculum in 1956. By 1959, about 25 thousand high school students were taking this course. A similar science project was the *Biological Science Curriculum Study* (BSCS) for a high school biology course in 1958. In mathematics, the *School Mathematics Study Group* (SMSG) represented a big curriculum project that involved half of all high school students studying the "new math." In social studies, the biggest project was *Man: A Course of Study* (MACOS). MACOS stressed cross-cultural views of human behavior. This project was guided by Jerome S. Bruner and funded by the National Science Foundation with a budget of three million dollars per year. Other social studies projects included the *Anthropology Curriculum Study Project* (ACSP) and the *Sociological Resources for the Social Studies* (SRSS), etc. (Bruner, 1960/1977; Cultural and Technology; Cultural and Technology; Cultural and Technology; Eisner, 1970; Supovitz, Mayer, & Kahle, 2000).

The Retreat of the New Curriculum

From the 1950s to the 1960s, millions of dollars and vast amounts of time were spent on various curriculum development projects. To determine the value of these new courses, Walker and Schaffarzick (1974) analyzed 23 long-term, large-scale studies directly comparing innovative courses and traditional courses. Twelve of them were in sciences, five in mathematics, four in social studies and two in English. Five studies were

in elementary schools and the remaining studies were in high schools or junior high schools. Among these 23 studies, four were to develop critical thinking, four scientific reasoning, one political attitude, three attitudes toward the subjects, and one about the preference among ways of using knowledge (Walker & Schaffarzick, 1974). Initial examination of these 23 studies showed that students' performances in the innovative groups were much better than that of their counterparts in traditional groups. But Walker and Schaffarzick (1974) found that if considering the learning content in terms of whether it favored the innovative group or traditional group, the optimal results of various studies needed to be reinterpreted. In short, their overall conclusion was that content bias in those studies was not taken into account, when evaluating the effect of these innovation projects. "Innovative students do better when the criterion is well-matched to the innovative curriculum, and traditional students do better when the criterion is matched to the traditional curriculum" (Walker & Schaffarzick, 1974, p. 94). Walker and Schaffarzick (1974) suggested that new curricula might be related to some particular patterns of performance, but did not necessarily mean overall superiority over traditional ones. Walker and Schaffarzick's review did not indicate a failure of the new curriculum movement, but rather they revealed the complexity within innovational practice and also revealed that "a great many seemingly obvious generalizations about education have proven embarrassingly difficult to confirm by research" (Walker & Schaffarzick, 1974, p. 97).

What was the overall effect of the new curricula in U.S. schools? Atkin and House (1981) concluded that millions of dollars of federally sponsored curriculum projects had little or no influence on changing school teaching. They (1981) further said,

"Teachers were influenced by external factors only to the extent that is suited them to be so influenced and to the extent that their circumstances allowed" (p. 13). Take social studies as an example. Rice (1992) reflected on the new social studies and concluded that most long-term and national or privately funded projects "had limited impact beyond the field-test schools" (p. 225). Beyer (1994) also summarized that even at the peak of the movement, only one-third of social studies classroom teachers utilized new materials and methods, "Didactic expository teaching and learning continued to be the norm in social studies" (p. 252). By the end of the 1970s, enthusiasm had declined. Support funding dried up for continued use of new materials, and schools reverted to using materials not much different from those used before the reform (Beyer, 1994). As with the progressive movement, the new curriculum movement did not take root in school practice.

Systemic Reform and Inquiry-Based Learning

Background

In the 1980s, the world was undergoing numerous changes. The world was transitioning from an industrial to an information society, in which technological innovations and applications had exhilaratingly changed every aspect of human society, from home to workplace, from everyday life to sophisticated scientific research (National Council of Teachers of Mathematics, 1989). Knowledge, learning, information, and skilled intelligence were not only crucial to individuals for productive, responsible and fulfilling lives, but also played an important role in sustaining a democratic society's economic vitality and security (American Association for the Advancement of Science, 1989; National Commission on Excellence in Education, 1984).

However, American education was regarded as failing to cater to the above demands of the new age. The 1983 report of the National Commission on Excellence in Education, *A Nation at Risk,* was the result of examining the quality of education due to the growing discontent toward American school systems (National Commission on Excellence in Education, 1984). The committee reported that American students were never first or second in 19 academic areas, when compared with their counterparts in other countries. In addition to this, American students in high school and college also showed declines in science and mathematics achievement, when compared with achievement in previous years. The Committee also stated that students were not equipped with higher-order thinking skills. Solving multiple step mathematic problems was a quite difficult task for a large number of students. Besides students at schools, "some 23 million American adults are functionally illiterate by the simplest tests of everyday reading, writing, and comprehension" (National Commission on Excellence in Education, 1984, p. 8).

The committee (1984) made six recommendations for excellence in education, including (a) emphasis of content in five new basics: English, mathematics, science, social studies and computer science; (b) use of more rigorous standards and raising the threshold for college admission; (c) significantly more time for learning; (d) preparation of qualified teachers; and (f) leadership and financial support for the reforms. Finally, the Committee called for action to reform U. S. education according to its recommendations.

Systemic Educational Reform

The report captured the attention of the nation. A variety of changes compatible with the recommendations was initiated at the state and local levels. The initial stage of

reform that emphasized “more rigorous academic content and higher standards for students and teachers” (p. 55) is called the “first wave” (p. 55) of the recent school reform movement (Vinovskis, 1996). The first wave also led some researchers and educators to reexamine the organization and governance of school systems and called for decentralizing authority to govern schools. The shift towards governance by school-based management is often referred to as school restructuring or the “second wave” (p. 55) of the reform movement. Both waves occurred in the 1980s (Vinovskis, 1996).

One feature of the 1980s reforms was the increasingly active involvement of various states in providing guidelines to implement reforms and funds in public elementary and secondary schools (Vinovskis, 1996). These efforts led to the National Governors Association’s endorsement of six National Education Goals in early 1990 (American Association for the Advancement of Science, 1993), which was especially momentous, because it provided a common set of educational objectives for the states, the federal government, and for the nation.

National goals called for a more coordinated, comprehensive, and integrated federal, state, and local reform effort. In addition, failure of the first and second waves, as well as the reforms in the 1960s, made people gradually realize fragmentary reforms were not adequate and could not make real improvement in student outcomes (Smith & O'Day, 1991). Thus, M. S. Smith and O'Day (1991) proposed systemic reform, which consisted of three aspects of reform. The first was to provide “a unifying vision and goals” (p. 246) at the state level. Second was a state level “coherent system of instructional guidance” (p. 247). To achieve these goals, the states should develop a curriculum framework with the curricular themes, topics, and objectives to “ensure that all students have the opportunity

to acquire a core body of challenging and engaging knowledge, skills, and problem solving capacities" (p. 247). The third aspect was to restructure the school governance system (Smith & O'Day, 1991). In the 1990s, systemic reform became the representative term to describe reforms in various components of the educational system.

National Standards

A significant feature of systemic reform was the effort to develop national educational standards (Vinovskis, 1996). The first important *Standards* was *Curriculum and Evaluation Standards for School Mathematics* created by the National Council of Teachers of Mathematics (NCTM) (1989). They set a successful example for later efforts to develop other standards. Due to the focus of this literature review, I limit my description to standards for mathematics, science, and social studies. My purpose is to illustrate how inquiry-based learning is addressed in those standards.

Curriculum and Evaluation Standards for School Mathematics. This was the first national *Standards* for mathematics to "create a coherent vision of what it means to be mathematically literate" (p. 1) in a technological society (National Council of Teachers of Mathematics, 1989). The *Standards* set five goals for students. One of them was to "learn to reason mathematically" (p. 6). The *Standards* further described the skills involved in mathematical reasoning, including: "making conjectures, gathering evidence, and building an argument to support such notions" (p. 6). Obviously, those skills were in accordance with inquiry skills and could be adequately mastered through inquiry-oriented activities, because inquiry-based learning aimed to develop such skills. Although here the *Standards* for mathematics did not directly use the term inquiry, the American Association for the Advancement of Science (AAAS) treated mathematics as a "part of

scientific endeavor" (p. 33) where inquiry is of central importance (1989). Later, AAAS used the term *mathematical inquiry* in *Benchmarks for Science Literacy* and described it as "a cycle in which ideas are represented abstractly, the abstractions are manipulated, and the results are tested against the original idea" (1993, p. 334). Here we can see that two important curriculum groups, NCTM and AAAS, both confirm the importance of inquiry skills in mathematics.

Expectations of Excellence: Curriculum Standards for Social Studies. This (National Council for the Social Studies, 1994) was developed to:

> provide criteria for making decisions as curriculum planners and teachers address such issues as why teach social studies, what to include in the curriculum, how to teach it well to all students, and how to assess whether or not students are able to apply what they have learned. (p. 13)

The *Standards* (1994) emphasized that students should be prompted to develop problem-solving thinking skills including:

> (1) acquiring, organizing, interpreting, and communicating information; (2) processing data in order to investigate questions, develop knowledge, and draw conclusions; (3) generating and assessing alternative approaches to problems and making decisions that are both well informed and justified according to democratic principles; and (4) interacting with others in empathetic and responsible ways. (p. 160)

Again, like the *Curriculum and Evaluation Standards for School Mathematics*, the standards for social studies did not use the term "inquiry" or "inquiry-based learning", but instead emphasized problem solving. However, they were two interchangeable terms

for social studies areas. Beyer (1994) made this very clear in his paper. He (1994) pointed out that people preferred to use *problem solving* in recent reform movements instead of the term *inquiry-based learning* used in the new curriculum movement. However, the key themes for problem solving proposed by people in systemic reform remained the same as those for inquiry-based learning in previous reform movements. Obviously, the *Standards* for social studies still revolved around the central theme of fostering inquiry-based learning (examples for social studies inquiry-based learning can be seen in Memory, Yoder, Bolinger, & Warren, 2004). VanFossen and Shiveley (1997) stressed that to achieve the goals listed in the social studies standards, "inquiry-oriented teaching might be the most appropriate methodology for the social studies, regardless of grade level" (p. 71).

Standards in Science Education. Different from standards for mathematics and social studies, inquiry or inquiry-based learning was emphasized repeatedly as one of the central tenets in science-related standards. Here, I want to discuss three science standards: *Science for All Americans* (American Association for the Advancement of Science, 1989), *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993), and *National Science Education Standards* (National Research Council, 1996).

The purpose of *Science for All Americans* was to formulate a national vision of what "knowledge, skills, and attitudes all students should acquire as a consequence of their total school experience from kindergarten through high school" (American Association for the Advancement of Science, 1989, p. 3). In it, AAAS emphasized that

students should master scientific inquiry methods and "exercise them in thinking scientifically about many matters of interest in everyday life" (p. 26).

If the *Science for All Americans* had formed a vision for science literacy, then *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993) spelled out specifically how students should progress towards the science literacy by the end of grades 2, 5, 8 and 12. Here, *Benchmarks for Science Literacy* also stressed the importance of students being able to understand scientific inquiry, but further described specifically what students should know about scientific inquiry at different grade levels.

National Science Education Standards were developed under the leadership of National Research Council, through coordination of several leading science and science educational associations, the U. S. Secretary of Education, and the National Science Foundation. They were to "provide criteria to judge progress toward a national vision of learning and teaching science" (National Research Council, 1996, p. 12). The *Standards* consisted of several areas, including science teaching, professional development, assessment, science education program and systems. Within those areas, inquiry was regarded as central in science learning and teaching (National Research Council, 1996). The students from K to 12 should have "abilities necessary to do scientific inquiry" (p. 105) and "understanding about scientific inquiry" (p. 105). To fulfill these goals, not only was inquiry-based learning important in teaching science but also for professional development or teacher education. Science teachers themselves should have extensive knowledge about scientific inquiry and should master skills for conducting scientific

inquiry (National Research Council, 1996). Thus, all national science standards emphasized the central role of inquiry in learning and teaching.

In summary, since the 1990s, systemic reform became a representative term to describe efforts to align the various components of the educational system, including standards, assessments, curriculum framework, textbook instruction, professional development and policies. Among those efforts, establishing standards was crucial because those standards provided vision, instructional guidance and a curriculum framework for what and how a particular subject should be taught. Fostering inquiry skills was still regarded as important and was being touted in the various national standards.

Vygotsky's Sociohistorical Theory of Psychological Development

As in previous reforms, a new round of advocating inquiry-based learning was associated with the new developments in educational psychology and learning theories. Since the 1980s, Lev Vygotsky's *Sociohistorical Theory of Psychological Development* has become the most influential theoretical perspective in inquiry-based learning research and practice.

Vygotsky (1978) aimed to develop a theory that would account for higher mental functions unique to humans. What he found was that signs, especially in language, were the central concept for understanding higher mental processes. Vygotsky (1978) viewed language as a psychological tool. Just as general tools could mediate human social activities, language mediated social activities in such a way that allowed these activities to be planned, presented symbolically through people's inner speech, and coordinated

and reviewed with others through external speech; therefore, language "alters the entire flow and structure of mental functions" (Vygotsky, 1981, p. 37).

For Vygotsky (1978), signs, especially language operations, were critical in the development of higher functions; the development of sign operations could indicate the development of higher mental functions. There were two stages of these sign operations, as Vygotsky (1978) proposed, "Every function in the child's cultural development appears twice: first on the social level, and later on the individual level; first *between* people (*interpsychological*), and then *inside* the child (*intrapsychological*)" (p. 57, italics in original). More specifically, through social interactions, children master social meaning and activities externally represented through language, counting, and other culturally-made signs. Then, this interpersonal process is internalized into an intrapersonal one (Vygotsky, 1978).

What were the implications of Vygotsky's theory on inquiry-based learning research? First, people proposed that inquiry-based learning should be aided by social interactions, either through a more knowledgeable person scaffolding a less knowledgeable person or through peer interactions (Lee & Smagorinsky, 2000b; Scardamalia & Bereiter, 1991). Second, discourse or dialogue was regarded as an indispensable part of the inquiry-based learning process (Pea, 1993; Wells, 2000).

Features of Current Inquiry-Based Learning

Of course, Vygotsky's idea was not the only source providing context to understand the complex inquiry-based learning phenomenon, other theoretical strands, such as situated approach to cognitive science, also provided new ways to look at the issue (Polman, 2002). New developments in educational psychology, as well as

technology, added new features to inquiry-based learning. Generally speaking, the following new features appear in today's inquiry-based learning research and practice. First, despite the differences in various inquiry models, these inquiry models share the common epistemological background of a constructivist perspective (Lim, 2001). Second, inquiry-based learning emphasizes unifying knowledge construction and developing inquiry skills in the learning process (Zuckerman, Chudinova, & Khavkin, 1998). Third, inquiry-based learning stresses the importance of authentic learning contexts mediated by technology (Chinn & Malhotra, 2002; Hancock, Kaput, & Goldsmith, 1992). Fourth, it underscores social interactions through discourse (Polman & Pea, 2001; White & Frederiksen, 1998). And, finally, reflection is crucial for successful inquiry-based learning (Loh et al., 2001).

Some Inquiry Models Developed in the Systemic Reform

In this section, I will discuss some inquiry-based learning models that have developed since the 1990s, which can illustrate some of the features discussed above.

El'konin-Davydov's Learning Cycle. This inquiry model, proposed by Zuckerman, Chudinova, & Khavkin (1998), was developed under the El'konin-Davydov educational system (Davydov, 1990). This model illustrates the feature of current inquiry-based learning research and practice that emphasizes the unifying of knowledge construction and development of inquiry skills.

The fundamental idea behind this model was to address the "two major areas of curriculum building" (p. 204) simultaneously. One was developing the ability for inquiry. The other was identifying "concepts and methods in the domain of knowledge in which this ability is manifestly embodied" (p. 204), and then "coordinating these two levels of

analysis by organizing their interrelation at each step of instruction" (Zuckerman, Chudinova, & Khavkin, 1998, p. 204).

This model suggested that students be introduced to new subject knowledge by discovering for themselves the most general features of the particular subject, which they later represented in a model. Then, students challenged this model with new empirical data, which led them to expand and reconstruct the initial model and look at the phenomenon through the lens of the model. They studied the essential features and verbalized them in scientific terms as initial concepts. Further study took the form of enriching the initial concepts every time a new fact arose and students came up against the discrepancies between the knowledge in the model and the new fact (Davydov, 1990; Zuckerman, Chudinova, & Khavkin, 1998). Six steps make up the model: (a) evoking children's curiosity; (b) verifying hypotheses through asking questions, making predictions and hands-on verification; (c) modeling preliminary concepts; (d) cooperating with peers to assimilate new concepts, terms, and methods; (e) enriching the initial model through explication of contradictions between phenomena depicted; and (f) stating new problems (Zuckerman, Chudinova, & Khavkin, 1998).

This model featured students constructing their knowledge through the process of building and refining their models. Through this process, students could gradually master various inquiry skills including: constructing hypotheses, collecting data, testing hypotheses, discoursing with their peers and communicating their findings, etc. Therefore, this inquiry process was a process of unifying knowledge construction and fostering inquiry skills.

A Specific Dialogue Sequence as a Cultural Tool. Different from the above model, Polman and Pea's (2001) model emphasized social interactions and the dialogue aspect of the inquiry-based learning process. Based on the concept of transformative communication in which "each participant potentially provides creative resources for transforming existing practice, in going beyond the common body of knowledge of the field in their inquiries and the conceptual tools developed to sustain these practices" (Pea, 1994, p. 288), Polman and Pea (2001) proposed a specific dialogue sequence called the *Cultural Tool*. The cultural tool model reflected how learning was transformed and enriched through a special sequence of dialogue. The dialogue consisted of four steps (Polman & Pea, 2001). First, the students made a move toward a goal in their research process, but were limited by their current knowledge. Second, the teacher saw additional implications in the students' moves, but these were not seen by the students. Third, the teacher and students worked together and reinterpreted students' moves. Finally, the teacher's reinterpretation and reappraisal were taken by the students. Learning took place in the Zone of Proximal Development (ZPD).

This inquiry model emphasized the social negotiation process of inquiry. Through this dialogue sequence, students' initially limited situational definitions were transformed into complex definitions in their inquiry process (Polman & Pea, 1997). Polman & Pea's (2001) cultural tool was based on direct analysis of the discourse genres in the classroom. It revealed how specific dialogue could facilitate students' inquiry-based learning. Although the cultural tool was based on observation in a project-based science classroom, the dialogue sequence itself had generality across different contexts for inquiry-based learning. Polman and Pea's research represents typical Vygotsky-influenced research on

inquiry-based learning, which emphasized knowledge construction through discourse (John-Steiner & Meehan, 2000; Wells, 1999).

Computer-Supported Collaborative Inquiry Models. Collaborative inquiry was considered desirable and advocated by current relevant research and practice because it reflected the authentic inquiry practice in professional fields (Lee & Smagorinsky, 2000a; Scardamalia & Bereiter, 1993). Computer supported collaborative inquiry was based on the research in computer supported collaborative learning. It was especially influenced by Scardamalia and Bereiter who proposed theoretical perspectives for computer supported knowledge-building communities.

Scardamalia and Bereiter's ideas (1993) can be summarized as follows. First, knowledge is regarded as a product relatively independent of an individual knower or creator, instead of as a mystery in somebody's mind. Scardamalia & Bereiter (1993) proposed that Newton's theory was not something encoded in Newton's brain, but was a product or knowledge artifact subject to being discussed, tested, taught, applied, evaluated, and credited. Similarly, students could also produce knowledge objects or artifacts in the form of ideas, intuitive theories, models, explanations, or questions, which were also subject to being tested, improved, evaluated, and referred. Second, this process of refinement of knowledge objects should be achieved through social discourse very similar to that conducted in the scholarly disciplines in the form of journals, conferences, correspondence, and debates (Scardamalia & Bereiter, 1993). Therefore, collaborative knowledge building occurred through bringing new ideas into the community discourse and commenting on one another's knowledge-building efforts (Scardamalia & Bereiter, 1993).

Because of the advancement of computer network technology, it was possible to design a learning environment to fulfill their theoretical propositions (Scardamalia & Bereiter, 1994). They actually developed such a learning environment called *Computer Supported Intentional Learning Environment* (CSILE) to support collaborative inquiry. They developed a hypermedia database network system. Students were allowed to post their ideas or working theories about a topic through notes (private or public) on their inquiry-based learning processes into the database system. Those notes could be reviewed by other students or their teachers in order to improve their original idea or working theories about a topic in a subject domain. The refined students' ideas in their notes could then become public to contribute to other students' learning (detail see Scardamalia & Bereiter, 1991). Scardamalia and Bereiter's work was an example of computer-supported collaborative inquiry and influential to later similar research.

Hakkarainen and his collegues' inquiry model was another example of a computer-supported collaborative inquiry model using a hypermedia network system very similar to that of CSILE. Their model was called *Progressive Inquiry* and consisted of: (a) creating context, (b) setting up research questions, (c) constructing working theories, (d) evaluating critically, (e) searching deepening knowledge, (f) generating subordinate questions, and (g) constructing new working theories (Dillenbourg, Eurelings., & Hakkarainen, 2001). Each step was accompanied by posts and comments by student peers or teachers. Thus, the inquiry was conducted collaboratively. These examples illustrated two features of today's inquiry-based learning research and practice. One is that technology-oriented efforts include inquiry-based learning. Second is the emphasis on collaborative learning in inquiry-based learning.

Projects

Today, we are still in the third movement promoting inquiry-based learning. As in previous periods, large sums of money have been invested in various inquiry-based learning research projects. Because we are still in the middle of the process, it is impossible to determine which are the most influential projects in the third movement period or make comments on their overall effect. So, in this section, I will first discuss in some detail the *Web-Based Inquiry Science Environment* (WISE) project, which is often cited in the literature, and then discuss other projects generally and try to identify some features of these projects.

Web-Based Inquiry Science Environment (WISE) is a longitudinal project supported by the National Science Foundation. In the middle of the 1980s, the project was at first called *Computer as Learning Partner,* involving partners including natural scientists, science education researchers, technologists and, classroom teachers. The result of the 15-year project was an instructional framework called *Scaffolded Knowledge Integration* with four design tenets and a list of pragmatic pedagogical principles associated with each tenet (Linn, 2000). The four tenets are (a) “making science accessible” (p. 782), (b) “making thinking visible” (p. 782), (c) “helping students learn from each other” (p. 782), and (d) “promoting lifelong science learning” (p. 782). Using this framework, a learning environment called *Knowledge Integration Environment* (KIE) was designed by the research team (Linn, 2000). Because the software used in later KIE became web-based, KIE is now called *Web-Based Inquiry Science Environment.* Although the name changed, the framework and goals of KIE or WISE remain the same (KIE Research Group and the UC-Regents, 1997). WISE or KIE supported three types of

online inquiry science projects: (a) debating about science relevant topics, (b) encouraging critique of science claims found in advertisements and news stories, and (c) enabling design of scientifically-warranted artifacts (Linn, 2000). In the process of doing their inquiry projects, students were allowed to type their ideas or thoughts as notes for later refinement, reflection, or debate (Linn, 2000).

There are several features of this project. The first is using cutting edge technologies and exploring their potentials as educational technology for inquiry-based learning. Second, the project aimed at structuring social or cognitive operation aspects of the inquiry learning process and providing pedagogical principles for supporting inquiry-based learning. Third, it connected inquiry-based learning with real world contexts (Linn, 2000). These features are underscored in today's relevant research and practice as I discussed in the section, *Features of Current Inquiry-Based Learning*.

Although, there are many other research projects different from WISE, most of them share the characteristics of the WISE project just discussed. For example, the *ChemViz* project at the *National Center for Supercomputing Activities* and the *Image Processing for Teaching* (IPT) project at the University of Arizona are examples of using advanced scientific visualization technology for science inquiry (Gordin & Pea, 1995).

Another project was *Global Learning and Observations to Benefit the Environment* (GLOBE) program, which connected inquiry to authentic contexts (Roschelle, Pea, Hoadley, Gordin, & Means, 2000). The project connected more than 3,800 schools around the world. The teachers and students in those schools collected local environmental data and reported them to scientists. Scientists provided guidance to analyze scientifically real environmental problems. The project motivated students to

engage in this process, not only because it provided long lasting value, but also because it provided a chance for students to deepen their understanding of scientific concepts and inquiry through discussing, analyzing, and interpreting data with their peers and scientists (Roschelle, Pea, Hoadley, Gordin, & Means, 2000).

Finally, like WISE's design principles for the inquiry-based learning environment, Scardamalia and Bereiter (1994) proposed three principles in their research project for designing technology-supported knowledge-building communities. The first was to focus on the problem and depth of understanding. The second was to develop decentralized, open knowledge environments for collective understanding. They proposed that inquiry could profit by encouraging complex interactions, including (a) distributing work among members through publication/review process, (b) sustaining increasingly advanced inquiry around the relative ideas based on collective understanding, and (c) reflecting, etc. The third principle was interaction within broad knowledge-building communities by encouraging participants at different levels to join in the knowledge building process.

In summary, since the 1980s, there has been renewed interest in inquiry-based learning. As in previous movements, various projects and programs were funded to support the adoption of inquiry-based learning into everyday routines in United States school systems. Before we celebrate any triumph, however, a question that any serious researcher would ask is: what can we learn from history?

What can We Learn from History?

We are still in the third movement of advocating inquiry-based learning. New theoretical perspectives have been introduced to inquiry-based learning research and

practice. A number of advanced computer and network technologies have also been utilized to support inquiry-based learning and teaching. As in previous periods, vast amounts of money have been used to foster inquiry-based learning. But will we succeed this time? To answer this question, we need to know why such a good instruction method did not take root in U.S. schools in previous movements. If we do not learn from history, we might make the same or similar mistakes that could eventually lead to failure in our new endeavor (Rice, 1992). I will focus on why inquiry-based learning did not take root during the new curriculum movement, narrowing my discussion to social studies.

The primary reason why I chose to focus on analyzing social studies in the new curriculum movement was the many similarities between what we are currently doing for social studies in the new reform and what people did in the new curriculum movement (Beyer, 1994). Beyer (1994) purported that the advocated instructional method was reminiscent, though not exactly a replication, of the New Social Studies, and also similar to the way people conduct curriculum projects in today's practice, e.g., the cooperation among "instructional designers, curriculum developers, classroom teachers, university scholars, media specialists, evaluators, and researchers" (p. 252). Therefore, similarities between past and current situations could easily exist in a lesson. In addition, what happened to the new social studies curriculum was not an isolated phenomenon at that time; many similar things happened in other domains, such as sciences and mathematics in the new curriculum movement. Detailed analysis of this can be seen in Atkin and House's article (Atkin & House, 1981). Thus, analysis of one case has general implications across contexts.

Basically, we could identify the following reasons or factors for the retreat of the new social studies movement. The first was related to students' readiness for the innovation. "Developers of inquiry-teaching methods assumed too much on the part of the students" (Beyer, 1994, p. 253). Usually, inquiry-based learning was very challenging for students, because it required students to have relevant knowledge about inquiry-based learning and adequate skills to fulfill their inquiry activities, from testing hypotheses, critically evaluating the data resources to interpreting their findings, as well as having a motivated attitude for their inquiry projects (Beyer, 1994). Unfortunately, while most students did not have the knowledge, skills and attitude necessary to succeed, when they were introduced to such tasks, most programs still held an unrealistic picture of their students as a group of learners who were willing and able to engage in such activities and provided few instructions in their learning process (Rice, 1992). Therefore, it was very hard for students to transform from their preferred learning styles, such as storing and recalling knowledge, to inquiry-oriented ones. Obviously, previous inquiry-based learning research and practice efforts were not grounded on sufficient understanding of students' inquiry-based learning processes.

Teachers' motivation also played an important role in influencing the implementation of the reform. Inquiry-based instruction was not easy to implement in traditional classrooms; it made great demands on the performance of teachers in the design and adaptation of multidimensionality in the classroom (Beyer, 1994). As Beyer (1994) described it:

> For teachers, inquiry is also hard work – physically in assembling, scheduling, and manipulating the audiovisual and other materials to be used, cognitively in

> planning for contingencies, and instructionally in guiding and facilitating student inquiry as it develops. Considerable knowledge of content as well as flexibility are also required of teachers. Clearly, … not all teachers were willing or able to devote the effort required for this kind of teaching. (p. 253)

Therefore, although many National Science Foundation sponsored projects had trained a substantial number of teachers to adopt new materials and inquiry-based teaching methods, many teachers were willing to install the new practice only to the extent that it did not dramatically change their own preferred teaching practice, such as recitation and teaching directly from the textbook (Kliebard, 1988).

Besides willingness, teachers' knowledge preparation was influential in limiting teachers' adoption of new practices. Inquiry-based teaching demanded that teachers have deep discipline knowledge, but, unfortunately, there was a trend of declining subject-specific courses in teacher programs during the new curriculum movement (Rice, 1992). Meanwhile, limited hours for professional development programs could only get teachers familiar with the new projects, rather than have any real "impact on remedying the teacher-training deficiencies" (Rice, 1992, p. 228). Obviously, inappropriate design of professional development and teacher education programs was a serious obstruction to adoption of new curriculum design (Senesh, 1981).

There were also other factors, for example, inquiry-based learning did not meet the expectations of school administrations and parents, especially when most school curriculum materials, which were already overstuffed, did not set inquiry-related capabilities as learning objectives and most standard tests did not assess inquiry abilities. Inquiry-based learning, which often needed large chunks of time, distinctive guidance

rather than just lecturing, and a different set of materials, often was regarded as a disruption of normal teaching (Beyer, 1994).

In addition, there were also problems with the inquiry-based new curriculum materials development at that time. People employed a simple development and dissemination model for designing new curriculum materials. Usually, university scholars developed the curriculum materials incorporating the inquiry methods first, and then the materials were field tested in school settings and modified based on the feedback from teachers and students, before national dissemination. However, most university scholars were not good at, or had little experience in, developing materials for K-12 curriculum. The direct result was that often the initial designs were discarded, thus wasting time and money. Additionally, the materials developed in the final grant year went directly to dissemination without field testing. In this situation, the many new curriculum materials were hard to assimilate into realistic classroom settings (Rice, 1992).

What's more, most innovators, local or national, had an unrealistic picture of the time needed for an innovation to take root in a school practice and become self-sustaining (Beyer, 1994). Because of this assumption, school administrators pursued one innovation after another, year after year, without success. Teachers, burned out from their efforts, avoided serious commitment to any innovation. Many prominent leaders of each innovation departed from the efforts to disseminate, resulting in an end to the innovation, due to a lack of "nursing support provided by their enthusiastic and high profile commitment to and endorsement of this educational innovation" (Beyer, 1994, p. 254).

There were other significant factors outside school settings impacting the implementation of innovation at that time. First, constantly emerging new curriculum

movements, such as the back-to-basics movement, the mini-course movement, the writing emphasis, and other sociopolitical issues, such as the Vietnam War and desegregation, shifted the interest of educators and educational administrators, who dropped inquiry-based teaching to meet the new interests (Beyer, 1994; Rice, 1992). Second, when funding for supporting the use of new curriculum materials was no longer available, schools and educators often reverted to the old social studies series (Rice, 1992). Third, many publishers had their own priorities for publication, and many new materials, seldom revised and reprinted, were soon out of print after a short period of time, making it more difficult to sustain use of new materials (Rice, 1992). Fourth, most projects focused on developing new materials, instead of helping schools diffuse and adopt them, which often needed a longer period, approximately ten years, than development. This period was an essential part of any new curriculum reform. But most projects were development-oriented, rather than diffusion-oriented. Therefore, not enough reform efforts helped diffuse the innovations into schools' everyday routines (Rice, 1992).

From the above discussion, we can see that reform could not succeed without a systemic approach supported by long-term commitment and collaboration among society, schools and government. A comprehensive approach is needed to address all aspects of the systems, from kindergarten to higher education, from teacher preparation to development of new materials and assessment methods, from utilizing new technology to restructuring school organization, etc. (American Association for the Advancement of Science, 1989).

One lesson learned related to my study was that it was essential to have a better understanding about students' experiences in their inquiry-based learning processes. Of course, having an adequate understanding was not enough for successful reform. But without it, it is impossible to have a successful reform. "The best conceived curriculum projects in the world will never succeed if students do not work" (Rice, 1992, p. 229). This remains the same in today's reform movements.

However, the role of students in educational changes and the need to have a better understanding of their experiences, their goals, their knowledge, etc. has long been neglected (Wachholz, 1994). In 1993, the American Association for the Advancement of Science (1993) called for an investigation into students' inquiry-based learning experiences that were effective for developing an understanding of the nature of science and science inquiry. In 1998, Krajcik and his colleagues (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998) further argued for more reports on students' inquiry-based learning attempts; current literature still lacked rich and deep understandings of students' learning experiences at different grade levels and in different subject areas. Without substantial understanding of students' inquiry-based learning experiences, it is impossible for us to know how well a specific inquiry instructional method can foster meaningful learning and which parts need to be improved. My study, focused on students' learning experiences under a specific inquiry model called I-Search, can contribute to filling the gap in the relevant literature.

Students' Inquiry-Based Learning Experiences

In the last section, I analyzed the historical and theoretical perspectives of inquiry-based learning. According to what the literature represents, it is essential to have

a substantial understanding of students' inquiry-based learning experiences. In this section, I will analyze how much we know about students' inquiry-based learning experiences so far, and what is needed for further investigation.

First of all, we need to figure out which aspects of students' learning experiences are worthy of discussion. These aspects are influenced by theoretical perspectives. New theoretical perspectives render some aspects of students' learning experiences, which might have been ignored previously, worthy of investigation. For example, for a long time, learning phenomena investigation focused on the individual learner. Only recently, researchers have begun to explore learners as a collective group, due to the impact of social constructivism. In this sense, the part of learning experiences which need to be explored is compatible with what is emphasized in theoretical perspectives. As discussed in the previous section, currently, collaborative learning, discourse and reflection have been added to modern inquiry models, due to the influence of constructivism, especially social constructivism.

Second, these aspects are also influenced by historical perspectives. In the previous section, I discussed a variety of inquiry models, from Dewey's reflective thinking model to today's collaborative inquiry models. Although they differ from each other, they share some key elements. For example, inquiry models always have a step of posting a question or identifying a problem. Then they associate investigation with generating or collecting relevant information or data. Also, inquirers need to make meaning out of their collected information or data in the sense that their tentative answers to that question or solution to that proposed problem or prior knowledge about their topics are revised based on the new insights grounded on the information or data. The

final step is often communicating findings. In a combination of both theoretical and historical influences, the following aspects of students' inquiry-based learning experiences should be investigated. They are: (a) selecting a topic, (b) generating questions, (c) exploring information or data, (d) making meaning out of information by responding to it, (e) discourse, (f) reflection, and (g) presenting findings.

Now, what I would like to do is to use several current inquiry models and identify the common components among them to illustrate my claim above. The first inquiry model was proposed by Krajcik and his colleagues, a project-based web-like inquiry model for science education. Their model consisted of (a) asking questions, (b) designing investigations and planning procedures, (c) constructing an apparatus and carrying out investigations, (d) analyzing data and drawing conclusions, and (e) collaboration and presenting findings (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998).

The second model El'konin-Davydov's learning cycle, which I discussed earlier, was proposed by Zuckerman, Chudinova, & Khavkin (1998). It could be used in broad domains in addition to science. Usually, six steps were included in the learning cycle: (a) evoking children's curiosity; (b) verifying experiment hypotheses through asking questions, making predictions and hands-on verification; (c) modeling the preliminary concepts; (d) cooperating with peers to assimilate new concepts, terms, and methods; (e) enriching the initial model through explication of contradictions between the phenomena depicted; and (f) stating new problems (Zuckerman, Chudinova, & Khavkin, 1998).

The third similar model was the *Inquiry Cycle* model proposed by White and Frederiksen (1998) for science education, which emphasized how students could develop their scientific concepts and models through the sequence of the inquiry process. It

consisted of five steps: (a) asking a well-formed, investigable research question; (b) generating a set of competing hypotheses to predict relevant phenomena; (c) carrying out experiments to test hypotheses; (d) constructing scientific models based on findings; and (e) applying models to various situations (White & Frederiksen, 1998).

The fourth model was *Progressive Inquiry* (Dillenbourg, Eurelings., & Hakkarainen, 2001) for collaborative inquiry learning in science, with cycles consisting of: (a) creating context, (b) setting up research questions, (c) constructing working theories, (d) making critical evaluations, (e) searching deepening knowledge, (f) generating subordinate questions, and (g) constructing new working theories. Each step was carried out through social interactions involving peers and instructors (Dillenbourg, Eurelings., & Hakkarainen, 2001).

The fifth inquiry model is the *Authoring Cycle* for literacy (Short, 1996), with seven steps: (a) building from the known, (b) taking time to find questions for inquiry, (c) gaining new perspectives through collaboration and investigation, (d) attending to difference and revising what was known for discrepancy between observation and theory, (e) sharing what was learned through transformation and presentation, (f) gaining new inquiries based on reflection, and (g) taking thoughtful new action (Short, 1996).

My final example is an inquiry cycle for social studies provided by Meyerson and Secules (2001), with five steps: (a) anchoring to active prior experiences or knowledge, (b) generating questions, (c) conducting research, (d) debating the controversy, and, finally (e) working together to offer solutions.

Comparing those models (Table 2.1), we can see that the following are common components among them: (a) selecting a topic, (b) generating questions, (c) exploring

information or data, (d) making various responses to collected information or data, (e) discourse, (f) reflection and (g) presenting findings. For some models, discourse and reflection were emphasized as embedded in the entire process of inquiry-based learning; for other models, there were two specific steps in the learning process. In either case, they were an indispensable part of inquiry-based learning from a contemporary point of view.

In the remaining part of this section, I will discuss the seven key components of an inquiry-based learning process to highlight what we know and what we don't know about students' inquiry-based learning experiences.

Selecting a Topic

Generally speaking, there was not much about this step in most inquiry models, although this must be the first step before any questions could be generated. The reason is that most students would be required to generate questions around pre-determined content. One common agreement about this step was that the topic should be interesting to the students to attract their attention and motivate them to carry out their inquiry tasks (Zuckerman, Chudinova, & Khavkin, 1998). However, a detailed picture of students' decision-making process in selecting a topic is still not available in literature. This is important for research and practice because different topics might lead in different directions for the inquiry. In addition, researchers have found that students lack motivation in their inquiry tasks (Blumenfeld et al., 1991; Edelson, Gordin, & Pea, 1999). Exploring this aspect of students' learning experiences will provide insights about the motivation problem in inquiry-based learning.

Table 2.1 Key Components in Contemporary Inquiry Models

	Project-based Learning Cycle	El'konin-Davydov's Learning Cycle	Inquiry Cycle	Progressive Inquiry	Authoring Cycle	Inquiry Cycle for Social Studies
Selecting a topic		Step 1: evoking children's curiosity		Step 1: Creating the context	Step 1: building from the known	Step 1: anchoring to active prior experiences or knowledge
Generating questions	Step 1: asking questions	Step 2: experimental verifying of hypotheses of hypotheses through asking questions, making predictions and hands-on verification	Step 1: asking a well-formed, investigable research question	Step 2: setting up research questions step 6: generating subordinate questions	Step 2: taking time to find questions for inquiry	Step 2: generating questions
Exploring information or data	Step 2: designing investigations and planning procedures Step 3: constructing an apparatus and carrying out investigations		Step 2: generating a set of competing hypotheses to predict relevant phenomena. Step 3: carrying out experiments to test hypotheses	step 5: searching deepening knowledge	Step 3: gaining new perspectives through collaboration and investigation	Step 3: conducting research
Responding to information or data	Step 4: analyzing data and drawing conclusions	Step 3: modeling the preliminary concepts Step 5: enriching the initial model through explication of contradictions between the phenomena depicted	Step 4: constructing scientific models based on findings	Step 3: constructing working theories Step 7: constructing new working theories	Step 4: attending to difference: revising what is known for discrepancy between observation and theory	Step 4: debating the controversy
Discourse	Step 5: collaborating and presenting findings	Step 4: peer cooperation helping students assimilate new concepts, terms, and methods		step 4: critical evaluation	Step 3: gaining new perspectives through collaboration and investigation	Step 4: debating the controversy
Reflection					Step 6: gaining new inquiries based on reflection	
Presenting findings	Step 5: collaboration and presenting findings		Step 5: applying models to various situations		Step 5: sharing what was learned through transformation and presentation	Step 5: working together to offer solutions

Generating Questions

Most inquiry models suggested asking questions as the first or a very early step in the inquiry-based learning process (Short, 1996; White & Frederiksen, 1998). These models also suggested students' own interests and goals should drive the inquiry process, instead of answering a question posed by a teacher which had no interest for the students (Short, 1996). This did not mean that only student-posed questions could initiate an inquiry; questions posed by teachers or a book could also initiate an inquiry. What was at issue was the students' attitude toward the question or topic rather than where it came from (Wells, 2000).

In reference to students' question generation phase, relevant research has informed us of the following. First, students' prior knowledge, including discipline knowledge, background knowledge, epistemological commitment, etc., were influential factors that helped shape what types of questions students could ask and would like to ask (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998; Scardamalia & Bereiter, 1992). This has been reported by different studies; for example, Krajcik and his colleagues (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998) found that middle school students usually used their personal experiences instead of scientific merit as a basis to ask questions. Zuckerman, Chudinova, and Khavkin (1998) found that elementary school students often asked naïve questions based on their curiosity, intuition, or prior knowledge, which was different from systematic questioning. The former was unstable, flowing from one to another without much reflection, while the latter was supported by reflection and persistence, "induced by the contradiction between unknown and already known" (1998, p. 204). Corresponding to the first point was that students' initial

questions were often vague, naïve, or even unanswerable, thus needing to be scaffolded and transformed into questions that had more cognitive growth value (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998). Several studies suggested that through asking a series of questions, students would be able to improve their question generation skills (Roth & Bowen, 1993). In addition, Hakkarainen and Sintonen (2002) pointed out that the more a student was able to generate specific sub-questions, the more he/she can construct knowledge. In sum, students' prior knowledge played a critical role in their initial stage of question generation, and they usually could not ask very good questions in their initial stage of question generation. Appropriate conditions and scaffolding were needed to help students ask questions of high educational value in their inquiry-based learning processes.

Asking questions was critical in the inquiry-based learning process; it was associated with the quality and direction of the inquiry process. Although the above studies have informed us to some degree about this step in students' learning, to design adequate conditions and scaffolding to help students generate high quality questions, we needed to investigate the complex cognitive processes and their social involvement required to generate good questions. For example, how did students generate their primary research questions? How did they generate their secondary questions? In short, the detailed picture of this step of students' learning experiences remains unclear.

Exploring Information or Data

Exploring information or data has a broader meaning than just looking for information somewhere. It refers to students having knowledge of searching, evaluating, interpreting and synthesizing multiple resources related to their inquiry-based learning, as

well as designing a plan for it. This also includes students being able to generate new or empirical data through scientific experiment or interviewing people. In addition, this includes students' recording and organizing related data. For science learning, this might include measuring accurately adequate data and organizing data in a way to address students' questions. For other disciplines, this might be collecting and organizing the related information from the library or the Internet in a way that could help answer their questions (Levstik & Barton, 2005; Wallace, Kupperman, Krajcik, & Soloway, 2000).

Researchers found that students from middle school to college generally did not master the relevant skills to explore relevant information or data. For example, Emmons & Martin (2002) reported that college freshmen often had minimal library research experience; they didn't know where to locate information, how to evaluate the credibility of the information or how to synthesize information for their inquiry questions. Their report was consistent with findings of studies conducted in different contexts. Researchers conducted studies that used the Web as the main source for inquiry-based learning projects. They found that adult and middle school students often skipped this phase when they explored Web information, or quickly went through many Web sites without much reflection on the content of the information (Change, Sung, & Lee, 2003; Wallace, Kupperman, Krajcik, & Soloway, 2000). Researchers also found that middle or high schoolers were not able to evaluate critically their collected information; for example, Hoffman, Wu, Krajcik, & Soloway (2003) reported that when students evaluated a Web site, they focused on the Web site's title or visual appearance, instead of engaging in a cogent analysis of the Web site's content. Researchers found that middle school students often generated search terms that did not match their research questions

(Abbas, Norris, & Soloway, 2002, as cited in Quintana, Zhang, & Krajcik, 2005). In addition, systematically collecting data, synthesizing different data, and transforming them into their own claims that could address their inquiry questions or problems also posed challenges for students (Dreher, 1995; Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998).

Although some information seeking literature could help us understand the challenges students face in this step, one significant difference between information exploring and organizing in inquiry-based learning and general information seeking was that the former was often guided by higher-order questions, while the latter was mainly related to how to use key words or other search strategies to find information. Particularly, the latter did not require any specific higher-order questions. Therefore, it is necessary to investigate whether and how students' research questions guided their exploring information and data, as well as how and whether students' search strategies changed with exposure to more information.

Responding to Collected Information

One important step in inquiry-based learning is the students' response to their collected information or data. One type of response that is emphasized in many inquiry models is student refinement or revision of their models, when they encounter new information or data (Coleman, 1998; Hakkarainen, 2004; Hawkins & Pea, 1987; Sandoval & Reiser, 2004; White, Frederiksen, & Spoehr, 1993). This revision of models happened when students constructed their knowledge (Zuckerman, Chudinova, & Khavkin, 1998).

What do we know about this aspect of students' inquiry-based learning? One typical response is that students change their initial generated models or working theories. However, not every student can modify his/her model towards an ideal direction. Hakkarainen (2004) found only some students could reconstruct their initially constructed theories from a functional or empirical-physical explanation type to a more theoretical- physical explanation, which was a desired direction of knowledge refinement for science education. Researchers discovered that students' initial theories or models about their topics were based on their intuitive or perceptual knowledge, relevant life experiences, personal preferences, beliefs, and assumptions (Hakkarainen, 2004; Zuckerman, Chudinova, & Khavkin, 1998). Usually, it was "inaccurate - or at least incomplete" (Levstik & Barton, 2005, p. 17). Some of students' initial theories or models were relatively hard to change without appropriate instructional interventions (Hakkarainen, 2004; Hawkins & Pea, 1987; Pea, 1993). Chinn & Brewer (1998) developed a taxonomy to describe people's responses to anomalous data. They found that people's responses were various, from ignoring to theory change. Those different responses are due to a variety of conditions, including people's prior knowledge, characteristics of anomalous data, and people's strategies for data processing (Chinn & Brewer, 1993).

Based on the above findings, we can see that we know very little about how students made different responses to their information or data. More specifically, in inquiry-based learning, students often are exposed to multiple and different resources, not just anomalous data. We do not know yet how an inquirer responds to a series of information he or she finds that ultimately leads to answers to their inquiry questions or

problems. Besides modifying one's models, there should be more types of responses possible when inquirers confront new data sources. However, we do not know what those types are. This question is important to investigate because the question's answer will help us understand the knowledge construction process in inquiry-based learning.

Discourse

Pea (1993) proposed that the "crucial aspects of learning are fundamentally built up through conversations among persons, involving the creation of communications and efforts to interpret communications" (p. 268). Here, discourse means communication occurs in the process of students' inquiry-based learning to attain the goal of learning. It can occur at any step of the inquiry phase. It can occur among peers or students and their teachers or other more knowledgeable people through oral or written, face to face, or through online communication.

What do we know about this aspect of students' inquiry-based learning? First, the traditional teacher-student discourse pattern was not adequate for open-ended inquiry-based learning. Mehan (1978) characterized this pattern as Initiation-Reply-Evaluation (IRE). Teachers initiated a question for the content they wanted to cover. Students replied with some correct answers. Teachers evaluated the adequacy of the responses and initiated another round of IRE. Polman & Pea (2001) pointed out that IRE was associated with the highly controlled classroom for "sequence and scope," in which knowledge was conveyed from authority to students for recitation. Therefore, it was not supportive of open-ended inquiry-based learning. Inquiry-based learning did not aim at target content to be conveyed and order to be maintained, but rather high-level cognitive skills and deep discipline knowledge (Polman & Pea, 2001). There was a need to establish a new pattern

of discourse for inquiry-based learning, in which students could be active inquirers and teachers could be active guides. Based on years of research studies, Polman & Pea (2001) proposed an alternative, promising discourse pattern, which was a special dialogue sequence called a “cultural tool,” to replace IRE for inquiry-based learning. This has been discussed in a previous section.

Second, no matter whether it was discourse between students and teachers or between peers, the discourse needed to be structured to support meaningful learning. Students did not automatically start discourse, even if they were grouped together. De Vries, Lund, and Baker (2002) reported on a study in a collaborative learning environment called CONNECT environment. Fifteen high school students first learned a scientific theory, then they were required to write an explanation for a sound phenomenon in the CONNECT. The most important lesson learned was that students’ discourse needed to be structured or scaffolded, otherwise the discourse would not automatically occur, even if students held radically different views on the same phenomenon. In addition, two studies reported that using instructional prompts, in the form of prompt questions or sentences, could encourage peer discourse (Coleman, 1998; Scardamalia & Bereiter, 1991). Both studies confirmed that middle school and elementary school students with instructional prompts had developed better understanding of scientific knowledge than other groups without prompts.

Still relatively little is known about discourse in inquiry-based learning. Berkowitz and Gibbs (1983) proposed that there were two types of transactions. A presentational transaction was only aimed at eliciting another’s reasoning. Operational transactions represented a high level of engagement, in which one operates on another’s

reasoning through clarification, competition, refinement, extension, contradiction, reasoning critique and competitive extension, etc. Operational transaction was closely related to the students' development. Similar to this, Kruger (1992) also reported that more sophisticated reasoning development is attributed to the highly active and engaged discourse among peers. Those types of discourses had not been explored in the inquiry-based learning research. In addition, current discourse in inquiry-based learning centers around facilitating explanation and argumentation about some discipline knowledge or conception (Bell & Linn, 2000; de Vries, Lund, & Baker, 2002). However, there has been a lack of focus on research on structured discourse for other components of inquiry-based learning, for example, structuring discourse to generate higher-order questions or design research plans. Obviously, many aspects of inquiry-based learning need scaffolded discourse. If we only focused on one aspect of inquiry-based learning discourse and ignored the others, meaningful inquiry discourse would not be achieved.

Reflection

Reflection was described as "the act of stepping back from one's activity to view actions, objects, system states, or emerging understanding from a different perspective" (Loh et al., 2001, p. 283). Reflection had been widely regarded as a critical step in inquiry-based learning. First, it was because inquiry-based learning usually made great demands on the performance of learners. Students faced more uncertainty and unpredictability than in a traditional classroom (Loh et al., 2001). Therefore, critical analytic reflection of one's innovative learning was a central skill that could help learners adopt this new learning mode. Second, reflection on the domain knowledge could raise students' awareness of how much they knew about their subjects and actively monitor

their learning, thus helping them consciously construct their discipline knowledge (White & Frederiksen, 1998).

What do we know about this aspect of students' inquiry-based learning? First, reflection has positive influence on developing students' discipline knowledge and their inquiry skills. White and Frederiksen (1998) introduced a peer and self-assessment activity called *Reflective Assessment* into seventh through ninth grade physics classrooms. Reflective Assessment allowed students to reflect on their progress of working on their own inquiry, as well as the products of their investigation. Through employing different quantitative methodologies, their overall finding was that reflection significantly helped students develop physics knowledge, as well as inquiry skills. In addition, reflection particularly benefited low-achieving or younger students. Second, students needed multiple instructional supports in their reflection activities in their inquiry-based learning process (White & Frederiksen, 1998). Loh, et al. (2001) conducted a pilot case study on how high school students made reflections in their inquiry physics projects. The researchers developed *Progress Portfolio Tools* for students to keep track of their scientific inquiry-based learning process. The researchers investigated students' reflection from their three sets of reflective activities, which included creating a record of progress, monitoring progress, and communicating process and results. They found that some students did not develop skills to keep track of what they tried, such as their ideas and decisions, but instead just tried to document "right answers." They also found that, although students could make strategic change through monitoring their own progress, they were not able to reflect on their investigation on a global level. They also found weakness in students' reflective activity when students communicated their findings,

such as packaging their artifacts together, instead of systematically communicating their way of interpreting data, rationales for their methods of investigation, etc. Overall, the researchers found that students needed time to form habits and skills for reflective inquiry. They needed a variety of instructional supports for them to build and apply their reflective skills for their inquiry-based learning (Loh et al., 2001).

Reflection has been widely accepted as one critical component for the inquiry-based learning research community. However, we still know little about this aspect of students' inquiry-based learning experiences. We lack substantial description for different learners' reflection activities on their inquiry in different learning contexts. If reflection is important in successful inquiry-based learning, this type of knowledge is necessary for further advancement of research and practice. In addition, there are different types of reflections. For example, McAlpine & Weston (2000) mentioned three types of reflection for teachers. Practical reflection focused on improving one's actions in different practical contexts. Strategic reflection involved generalized knowledge or principle-based knowledge across contexts. Epistemic reflection "represents a cognitive awareness of one's reflective processes, as well as how they may impede reflection and enactment of plans" (McAlpine & Weston, 2000, p. 364). None of these different genres of reflections has been explored in the inquiry-based learning area. I believe extending the scope and genres of reflection in inquiry-based learning can push forward the relevant research.

Presenting Findings

Presenting findings is the final stage in an inquiry-based learning process, in which students demonstrate what they had learned in the prior inquiry steps (Short, Harste, & Burke, 1996). Usually, presentation could create discourse among students and

various audiences, such as parents, teachers, and other public audiences. At this stage, students could receive feedback from other people. Also, students could identify weaknesses of their inquiry-based learning process and, sometimes, could find new directions for conducting new inquiry-based learning (White & Frederiksen, 1998).

Although important, people often treat this phase simply as an ending point for inquiry or a starting point of a new inquiry-based project. Only limited knowledge about this stage of students' learning has been available. For example, Loh and his colleagues found students were not able to communicate systematically their findings in a way that they could use to interpret their data, giving rationale for their methodology, etc. (Loh et al., 2001). Obviously, other important aspects at this stage need further investigation. For example, how did students determine the content of and format for presenting their findings? In short, the detailed picture of this stage of students' learning is still vague. Table 2.2 summarizes the key points about what we have known and what we need to know about students' inquiry-based learning experience.

Based on the above discussion, we can see our knowledge about students' inquiry-based learning experiences is still meager; we still lack substantive understanding about students' inquiry-based learning experiences which is crucial for advancing our relevant research and practice. My study is designed to answer some of the important questions that will contribute to the knowledge base in research and practice.

Table 2.2 What do We Know and Need to Know about Students' Inquiry-Based Learning Experiences?

Phases	What do we know?	References	Grades/Area	What we need to know
Selecting a topic	Topic should interest students	(Zuckerman, Chudinova, & Khavkin, 1998)	Elementary school students, science	The detailed picture of students' decision making process of selecting a topic
Generating questions	Students' prior knowledge influences students' question generation	(Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998) (Zuckerman, Chudinova, & Khavkin, 1998)	Middle school students, science Elementary school students, science	The detailed process of how student generate their primary and secondary questions
	Students' initial questions are vague, naïve, even unanswerable, need scaffolding	(Zuckerman, Chudinova, & Khavkin, 1998)	Elementary school students, science	
	Helping students ask series of questions could help improve students' questioning skills	(Roth & Bowen, 1993)	Middle school students, science	
	Positive relationship between the ability to generate specific sub-question and knowledge construction	(Hakkarainen & Sintonen, 2002)	Middle school students, science	
Exploring information or data	Students do not have enough skills at this stage for locating, evaluating, synthesizing information	(Emmons & Martin, 2002) (Change, Sung, & Lee, 2003) (Wallace, Kupperman, Krajcik, & Soloway, 2000)	College freshmen, information literacy College students, Web-based inquiry Middle school students, Web-based science inquiry	Whether and how students' inquiry questions guide their exploring, generating and organizing of their data or information How and whether students' search strategies change when exposed to more and more information
	Students often generate search terms that do not match their research questions	(Abbas, Norris, & Soloway, 2002, as cited in Quintana, Zhang, & Krajcik, 2005)	Middle school students; Science	

Table 2.2 (cont.)

Phases	What do we know?	References	Grades/Area	What we need to know
Responding to information or data	Students' initial theories and models are based on their intuitive or perceptual knowledge, relevant life experiences, personal preferences or beliefs or assumptions	(Zuckerman, Chudinova, & Khavkin, 1998) (Hakkarainen, 2004)	Elementary school students, science Middle school students, science	How students make various types of responses to information
	Students' initial theories or idea about their topic are inaccurate or incomplete	(Levstik & Barton, 2005)	Elementary and middle school students, history	
	Some concepts held by the initially constructed knowledge are hard to change	(Hawkins & Pea, 1987)	Middle school students, science	
	Some students could not modify their models towards a desired direction	(Hakkarainen, 2004)	Middle school students, science	
	Students made various responses to anomalous data	(Chinn & Brewer, 1998)	Undergraduate students, science	
Discourse	Alternative discourse patter to replace IRE in inquiry-based learning is a culture tool.	(Polman & Pea, 2001)	High school students, science	How discourse could be structured at different phases of inquiry
	Discourse needs to be structured to support meaningful learning	(de Vries, Lund, & Baker, 2002) (Coleman, 1998)	High school students, science Elementary school students, science	
Reflection	Reflection can develop students' discipline knowledge and their inquiry skills	(White & Frederiksen, 1998)	Middle school, Science	How students reflect on their inquiry-based learning
	Students need instructional support in their reflective activities	(Loh et al., 2001)	High school students, Science	What the different genes of reflection are in the inquiry-based learning process
Presenting findings	Students are not able to systematically communicate their findings in a way to interpret their data, give rationale for their methodology, etc.	(Loh et al., 2001)	High school students, Science	How students determine the content and format of presenting their findings

I-Search

In the last section, I analyzed students' inquiry-based learning experiences in terms of what we know and what we need to know in the future. Based on the above literature review, we can conclude that we still lack detailed description about students' inquiry-based learning process, which is crucial for advancing our relevant research and practice. In this section, I will focus on discussion of the I-Search inquiry model, which is one model under which I investigated students' learning experiences. I will conduct a literature review for I-Search around its origin, theoretical foundation, related research and practice, and students' I-Search learning experiences. I will also discuss how my study will contribute to the ongoing discourse in relevant areas.

Origination of I-Search and Its Theoretical Foundation

In 1988, Ken Macrorie published his influential book *The I-Search Paper: Revised Edition of Searching Writing* (Macrorie, 1988). The book was based on his dissatisfaction with traditional college English writing course textbooks, which only presented students with the final product of knowledge, such as ideas and principles, but hid the process or experiences of generating that knowledge. Macrorie (1988) said, "They peddle the ideas, methods, principles and knowledge of authorities but abstracted and detached from the experience that generate them" (p. iv). When students or novices who did not have much experience constructing their own knowledge struggled to install those authorities' knowledge and did not master it, the result was poor writing and meaningless term papers or research papers, which consisted of a list of compiled ideas or sentences copied from different resources without the students making their own meaning out of the source materials (Macrorie, 1988).

Recognizing the problems in those traditional textbooks, Macrorie (1988) decided to write a new kind of textbook. Because this new textbook was so different from the traditional ones, he called it a “contextbook” (p. ii). There were several fundamental ideas behind the design of his contextbook. First was to treat the writing process as a learning process in which students could generate new knowledge or new meaning in writing their research papers. Second was to reveal explicitly the process of knowledge generation and help learners learn that process when they constructed their own knowledge, so they could be their own authority on the new knowledge they created in their writing. Macrorie (1988) wrote that his book “presents readers with ways of building and forming their opinions and knowledge, of building upon their own experience, which can make them authorities as well” (p. ii). The third idea emphasized students’ own interest for driving knowledge construction. The personalization is the primary reason Macrorie used “I-Search” instead of teacher- or other- search, etc. The fourth idea was to use an inquiry-based learning approach. Macrorie (1988) wrote about this in his book: “I Search. That’s the truth of any inquiry” (p. v). Fifth, the writings should have real meaning for students’ lives. The sixth idea was to underscore the balance between “I and Others” (p. 150), recognizing that, although the learner, “I,” played an important role, the learner was not alone in his or her learning process. “Others” were resources for “I,” learning through collaborative learning. Finally, the paper should be written in story style, instead of rigid academic paper style.

Based on the above ideas and several years of field testing, Macrorie (1988) proposed a model called “I-Search” for writing research papers. I-Search meant “A person conducts a search to find out something he needs to know for his own life and

writes the story of his adventure" (p. iii). An I-Search paper consisted of the following four parts (Macrorie, 1988):

1. What I Knew (and didn't know about my topic when I started out).
2. Why I'm Writing This Paper. (Here's where a real need should show up: the writer demonstrates that the search may make a difference in his life).
3. The Search (story of the hunt).
4. What I Learned (or didn't learn. A search that failed can be as exciting and valuable as one that succeeded). (p. 64)

According to Macrorie (1988), through writing I-Search papers, students could learn valuable lifetime skills, including "listening, interviewing, reading, quoting, reporting, and writing in a way that others will profit from and enjoy" (p. 71). Although the contextbook was specifically designed for college English courses, Macrorie (1988) recommended that his model be applied in other situations, such as writing for literature and research projects and introductory courses in a variety of fields or disciplines such as history, social studies, science, etc. Macrorie's book also included many amazing I-Search Papers finished by his or other teachers' students, which illustrated incredible value and potential for the I-Search model in developing meaningful learning.

From the above discussion, we can see that Macrorie basically grounded his ideas in constructivism. Thomas J. Smith (1994) also confirmed that Macrorie's I-Search came out of a writing process philosophy grounded on a new constructivist educational paradigm during the 1970s, which emphasized that "teaching writing as well as teaching itself should be more concerned with the process of producing the product than the final product itself" (p. 3). Thomas J. Smith (1994) further pointed out that because the writing

was constructive in nature, the role of students and teachers in the writing process was greatly amended. It not only required the learner's personal goals to play a driving role in the writing process, but also demanded that teachers be able to assist students' meaning-making process through writing instead of only assessing students' final products – term papers or research papers.

Research and Practice on I-Search

Zorfass and Colleagues' Research and Practice

Since its formation, the I-Search process has triggered interest beyond the community of English literacy and has been researched and adopted in different settings. Zorfass is one of the scholars who was committed to the research and practice of I-Search for more than ten years. In 1986, the U. S. Department of Education, Office of Special Education Projects (OSEP), funded the Education Development Center, Inc. (EDC) for incorporating technology into middle school curriculum (Zorfass, 1998). Zorfass, a director of the project, based on a three-year study, concluded that technology integration could not be successful unless it could strongly connect with the middle school curriculum. At that time, she became aware of Macrorie's (1988) I-Search and realized that she and her colleagues could use I-Search as a frame to deepen their project, because the I-Search provided abundant opportunities for using technology (Zorfass, 1998).

She divided the I-Search process into four phases of inquiry. The first phase was for students to pose their questions. This phase was followed by designing research plans. The third phase involved gathering, analyzing, and synthesizing information. The last phase was preparing papers and exhibitions for students' I-Search projects. Zorfass's I-Search paper included seven components: (a) my research questions, (b) my research

plan, (c) what information I learned as a result of my search, (d) what this content meant to me, (e) what I have learned about myself as a researcher, (f) references and (g) appendices (Zorfass, 1998). Zorfass guided a test of her I-Search model in four middle schools in Massachusetts, New Hampshire, and New York. The result of their field test was the publication of *Make IT Happen!* (Zorfass, 1991), in which she provided guidance for how to design and implement the I-Search units. This book was revised and republished in 1996 to include more materials based on further research on the impact of I-Search in two middle schools (Zorfass, 1996). Since 1991, Zorfass and her colleagues have helped as many as sixteen school districts to design and carry out I-Search units (Zorfass, 1998). In 1998, Zorfass (1998) published her new book, *Teaching Middle School Students To Be Active Researchers*. This book described strategies used by middle school teachers to help their learners to become "meaning makers,… self-motivated inquirers, investigators, and seekers of knowledge" (Zorfass, 1998, p. 2) using I-Search as a vehicle.

During her long-term commitment to research and practice on I-Search, Zorfass tried different approaches to apply I-Search. First, she used I-Search to foster more natural incorporation of technology into middle school curriculum (Zorfass, 1991). She even guided the development of software called *Search Organizer* to help middle school teachers and students carry out I-Search units (Zorfass, 1998). Second, she used I-Search in a Science Quest project funded by U. S. National Science Foundation for informal science education for 10- to 14- year old middle schoolers in high-poverty urban areas (Zorfass & Dorsen, 2002). Third, she (Zorfass, 1998) used I-Search in an interdisciplinary curriculum organized around a central theme of helping students

develop integrated conceptual knowledge across different disciplines. Those disciplines include science, social studies, mathematics, English language arts, etc.. Zorfass and her colleagues' longitudinal research and practice was documented in books, articles and web sites, aiming to guide middle school teachers to design and implement I-Search projects.

Joyce and Tallman's Research and Practice

Joyce, a high school media specialist and former English teacher, and Tallman, a university professor, were two scholars who had collaboratively contributed to I-Search research and application. Joyce (1995) reported her initial effort to adopt I-Search in 1995, when she and her partner, a middle school English teacher, Bettie Martin in Maine, were trying to teach Martin's students a thirteen-step research process recommended in *Information Skills Guide for Maine Educators* (Maine Educational Media Association Ad Hoc Committee on Information Skills, 1990). This thirteen-step research process was made up of five components: pre-search, search, interpretation, application, and appreciation. Although the thirteen-step research process looked promising, Joyce and Martin realized they "needed a 'vehicle' to drive the process" (Joyce, 1995, p. 31). At that time, Macrorie's I-Search Paper inspired them. They decided to try to use I-Search as a vehicle to teach their research processes. The result of their pilot was very encouraging. They found not only that the I-Search was compatible with their thirteen-step research process, but also that it could provide additional benefits, such as (a) helping students to evaluate the quality of information, (b) helping teachers keep track of students' learning process and provide adequate strategies to overcome problems in learning, and (c) contributing to students' "intellectual, social and emotional growth" (Joyce, 1995, p. 37).

Joyce and Martin's initial effort at using I-Search to teach students research processes at Stearns High School in Millionocket, Maine, was also documented by Tallman, a professor at the University of Georgia (Tallman, 1995a, 1995b). Tallman designed a qualitative study to investigate ninth grade students' and teachers' experiences during their I-Search units (Tallman, 1995b). Her study documented not only the advantages that could be gained through I-Search, but also strategies Joyce and Martin had designed to scaffold students' learning (Tallman, 1995a, 1995b). Starting in 1994, she had also been teaching the I-Search in her own graduate education classes.

Based on their research and practice, Joyce and Tallman co-authored a book, *Making the Writing and Research Connection with the I-search Process* (1997). Later, based on users' feedback for their book, the book was revised and republished in 2006 (Tallman & Joyce, 2006). Generally speaking, Joyce and Tallman's book aimed to provide a step-by-step guide for helping teachers and school librarians to teach students research skills. Due to the background of Joyce and Tallman, their work contributed to research and practice of I-Search by adding school media specialists' perspective to I-Search as a research/writing process. Because my study investigated students' experiences under Joyce and Tallman's I-Search model, I will discuss their model in detail later.

Duncan and Lockhart's Research and Practice

Like Joyce and Tallman, Duncan and Lockhart also contributed to the research and practice of I-Search from the school librarian media specialist perspective. What they did was to combine a five step information problem solving model with the I-Search process (Duncan & Lockhart, 2000). They proposed five steps:

1. What do I want to know? At this step, students were required to choose their topic and develop questions.

2. Where can I find the answers? At this step, students found resources and experts.

3. How will I record the information I find? At this step, students were required to take notes, cite resources adequately, and write their search logs.

4. How will I show what I learned? At this step, students were required to write an I-Search paper with a format very similar to that recommended by Marcrorie (1988). Students also needed to present their I-Search projects in an appropriate format such as dioramas, posters, big books, puppet shows, songs/raps, etc.

5. How will I know I did a good job? At this step, students' I-Search projects were assessed.

Duncan & Lockhart (2000) wrote a book, *I-Search, You Search, We All to Learn to Research*, which was also a how-to manual to help teachers instruct elementary school students in the I-Search process from start to finish around the above five steps. Later, they (2005) published a new book, *I-Search for Success*. Although this new book still used their five-step information problem-solving frame, and their focus was still to help elementary school teachers and librarians by including lots of instructional tips, materials, and lesson plans in their book, their new book illustrated their approach to using I-Search by addressing new mandated standards, including Information Literacy Standards, and McREL/Benchmarks Language Arts standards. Their contribution to the I-Search field was to extend the scope of I-Search application to elementary school students and combine an information problem-solving model with I-Search processes.

Other Research and Practice in I-Search

Besides the above three groups of people, there were many other scholars and educators who endeavored to practice and research in I-Search. For example, Dellinger, an English teacher at Burns Senior High School, reported her unique way to apply I-Search in her class. Her goals were to help students become collaborative researchers, master inquiry tools and improve writing skills. She employed a three-step method to achieve her goals. The first step was to ask students to finish a collaborative academic research project. In the process of conducting this project, the teacher would give very detailed instruction to help students master inquiry skills. Then students needed to conduct an individual I-Search project to use the inquiry skills they learned in the previous project and to conduct real research. Finally, students were required to write a saturation report, which meant using fiction techniques to present factual materials to hone students' writing skills (Dellinger, 1989).

Kaszyca and Krueger (1994) also reported their effort to apply I-Search based on their four years' experience with teaching I-Search projects to 10^{th}, 11^{th} and 12^{th} graders in English classes integrating literacy research. They tried to create a collaborative learning environment in which multiple voices from peers, students' parents, teachers, and other audiences were included in the process of students' I-Search projects. Kaszyca and Krueger (1994) concluded, based on their experiences, that collaborative learning could greatly enhance I-Search learning.

Different from the above teachers, Davis (1995) documented how he used Usenet newsgroups as primary I-Search project resources in his sophomore English classes. Students felt challenged by having to face conflicting or multiple points of views existing

in the newsgroup messages. Students had to learn how to judge the quality and credibility of the information to improve their critical thinking (Davis, 1995).

If the majority of literature on I-Search focused on documenting how teachers or other people such as librarians adopted I-Search to their classroom settings, either by their own experiences or utilizing strategies recommended by researchers, then Rubin's (2002) research report seemed unique because the researcher reported six female middle school students' I-Search experiences. Rubin's (2002) qualitative study confirmed that I-Search could facilitate students' development of deep knowledge as well as various inquiry skills.

In summary, since the introduction of Marocrie's I-Search book, the idea has been adopted into a wide variety of instructional settings. It has been used in (a) different student populations in elementary school (Duncan & Lockhart, 2005), middle school (Persky, 1992; Tallman, 1995b), high school (Dellinger, 1989; Jensen, 1989; Nicolini, 1999) and college (Alejandro, 1989; Davis, 1995; Reigstad, 1997; Smith, 1994), and by remedial students (Arnold, 1989); (b) a number of subject domains, including English language arts, science, social studies, literacy, and mathematics (Zorfass, 1998; Zorfass & Dorsen, 2002), English writing (Davis, 1995; Dellinger, 1989; Kaszyca & Krueger, 1994), social issues and critical literacy (Rubin, 2002); and (c) for different purposes, including facilitating technology integration (Zorfass, 1996), training students to be collaborative researchers (Dellinger, 1989), active researchers (Zorfass, 1998), and information problem solvers (Duncan & Lockhart, 2000), as well as helping students master research skills (Tallman & Joyce, 2006) and writing skills (Dellinger, 1989), etc.

Although the applications of the I-Search varied among its populations, subject matters, and purposes, they shared several common features: (a) student-centeredness, emphasizing research questions and processes relevant to students' lives and experiences (Joyce & Tallman, 1997; Tallman, 1995b; Tallman & Joyce, 2006); (b) inquiry-based research, involving posting questions, investigating, exploring information, and transforming information into answers for research questions, etc. (Zorfass, 1998); (c) critical thinking skills, focusing on students selecting, interpreting, analyzing and incorporating multiple points of view related to their own inquiry (Tallman & Joyce, 2006); (d) first-person writing style for the story of the student's search and final product, such as a paper or presentation (Persky, 1992; Smith, 1989); (e) a collaborative research process with interactions among peers, teachers, librarians, experts, parents, etc. (Dellinger, 1989; Kaszyca & Krueger, 1994), and (f) emphasis on reflective journaling of the research process (Tallman & Joyce, 2006).

What Do We Know about Students' I-Search Experiences?

A repeated theme in research and practice of I-Search is its promising approach to engaging and motivating students' learning, improving their learning discipline knowledge, and developing their higher-order thinking skills and positive attitude to learning (Duncan & Lockhart, 2000; Persky, 1992; Rubin, 2002; Tallman, 1995a, 1995b; Zorfass, 1998; Zorfass & Dorsen, 2002). As Doll (2003) summarized, "Overall, there is evidence that this [I-Search] model has been successful with and is recommended for instruction with a wide range of students of varying developmental and ability levels" (p. 25).

However, most literature on the I-Search was about how teachers implemented or should implement I-Search into diverse settings. There was a paucity of literature systematically documenting students' I-Search experiences. I was able to find only one research study that reported on six female middle school students' I-Search experiences by Rubin (2002). Rubin's paper was also the only paper I was able to find that had descriptions of research context, methodology used for data collection and analysis with some detail. Although there were descriptions about students' I-Search experiences scattered among various other relevant I-Search papers or books, they were anecdotal evidence used to support the effectiveness of a particular instructional strategy within the I-Search process, rather than to provide us with a complete picture of how students accomplished their projects. Obviously, despite the fact that I-Search has been widely adopted, we still have only sparse knowledge about students' I-Search learning experiences. In the following section, I will analyze this question around the seven aspects of inquiry-based learning.

Selecting a Topic

Unlike other inquiry-based learning models where the learning content had been predetermined, the I-Search gave students more freedom to choose topics that were meaningful for them. So, usually, students needed to make a decision about which topics they wanted to choose before they generated any questions for a topic.

There was evidence that allowing students (9th grade) to choose inquiry topics that reflected their personal concerns could greatly motivate students' learning (Rubin, 2002; Tallman, 1995b). In addition, students who had strong interest in their topics often could produce higher quality research products, while engaging in higher-order thinking

skills in their research process and gaining more self-esteem. On the contrary, if students chose topics with little personal interest, they tended to employ unproductive approaches in their inquiry-based learning process (Tallman, 1995b). Tallman further pointed out that some students needed help to find an engaging topic (1995b).

Generating Questions

Scholars also reported that although some middle or high school students were good question generators, some had difficulties formulating good research questions; therefore, instructional interventions were necessary for those students (Tallman, 1995b; Zorfass & Dorsen, 2002). Students who had chosen a topic with few personal concerns had more difficulties generating good research questions than those who had a topic with strong personal interest (Tallman, 1995a). Persky also found that middle schoolers could change their questions, when they were exposed to new information in their learning process (Persky, 1992). The findings were in accordance with other reports about students' question generation in their inquiry-based learning process (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998; Zuckerman, Chudinova, & Khavkin, 1998).

Exploring Information or Data

Students were reported as being able to utilize diverse resources for their I-Search projects, including interviews, library books, videos, photographs, Internet information, field trips, newspapers, magazines, and historical records, etc. (Jensen, 1989; Persky, 1992; Tallman, 1995b). Dellinger reported that students could even design complex surveys and use programs to produce data (Dellinger, 1989). Students showed some ability to triangulate evidence from multiple resources to form conclusions (Rubin,

2002). However, evaluating the credibility and quality of multiple resources with contradicting points of view proved to be a great challenge for students (Davis, 1995).

Responding to Information or Data

There was no documentation about how students made various responses to their collected information. But there were reports about the results of their making meaning out of the information. Most research studies reported that students developed deeper knowledge (Davis, 1995; Joyce, 1995; Rubin, 2002; Tallman, 1995b; Zorfass & Dorsen, 2002). The deeper knowledge took various forms, including: (a) thinking of an issue in a more sophisticated manner (Davis, 1995; Joyce, 1995), (b) becoming experts on their topics (Tallman, 1995b), and (c) reinterpreting their own personal experiences under wider social concerns (Rubin, 2002).

Discourse

Essentially, each step in the I-Search process involved plenty of interaction among students, teachers, school media specialists, experts, parents, relatives, friends, etc. Researchers found that discourse enhanced inquiry-based I-Search learning (Dellinger, 1989; Tallman, 1995b). Kaszyca and Krueger (1994) documented some experiences of students' discourse in their I-Search processes. They found that when discourse was emphasized, students would play a more active role in their own learning to seek help from other people, and students would also be better help providers for their peers' learning. What's more, students became more open to criticism/advice from other people, including peers and parents. In addition, I-Search discourse inviting people other than classmates into the learning process could create an authentic environment for students' learning (Kaszyca & Krueger, 1994).

Reflection

I-Search provided ideal channels for students' reflection, because it required students to document purposely their processes as they carried out their I-Search projects. Kaszyca & Krueger (1994) reported that asking students to document their I-Search processes enhanced their metacognition. Tallman (1995b) also found that reflection in I-Search helped develop better research strategies that students could transfer to different settings for other research projects. However, she also pointed out that some students felt it was difficult to reflect on their I-Search learning processes, especially when they selected impersonal topics (Tallman, 1995b).

Presenting Findings

The primary format for presenting findings was the I-Search paper with four components described by Macrorie (1988). Some researchers and educators supplemented this with an additional format of presenting, such as a PowerPoint presentation, drama, Web site, newsletter, etc. (e.g. Dellinger, 1989; Zorfass, 1998). Thomas J. Smith (1994) reported that students gave positive evaluations on I-Search papers; I-Search papers provided them with the chance to understand meaningful research, to learn from each other, and gain deeper understanding of their interests. Reigstad (1997) also proposed that the I-Search paper could provide evidence for students' learning. Tallman found that writing in first-person perspective was an unusual experience for most students. She reported that failure or success in students' information seeking could be reflected in students' I-Search papers. She also found those students, who were not good at reflective thinking and were not able to use their own language in

Table 2.3 What do We Know about Students' I-Search Experiences?

Phases	What do we know?	References	Grades/Areas
Selecting a Topic	Allowing students to choose their own topics could motivate their learning	(Rubin, 2002) (Tallman, 1995b)	9th, social issues 9th, high school, English
	Students who had strong interest in their topics could have high quality products, higher-order thinking and improved self-esteem	(Tallman, 1995b)	9th, high school, English
	Students with less interest in their topics would employ unproductive approaches	(Tallman, 1995b)	9th, high school, English
	Some students needed help to find an engaging topic	(Tallman, 1995b)	9th, high school, English
Generating Questions	Some students had difficulty generating research questions	(Tallman, 1995b) (Zorfass & Dorsen, 2002)	9th, high school, English Middle school students, science
	Students who chose topics with little personal interest had more difficulty generating question than others	(Tallman, 1995a)	9th, high school, English
	Students could change their questions when exposed to more information	(Persky, 1992)	Middle school students, interdisciplines
Exploring Information or data	Students were able to use diverse resources	(Jensen, 1989) (Persky, 1992) (Tallman, 1995b)	High school students, N/A Middle school students, interdisciplines 9th, high school, English
	Students could design complex methods to generate data for research	(Dellinger, 1989)	High school students, English
	Students showed some ability to triangulate evidence	(Rubin, 2002)	9th, high school, social issues
	Students had difficulty evaluating the quality and credibility of diverse resources	(Davis, 1995)	Sophomore, English

Table 2.3 (cont.)

Phases	What do we know?	References	Grades/Areas
Respond to information or data	Thinking in a more sophisticated manner	(Davis, 1995) (Joyce, 1995)	Sophomore, English High school students, English
	Became experts on inquiry topics	(Tallman, 1995b)	High school students, English
	Enriching understanding of one's own experiences	(Rubin, 2002)	High school students, social issues
Discourse	Discourse enhanced I-Search learning	(Dellinger, 1989) (Tallman, 1995b)	High school, English High school students, English
	Discourse made students good help receivers and providers; gave students a more authentic learning environment	(Kaszyca & Krueger, 1994)	High school, English
Reflection	Reflection enhanced students' metacognition	(Kaszyca & Krueger, 1994)	High school, English
	Reflection promoted better and transferable research skills	(Tallman, 1995b)	High school students, English
	Some students had difficulty reflecting, especially with impersonal topics	(Tallman, 1995b)	High school students, English
Presenting findings	Students gave positive evaluations of I-Search papers	(Smith, 1994)	Undergraduate and graduate students, writing
	I-Search paper could be used as evidence for students' learning	(Reigstad, 1997)	Undergraduate students, writing
	Some students were not used to first-person writing style	(Tallman, 1995b)	High school students, English
	Some students who were not good at reflective thinking and unable to write their journals in their own language had trouble writing an I-Search paper	(Tallman, 1995b)	High school students, English

their journals, had trouble writing their I-Search papers (Tallman, 1995b). Table 2.3 summarizes the key points about what we know about students' I-Search experiences.

Based on the above analysis, what we found out about students' I-Search inquiry-based learning experiences was compatible to that reported in other inquiry models I discussed in previous sections. What's more, I-Search research provided additional insight into the relevant literature. For example, I-Search researchers found that students had difficulty reflecting on their own learning processes, when they were working with impersonal topics (Tallman, 1995b). This finding had not been documented by research in other inquiry models. However, we might also notice that most of the important questions I listed in previous sections were also not answered by I-Search research and practice. There was still no detailed description about students' I-Search learning experiences along the different stages of inquiry-based learning.

Critique

Research on students' I-Search learning experiences showed weaknesses similar to those in the literature on students' general inquiry-based learning experiences. There were three problems in I-Search research on students' learning experiences. First, if scholars had claimed that we did not have substantive understanding of students' inquiry-based learning experiences to sustain further relevant research and practice (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998), then this problem was even greater in I-Search literature. In addition, although the research on I-Search added some insights into the knowledge base, many important questions remained unanswered.

What's more, I-Search literature on students' learning experiences was biased to mainly report students' positive experiences, instead of documenting a wide range of students' experiences, including positive and negative experiences. Rubin (2002) reported that he only

selected participants who “have been particularly engaged and affected by their I-Search experience” (p. 4). Thus, his study could not “offer insight into how the project was experienced by a large variety of students – in particular by boys and students less interested in the assignment” (Rubin, 2002, p. 4). Rubin’s case was not rare; most other scholars also reported mainly students’ positive experiences. Only Tallman’s report provided some description about challenges students faced and some negative experiences in students’ I-Search processes (Tallman, 1995b).

Finally, it was very hard to find a research study with detailed description of the research methodology that produced the findings. Only one, which was Rubin’s study, has a research methodology description, so it was hard for other people to make judgments on whether an adequate research method was used or how the researchers on I-Search came to the conclusions they claimed in their studies.

The Contribution of My Research

The purpose of my study was to explore students’ I-Search inquiry-based learning experiences around five aspects: selecting a topic, generating questions, exploring information, responding to information, and presenting findings. Due to the limitation of time and resources, I did not investigate discourse and reflection. My research contributes to the relevant research and practice by providing a detailed description of six participant students’ I-Search learning experiences, as well as research methodology, including rationale for research methodology design, the context for the study, detailed description of each participant, and procedures for data collection and data analysis. Therefore, my study extends the horizon of people’s view of inquiry-based learning, and begins to fill the gap in the I-Search literature.

Chapter Summary

Inquiry-based learning has been researched and practiced for over a hundred years. It was the main tenet in three American education reform movements. Historical lessons indicate that we must have substantive understanding about students' inquiry-based learning experiences. However, current literature still lacks such knowledge. This is especially true in the I-Search area. Effort is needed to fill the literature gap to advance relevant research and practice.

CHAPTER 3 METHODOLOGY

Generic Qualitative Methodology

The purpose of my study was to provide a detailed description of students' inquiry-based I-Search learning experiences as they carried out their I-Search projects. The purpose was supported by the following five questions:

- How do students choose their I-Search topics?
- How do students generate their I-Search questions?
- How do students explore information related to their I-Search topics?
- How do students respond to their collected information?
- How do students present their I-Search findings?

The study employed a qualitative methodology. First, qualitative methodology emphasized the importance of people's experiences, perceptions, feelings and the meaning they made in their lives (Merriam, 1998). This was parallel to the focus of this study where students' experiences and perceptions were critical in understanding their inquiry-based learning. Second, the qualitative methodology underscored the processes instead of outcomes or products (Bogdan & Biklen, 2003). This was compatible with my study where I investigated students' learning processes. Third, using a qualitative methodology provided a wealth of detailed information about issues under investigation, thus increasing the depth of understanding of the cases and situations studied (Patton, 2002). This study aimed to provide a detailed description of learners' inquiry-based learning processes as they carried out their projects in the I-Search model; therefore, qualitative methodology was the best investigative tool to serve the goal of my study.

More specifically, this study used a basic or generic qualitative approach. This approach was defined by Merriam (1998) as an approach employed by qualitative studies that exemplified five qualitative characteristics, including (a) focusing on understanding meaning, (b) utilizing the researcher as an instrument for data collection and analysis, (c) doing fieldwork, (d) utilizing inductive strategy, and (e) gathering rich description. This type of qualitative methodology was not intended to build theory or focus on culture or a single unit or system (Merriam, 1998). The generic qualitative study seeks to "discover and understand a phenomenon, a process or the perspectives and the worldviews of the people involved" (Merriam, 1998, p. 11). The goal of the present study was not to build theory, nor emphasize cultural issues or a single unit, but to understand students' inquiry-based learning experiences. Therefore, a generic qualitative approach matched the goal and focus of my study. In addition, generic qualitative study often seeks to identify recurring patterns in the forms of themes or categories (Merriam, 1998). My study sought to identify patterns through comparing qualitative data of different participants to delineate their learning experiences in their inquiry-based learning processes. Thus, the patterns identified through employing the generic qualitative method helped answer the research questions for this study.

Research Context: Tallman and Joyce's I-Search Model

This study investigated students' inquiry-based experiences under a specific I-Search model developed by Tallman and Joyce (2006), which was the combination of a thirteen-step research model recommended by Maine Educational Media Association Ad Hoc Committee on Information Skills (1990) with Macrorie's (1988) I-Search writing process. Tallman and Joyce (2006) called their model, "an adapted version of the I-Search as a research/writing process that

focuses on higher-order critical thinking skills, to build information literacy as well as writing skills" (p. 12).

Basically, the Tallman and Joyce's (2006) I-Search process can be divided into several phases. The first phase is selecting topics. This step helps students choose an engaging topic, required them to create personal interest webs and topic webs, write about this process in reflective journals, and encouraged them to talk to their family members and friends, etc., to decide their topics.

The second phase helps students generate questions. In this step, students are required to complete their first pre-notetaking sheet in which they need to write what they know, what they do not know, and what they want to know about their selected topics and write about the process in their reflective journal. Then students are required to do background reading. Based on the background reading, students need to create their second pre-notetaking sheet, in which higher-order research questions should be generated. Students are also required to write their thoughts about the process and questions in their reflective journal (Tallman & Joyce, 2006).

The third phase of the I-Search process is to explore relevant information and make a response to their collected information. At this step, students are required to complete a double-entry draft in a two-column table format that will help them evaluate the information they find and make meaning out of it (Tallman & Joyce, 2006). Each resource takes one double-entry draft page. In the left side content column, students record the information from their sources, carefully noting bibliographic information. In the right side reflection column, students record their reflective thoughts about the information, and how it informs their questions, or stimulates more questions and ideas about their topics. Following each double-entry draft, students write evaluation and synthesis comments about the resource in their reflective journal (also known as a

learning log because students are learning about their topics in the process of writing about their resource information and how it applies to their topic questions) (Tallman & Joyce, 2006).

The final stage is presenting their I-Search product. For this product, students need to address five issues: (a) why the topic choose them, (b) the story of their search, (c) their findings, (d) how they will apply their findings, and (e) their final reflection. The final product can be a response to each of this issues in written format or this plus another format that fit the topic questions more appropriately, such as a letter to relatives or plans for some future event, an action agenda, web page, or newsletter, etc. (Tallman & Joyce, 2006). Table 3.1 illustrates the various documents generated at different phases of the I-Search processes.

Table 3.1 Documents Generated in Different Phases of I-Search

I-Search Phases	Documents Created by Students at Each Steps
Select topics	• Personal interest web and journal reflection • Topic web and journal reflection
Generate research questions	• First pre-note taking sheet and journal reflection • Background reading reflection • Second pre-note taking sheet and journal reflection
Explore and respond to information	• Double-entry draft, learning log after each entry and journal reflection
Present final products	• I-Search process reflection and additional format presentation depending on topic questions requirements

Research Setting

The research site was a graduate online course in information literacy in a large, public Southeastern university in the spring of 2006. There were a total of 33 graduate students in this

course with three male students and 30 female students. The students ranged in age from 25 to 55 with a variety of ethnic and racial backgrounds, as well as educational and professional experiences.

The goal of this course was to develop students' capability to incorporate technology, information literacy skills and strategies through research processes. Each student in this class was required to finish three projects. The first was to compare two information research process models. The second was to accomplish a I-Search project following the guidance in Tallman and Joyce's (2006) book, *Making The Writing and Research Connection with the I-Search Process: A How-To-Do-It Manual for Teachers and School Librarians*. The third project was to design and plan collaborative curriculum units with classroom teachers. The second I-Search project was the focus of my research study.

This online class blended mainly asynchronous work in the WebCT environment with synchronous online chat. A mandatory face-to-face session at the beginning of the semester acquainted students with the course goals, objectives, the instructor's expectations and teaching methods. There were weekly synchronous chat hours on Tuesday and Thursday from 7:30 – 8:30pm in the WebCT chat room. Students were required to attend online chat at least once per week. The online chat discussion topics were related to different projects students were carrying out. The instructor split the students into four different forums online to encourage more interactions within each forum on the asynchronous discussion board throughout the different stages of students' projects. The other forms of online instructions and interactions included email communication between instructor and students, as well as discussions that could take place during a face-to-face course all students had together the same semester.

Participants

Merriam (1998) proposed that there were two sampling methods, probability and non-probability sampling. Probability sampling often related to random sampling. The researcher employs it to generalize findings to the population from which the sample was drawn. Usually, this type of sampling is not utilized in qualitative studies. Most qualitative studies use non-probability sampling in order to develop deeper understanding of the phenomenon of interest (Merriam, 1998).

In my study, volunteer-based criterion was utilized to select participants. Several reasons led to my use of this method. First, as I discussed in my literature review, we had a paucity of knowledge concerning the I-Search process. Each participant was important, in my point of view, in terms of having potential to contribute to our understanding of students' I-Search processes. Second, before students started their I-Search projects, I had no way to know in advance what type of learning experiences would happen. So it was impossible for me to select a sample in advance that would capture a maximum of variety of learning experiences. However, a volunteer-based sample would still be possible to offer a useful manifestation of the phenomenon of interest. Third, as Patton (2002) pointed out, "data collection consists of using whatever resources are available to do the best job possible" (p. 401). For practicality, this was a convenient method allowed by the realistic situation.

Before the class began, I contacted the online course instructor to seek volunteers from her class. The course instructor let me introduce my research study in the first face-to-face class. Seven students signed up to participate in the study. One student withdrew his participation due to his changing work place and schedule conflict. Thus, there were total of six participants, five female students and one male student in this study. All six participants could verbally articulate

with clear self-expression, which was very important for providing high quality data for qualitative study (Patton, 2002).

The sample size was adequate for my qualitative study. Usually, unlike quantitative researchers, qualitative researchers work with smaller sets of people. The quality of data was not determined by sample size, but by purpose of the research (Patton, 2002). In my study, five in-depth interviews with each of the six participants and numerous documents created by participants in their I-Search process produced a large amount of data from the six participants. The abundant data provided an in-depth understanding of the phenomena under study, thus achieving the goal of this study. As a further justification for the study participant numbers, many successful similar previous studies used from five to eight participants (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998; Wallace, Kupperman, Krajcik, & Soloway, 2000). Thus, a sample size of six is an acceptable number for this type of study.

Data Generation

Data Sources

According to Patton (2002), three types of qualitative data could yield relevant findings: intensive interviews, direct observations and written documents. Because this was an online course, direct observation was not possible. To gain comprehensive understanding of the phenomena under investigation, my study consisted of two other main types of data: documents and interviews.

Documents

According to Bogdan & Biklen (2003) there are three types of documents: personal documents, official documents and popular cultural documents. Personal documents are first-narrative descriptions of an individual's actions, experiences, or attitudes. Official documents are

those produced by “organization employees for record-keeping and dissemination purposes” (p. 58). Popular cultural documents are those “produced for commercial purposes to entertain, persuade and enlighten the public” (p. 58). The documents in this study were personal documents, including students’ reflective journals, personal and topic webs, double-entry drafts, pre-notetaking sheets, background reading reflective journals, and final project reports. These documents were created by the students during the process of their I-Search projects. These documents recorded their research steps, their reflection on their own learning, etc. The reason to include these documents as primary data for this study was that they were in accord with the criterion that “the best primary sources are those recorded closest in time and place to the phenomenon by a qualified person” (Merriam, 1998, p. 122).

Participants generated abundant documents throughout their I-Search processes according to the guidance written in Tallman and Joyce’s book (2006). These documents could be divided into four phases. At each phase, students produced a variety of documents that revealed their thoughts, decision making, strategies and their knowledge about their topic, which were valuable in providing important information for my study. Table 3.2 details the documents students created at different stages and the roles of the documents. Besides the different roles, these documents also provided cues to help participants to reflect on their meaning making activities in their I-Search projects in my data-gathering interviews. The documents helped me to generate probe questions in the interviews to elicit participants’ thinking, reasoning, activities and their knowledge development processes.

Table 3.2 I-Search Documents and Research Questions

I-Search phases	Documents	Time for Collection	Role of Documents	Help Answer Research Questions
Select topics	Personal interest web and corresponding journal reflection (#1)	Immediately after the due day of the assignment	Revealed what might be possible to a I-Search topic and students' thinking process of selecting a topic	Q1
	Topic web and corresponding journal reflection (#2)		Revealed the students' initial responses about their selected topics and their decision process for their topics	Q1
Generate research questions	First pre-note taking sheet and corresponding journal reflection (#3)	Immediately after the due day of the assignment	Revealed students' initial knowledge about their topics and what they might want to know about their topics	Q2
	Background reading reflection		Revealed how information helped build up background information to generate questions	Q2
	Second pre-note taking sheet and corresponding journal reflection (#4)		Revealed how students generated their questions based on their background reading and reflected on the process	Q2
Explore and respond to information	Double-entry draft (including analysis and synthesis reflection) and corresponding journal reflection (#6)	Immediately after the due day of the assignment	Revealed how students made meaning out of the information they collected as well as how they looked for relevant information	Q3, Q4
Present final products	I-Search paper including: "(a) why the topic chose me, (b) story of my search, (c) my findings, (d) how I will apply my findings, and (e) final reflection"	Immediately after the due day of the assignment	Provided data about students' reflection on their entire I-Search experiences and their research findings	Q1-5
	Additional forms of presentation		Represented the format and content of students' research findings	Q5

Note. Journal number was assigned according to the course syllabus.

Interviews

The second main data resource for my study was interviews. The purpose of interviews is to capture people's perceptions, experiences, opinions, feelings, and knowledge from their own perspectives (Bogdan & Biklen, 2003; deMarrais, 2004). Data collected through interviews constituted the primary data sources for this study. The interviews focused on learners' inquiry-based learning experiences in the different phases of their I-Search processes.

There are different labels for interviews, such as intensive interview, narrative interview, and life history interview, each of which illustrated a different aspect of the qualitative interview (deMarrais, 2004). Patton (2002) classified them as three types of interviews: informal conversational interview, interview guide and standardized open-ended interview. They are different to the extent in which interview questions are formed and standardized before interviews (Patton, 2002). My study used the interview guide approach, which outlined a list of topics or issues to be explored. The interview guide ensured my exploration of the same issues across different interviewees that were very important for this study. Meanwhile, this approach still allowed me the flexibility to explore, probe, and ask questions that could "elucidate and illuminate that particular subject" (Patton, 2002, p. 343), although the degree of detail and flexibility varied in different interviews.

The First Student Interviews. I conducted the first student interviews one week before the students started their I-Search projects. One purpose was to gain background information of the participant, which was related to his or her I-Search inquiry-based learning experiences. Participants' academic backgrounds, work experiences,

understanding of inquiry-based learning, as well as initial impressions and thoughts about their upcoming I-Search assignment were the main foci of these first student interviews. The question types in this interview were background questions to identify their characteristics, and opinion and value questions to help me understand their opinions, judgments, goals, and intentions and expectations related to their inquiry-based I-Search learning projects (Patton, 2002).

The Second Student Interviews. I conducted the second student interviews within one week after the participants decided their inquiry topics. The purpose was to understand how students selected their topics. Two webbing documents and corresponding journal reflections were collected and examined. From these documents, I generated additional questions, which I thought might elicit important information about students' I-Search experiences.

The Third Student Interviews. The third student interviews were conducted also within one week after the participants generated their inquiry questions. The primary goal for this interview was to explore how students generated their questions. I collected and examined documents, including the two pre-notetaking sheets, corresponding journal reflections, and background reading reflections created by each participant, before I conducted the third student interviews.

The Fourth Student Interviews. I collected and examined the participants' double-entry drafts and corresponding journal reflections before I conducted the fourth interviews. Then within one week, I conducted the fourth students' interviews to probe students' experiences at this stage of I-Search learning processes. The goal for these

interviews was to investigate how students explored and responded to relevant information, covered in my third and fourth research questions.

The Fifth Student Interviews. The fifth interviews were conducted within two weeks after I collected the participants' documents that they created at the final stage of their I-Search process. The purpose of this interview was to understand how students decided the type of presentation that best fit their findings, thus answering question five. In addition, most participants' documents provided additional insights into their entire inquiry-based I-Search experiences.

In short, the second through the fifth interviews were designed to parallel the different stages of the students' I-Search process and answered different research questions. Each interview focused on facilitating students' reflections on details of their learning processes and the meaning of these experiences. Most of my interview questions were open-ended questions that allowed the interviewees to select from their "full repertoire of possible responses those that are most salient" (Patton, 2002, p. 354). Generally, there were three types of interview questions in the second through fifth interviews. Experience and behavior questions (Patton, 2002) helped elicit students' behavior, strategies, actions, or activities to accomplish their inquiry-based projects. Opinion and value questions (Patton, 2002) elicited their perceptions of their learning experiences. Knowledge questions (Patton, 2002) brought out students' understanding about their own inquiry topics developed as their research progressed. Appendix B contains the sample of my interview protocol.

The interview questions were arranged according to Patton's (2002) suggestions. Namely, I asked straightforward descriptive questions first, followed by probing

questions to elicit greater detail to piece together the descriptive picture of students' learning processes. I followed this with opinion and value questions for students to interpret their experiences. The opinion and value questions were "likely to be more grounded and meaningful once the respondent has verbally 'relived' the experience" (Patton, 2002, p. 352). I made use of knowledge questions in their appropriate contexts. These strategies increased the quality of the interview data.

In summary, documents and interviews were two primary sources in my qualitative study. These two types of sources were supplementary to each other to help answer the research questions in my study. Table 3.3 shows the relationship between my research questions and data sources in my study.

Table 3.3 Research Questions and Data Sources

Questions	Data Sources
Q1 How do students choose their I-Search topics?	• Personal interest Web and topic web, corresponding journal reflections. • Second student interviews
Q2 How do students generate their I-Search questions?	• Pre-note sheet 1, 2, background reading, and corresponding journal reflections • Third student interviews
Q3 How do students explore information related to their I-Search topics?	• Double-entry draft (including reflections after each entry) and corresponding journal reflection. • Third and fourth student interviews
Q4 How do students respond to their collected information?	• Double-entry draft (including reflections after each entry) and corresponding journal reflection. • Fourth student interviews
Q5 How do students present their I-Search findings?	• I-Search paper (also helped to answer Q1-4) and additional presentations for their final products • Fifth student interviews

Data Collection Procedures

In the last section, my discussion mainly focused on the types of data involved and their roles of answering my research questions. In this section, I describe how various data were collected chronologically. Basically the procedure involved multiple tasks, including getting Institutional Review Board (IRB) approval, recruiting participants, establishing rapport with participants, keeping track of documents I needed to collect, and arranging interviews. It also involved communicating with the online instructor, collecting course materials (e.g. the syllabus, project assignment description), attending at the online discussions and reading messages posed to the online discussion board (WebCT) to gain more understanding of the context in which the I-Search projects were carried out. Figure 3.1 illustrates the data collection procedures and how data resources related to different research questions.

Before the Beginning of the Course

About two weeks before the beginning of the course, I contacted the course instructor to ask her permission to allow me to conduct the study in her class. The course instructor agreed and granted me access to her course materials in WebCT. So I had the chance to learn about the class schedule, syllabus, course projects etc. During this period, I became familiar with her course, and made tentative data collection and interview plans according to her course schedule.

Week 1 to Week 2

The class began on January 9, 2006. The first class was a mandatory face-to-face class. All students enrolled in this course attended the class. The instructor introduced the

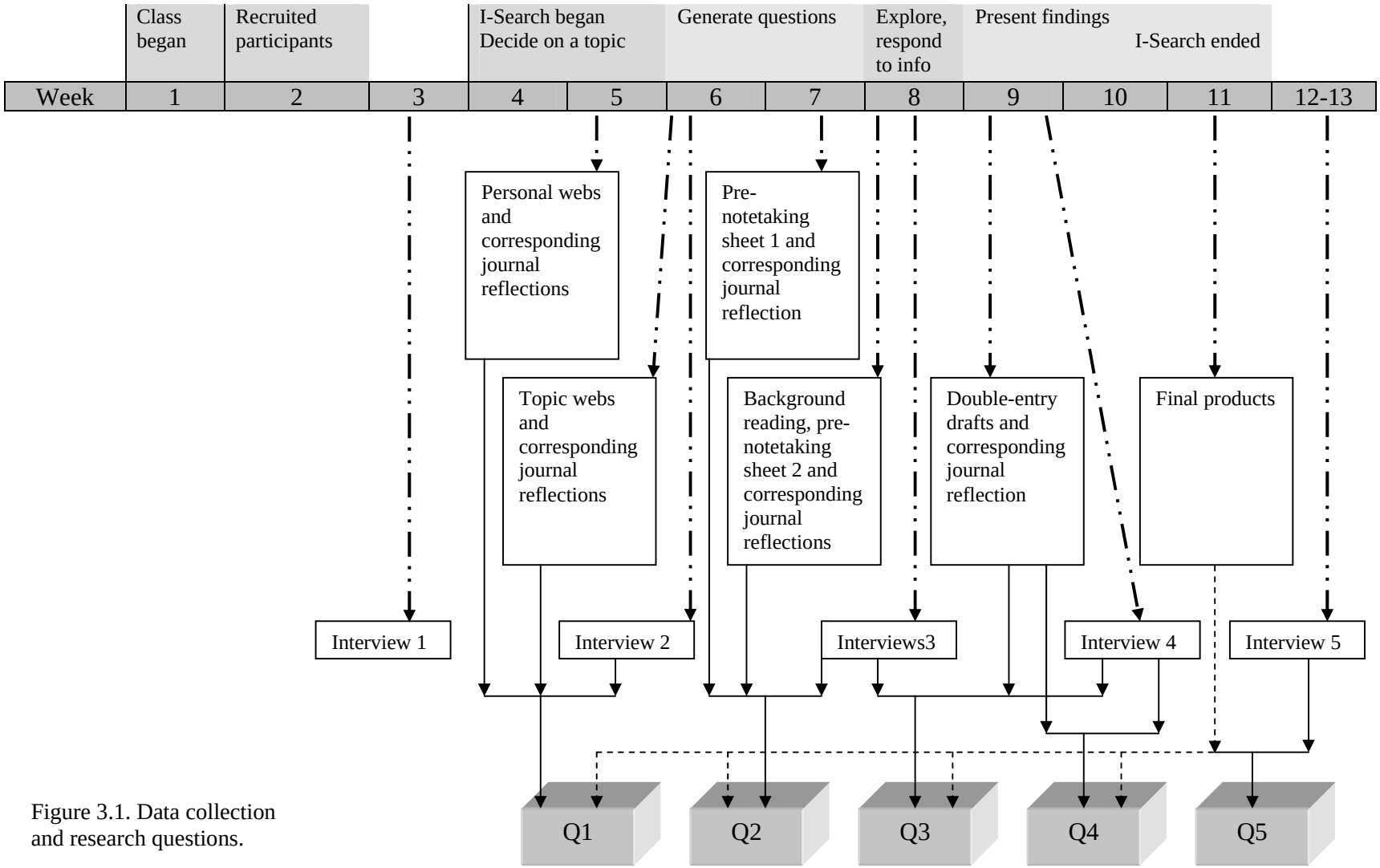

Figure 3.1. Data collection and research questions.

goals and requirements of the course. She also introduced the projects, including the I-Search project, which students had to accomplish for the course. I was given 20 minutes to make a presentation to inform the students about my research, including the purpose of my research, and how many volunteers I needed for finishing my research. I told them what the volunteers were expected to do if they would like to participate in my study, as well as how I would keep their information confidential when I used their data in my research. I also posted my *Invitation for Participation Letter* on the course WebCT discussion board to let students know more about my research. Within ten days after the first class, I was able to recruit seven participants (one withdrew later).

Week 3

One week before the class started their individual I-Search projects, I met with each of the six participants at different times during Week three. Before the interviews, I explained the purpose and procedures of my study. After answering participants' questions, I obtained signed consent forms from each participant before I conducted the first interviews. These interviews were short, ranging from 20 to 30 minutes and were audio-taped. My focus was to collect information about participants' past working experiences and academic background, their conceptions about learning and inquiry-based learning, as well as their initial responses to the upcoming I-Search projects. The interviews served two purposes. One was to understand participants' past experiences and perspectives related to the research topic, from which I hoped to better understand their behavior and thinking processes during their I-Search projects. Second was to establish good rapport between myself and participants, which was critical for further interviews.

Week 4 to Week 6

The students started their I-Search project in Week four. The instructor gave them two weeks to decide their inquiry topics. In Week four, students were given one week to draw a personal Web putting themselves at the center and connecting with their interests, family, activities, teaching, health, and hobbies which might give clues for a good research topic. They were also required to begin a journal where they would write reflections about each of the I-Search strategies and the results of using these strategies. The first journal reflection corresponded to and was due at the same time as the personal Web. Their assignments were due on the first day of Week five. Then in the Week five, students were required to select one topic from their personal Web they created in Week four to create a topic web with their selected topic in the center. They reflected on this process in their journals. Both webbing documents and the corresponding journal reflections were submitted on the first day of Week six. If any students had more than one topic that interested them, they were also required to create additional webbing for their extra topic, namely, one webbing document was created for each topic

I collected participants' webbing documents and their journals immediately after their due dates in Week five and six. Then I scheduled the second interviews with participants in Week six. The main focus for these interviews was to understand participants' topic selection process, including the goal for their topics, the alternative choice for topics, and influential elements that shaped their final topic decision. I also made an effort to delineate their initial knowledge about their topics by asking them what they knew about their topics at the time of interviews. In the process of interviews, I presented them with their own documents and asked them to elaborate some points which

did not seem clear to me but might be important to the study. The interviews lasted from 20 minutes to 60 minutes. All were audio-taped. I conducted the interviews by mainly following the interview protocol. The questions varied marginally in each interview for the purpose to best elicit participants' responses that were relevant to my research study.

Week 6 to Week 8

Beginning in Week six, students were required to finish their first pre-notetaking sheet, which was a table with three columns, *What I know*, *What I don't Know*, and *What I Want to Know* about their topics. The instructor asked that students create one or more higher-order research questions, using the starter words "How" (explains process), "Why" (creates understanding), or "Which" (compares and contrasts). They could supplement the main research question(s) with secondary questions starting with "What" or "When," if applicable. Students were to reflect on creating their research questions in a corresponding journal reflection. The resulting first pre-notetaking sheet and journal reflection were due on the first day of Week seven.

In Week seven, students needed to read at least two resources that gave them general ideas or background information on their topics. Their background reading resulted in a corresponding journal reflection discussing what they could remember from their readings that applied to their research questions. They had to write their reflection with the resources closed. Based on their reading, students were also required to create a second pre-notetaking sheet and make any necessary changes, and wrote a corresponding journal reflection discussing their changes and their use of background reading to refine their research questions. The second pre-notetaking sheet and journal reflections on

question refinement and background reading strategies were due on the first day of Week eight.

As before, I collected participants' documents immediately after their due dates, and then met them in Week eight for the third interviews. The main focus for these interviews were participants' question generation processes, background reading process and their growth of knowledge on their inquiry topics at the time of interviews. I also asked participants to explain to me the differences between their two pre-notetaking sheets and their opinions of the higher-order questions they generated. As in previous interviews, documents were presented to participants and different probing questions were asked to seek deeper understanding of their learning experiences particularly related to question generation for their I-Search projects. Time for these interviews lasted from 36 minutes to one hour and 45 minutes. All interviews were audio-taped.

Week 8 to Week 9

Starting from Week eight, students were required to write double-entry drafts for each resource they used. Each double-entry draft consisted of a two-column table, with the left column for quotes or phrases from their resources, and the right-side column for student responses in their own words about how and why the resource contributed ideas or facts toward answering their research questions. Students also were required to write a reflective journal for this process. The due date for the above assignments was on the second day of Week nine.

Same as before, I collected participants' documents before the interviews. My focus for the fourth interviews was their process of exploring information and their making meaning out of those resources. Participants' double-entry drafts and their

journals were presented to help them reflect on their experiences on this stage of inquiry-based I-Search learning. Different probing questions were also generated from their documents to elicit necessary responses from participants. These were the longest audio-taped interviews, lasting from one hour to two hours.

Week 9 to Week 13

From the third day of the Week nine, students were given 18 days to finish their final I-Search products. Students were expected to create two final I-Search products. One was to write a short paper in first person style that included the following sections: (a) "why my topic chose me," (b) "the story of my search," (c) "what I found," (d) "how I am going to apply my findings to answer my research or essential question(s)," and (e) a reflection on my I-Search process. They also had to select an appropriate format to present their I-Search products which could be, but not limited to, a scrapbook, a paper, a PowerPoint, a letter to relatives, or an action plan, etc. The idea was to get students to realize that different topics and research questions did not necessarily fit one final format: one format did not fit all questions.

Again, I collected participants' documents before scheduling final interviews, as I did prior to three previous interviews. But there was a longer time interval, 7-12 days, between interviews and documents collection. The longer time intervals would allow participants to have a better reflection on their overall I-Search experiences. My focus on these interviews was on their decision process for generating their final I-Search products, the connection between the information collected in their previous stage in double-entry drafts and their final products, as well as their overall perceptions of their

own inquiry-based I-Search experiences. The time of those interviews varied from 48 minutes to one hour and 40 minutes. Table 3.4 illustrates the data collection procedure.

Data Analysis

Data Analysis in the Data Collection Phase

Qualitative data analysis extracts meaning out of data and transformed data into findings (Merriam, 1998). It involves "working with the data, organizing them, breaking them into manageable units, coding them, synthesizing them, and searching for patterns" (Bogdan & Biklen, 2003, p. 147).

Data analysis often naturally occurs in the data collection process because of the interactive nature of data collection and analysis (Merriam, 1998). When I talked to the instructor, examined online course materials, read posted online discussions and chats, ideas about directions for analysis would occur, and insights would emerge in my mind. Examination of increasingly accumulated documents created by students and interview transcriptions also allowed initial patterns, themes, and interpretations emerging to reveal the analytical possibilities. These were written into memos, which informed later data analysis. However, a rush to conclusions at this stage was purposely avoided to allow openness of the inquiry. Analytic insights emerging in this data collection stage could improve not only the quality of the collected data, but also the data analysis in the next phase (Patton, 2002).

Organization of Collected Data

The collected data were voluminous. Adequate organization of the data was needed to serve the goal of the study. First, all the electronic data were burned onto CDs

Table 3.4 Data Collection Process

Class Schedule	Important Dates and Events	Data Collection
Before class began		• Contacted the course instructor, acquainted with the course materials
Week 1	Class began on January 9, 2006	• Attended first face-to-face class to introduce my study
Week 2		• Recruited seven participants (one withdrew later)
Week 3		• First student interviews • Established rapport with participants
Week 4	Started I-Search project	
Week 5	Monday, February 6, 2006, the personal interest Web and corresponding journal reflection due	• Collected students' personal Webs and their corresponding journal reflections
Week 6	Monday, February 13, 2006, Topic web and corresponding journal reflection due	• Collected topic webs and corresponding journal reflections • Second student interviews
Week 7	Monday, February 20, 2006, pre-notetaking sheet one and corresponding journal reflection due	• Collected pre-notetaking sheet one and corresponding journal reflection
Week 8	Monday, February 27, 2006, background reading corresponding journal reflection, pre-notetaking sheet two and corresponding journal reflection due	• Collected background reading corresponding journal reflection, pre-notetaking sheet two and corresponding journal reflection • Third student interviews
Week 9	Tuesday, March 8, 2006, double-entry drafts and corresponding journal reflections due	• Collected Double-entry drafts and corresponding journal reflection • Fourth student interviews
Week 10		
Week 11	Sunday, March 26, 2006, final I-search products due	• Collected participants' final I-search products
Week 12- 13		• Fifth student interviews

for at least two copies to protect against loss of data. Any paper documents were also photocopied for the same reason. These back-up files were appropriately labeled with short descriptions and stored for safekeeping.

Seven folders were used to organize data. Six folders were labeled with participants' pseudonyms. The data collected on each participant were saved in his or her individual folder. Participant's individual folder included the participant's interview data, webbing documents, pre-note taking sheets, double-entry drafts, journals, I-Search side paper and final project products. In short, each participant's folder consisted of all the information about this participant. The result of this procedure was generation of comprehensive, systematic, and in-depth information about each participant.

The remaining one folder was labeled as course materials. Documents created by the instructor posted on WebCT, such as the syllabus, project descriptions, sample works, and other documents related to how the online course was implemented to support students' learning were included in this folder. Although the files in this folder were not directly used as data, the diverse sources could tell the setting of the online course, the elements designed and implemented by the instructor to support students' inquiry-based learning. These files set the contexts for understanding the learners' learning processes.

Analyze Individual Participant's Data

First, I analyzed participants' data individually. For each participant, I divided his/her data into five parts: (a) personal background, (b) selecting a topic, (c) generating questions, (d) exploring and responding to relevant information, and (e) presenting findings. These five parts were sequentially analyzed.

Open Coding

The first part was selected for open coding. Coding involves making links between the original raw data with researchers' theoretical conceptions by attaching labels or tags to chunks of data (Coffey & Atkinson, 1996). In the early stage of coding, an "open" approach or open coding was used to underscore the importance of being open to data and their meanings (Strauss & Corbin, 1998). This approach often occurred in several steps: data were broken down into discrete events and objects, and given names that stood for these.

I read the data at least twice to have a holistic picture of my data, as Giorgi (1997) suggested. While I was reading, I highlighted parts of the data that seemed significant to the phenomena relevant to my research focus. Based on the cycle of reading data and highlighting the places, I was able to discriminate among and clarify units of analysis, which were the "smallest piece of information about something that can stand by itself" (Lincoln & Guba, 1985, p. 345). Then I coded the transcription in a line-by-line manner (Charmaz, 2002). This was a process of searching for patterns and concepts that my data covered (Ezzy, 2002). In the margin of my data, I labeled the units of analysis. When I finished this, I had many codes listed in the margin of my transcriptions. I typed them into a separate document, a list of open codes. The open code list consisted of codes and line numbers for each code in the original data. The result of this step of analysis was a list of substantive codes generated from empirical data for each participant at this stage of his/her I-Search process.

Categorizing

The second step to code this part of data was categorizing. Categorizing involved reducing data and presenting the data in a more concise and abstract way through grouping parts together (Moustakas, 1994; Strauss & Corbin, 1998). When I examined the open codes created in the last step, I compared the open codes piece by piece for similarities and differences. Then I clustered recurring regularities and removed overlapping or repetitive statements. By sorting out redundancies and fitting together codes, I developed a list of categories which were more abstract than the open codes to represent the phenomena (Strauss & Corbin, 1998).

According to Guba (1978), there are two criteria for categorizing: *internal homogeneity* and *external heterogeneity*. The former concerns how well data belonged in a category in a meaningful way. The latter concerns the extent to which distinctions between categories are clear. To meet the criteria, I worked back and forth between data and category systems to verify the classification of categories and accuracy of data placement in categories. The result of this step was a category list for the first part of the qualitative data for the first participant.

Describing

According to Patton (2002), it is important to focus initially on understanding the individual case before cross-case analysis could be done. To do so, a careful write up for each case was necessary. Thus the third step was to construct description based on the category identifies in the prior steps. To do so, I went back to the analysis results in the prior steps and glanced at the transcription again, asking myself which were the important

themes that represented the participant's experiences at this I-Search stage. I tried to develop the description to reflect accurately the participant's experiences.

These above three steps, open coding, categorizing and describing, were repeated until all five parts of the participants' data had been analyzed. Following this, I constructed a description of the participant's overall I-Search experiences mainly around the five research questions, as well as special issues identified based on the results of previous analysis steps. This formed the draft for each participant's profile in chapter four. By this time, the analysis for one participant's data was finished. The result was a document with open codes, categories and descriptions organized for ready access for the first participant. The results of above analysis were sufficiently detailed and comprehensive to illuminate the focus of inquiry so that it could form a foundation for the quality of data analysis in the next step. The above procedures were repeated until all participants' qualitative data were analyzed individually.

Comparison among Participants' Data to Identify Themes and Generate Conclusions

This step used mainly cross-case analysis to search for patterns and themes. The analysis steps were centered on answering the five main research questions. At first, the data and analysis documents related to all participants' topic selection were isolated. I reread the relevant case descriptions and categories to gain a more complete picture of the participants' topic selection process. Then I used the constant comparative method to compare the differences and commonalities between categories among the six participants. Once I reached a shared meaning and essence of the experiences for those participants (Moustakas, 1994), I could identify a new theme or pattern, and create new categories that represented the six participants' learning experiences at this stage by

clustering individual participant's relevant categories. This process was done through cycles of referring back to data, categories, descriptions and comparison among them.

During this process, if any discrepancy was identified, for example, a piece of qualitative data did not seem to support the newly created categories, I would reexamine the relationship between categories and themes and the overall structure of the themes. I might generate new categories and discard old categories or combine them with other categories. I might also rearrange the hierarchy among the categories to best represent the phenomena thematically. I conducted this thoughtful examination through constant comparison between themes, categories, and data, as well as negotiation with my discipline knowledge. Then, a description for each category was written employing language mostly in accord with my disciplinary perspective. This procedure was repeatedly conducted until all the remaining qualitative data were analyzed around the four other research questions.

The result was a list of codes, which is also called a "master list" by Merriam (1998, p. 181) or "coding schemes" by Bogdan & Biklen (2003, p. 161). A master list is "a primary outline or classification system reflecting the recurring regularities or patterns" (Merriam, 1998, p. 181). The generation of it is usually influenced by research questions, particular concerns, theoretical approach and academic disciplines (Bogdan & Biklen, 2003).

The result of this step of analysis was thematic portrayals of the inquiry-based learning experiences for all participants, which could describe things underlying the dynamic phenomena in terms sufficient to illuminate and answer the five primary

research questions (Please see appendix C for Code Matrix). Figure 3.2 illustrates the data analysis procedure.

Inductive and Deductive Approach

Generally speaking, there are three different approaches for data analysis. One is inductive analysis, involving "*discovering* patterns, themes, and categories in one's data" (Patton, 2002, p.453, italics in original). This approach often emphasizes findings being grounded in data instead of according to some predetermined theoretical framework (Schwandt, 1997). A deductive approach refers to generating theories, hypotheses or propositions that were confirmed or disconfirmed by the data (Patton, 2002). A third approach is called abduction, which is a combination of inductive and deductive analysis (Denzin, 1978).

I used the third approach to guide my data analysis. Specifically, I emphasized using inductive analysis at the earlier stages of the data analysis, when I was open coding and categorizing, to ensure the codes and categories emerged from the data. Meanwhile, I utilized the deductive approach when I used the relevant literature to provide nuances for bringing focus to the data analysis. The deductive approach provided a general sense of reference and a direction, as well as a frame in which to organize data to make sure the research's goals could be fulfilled and research questions could be answered.

Credibility, Generalization and Limitations of My Study

Credibility

One important issue related to qualitative study is its credibility. Following some of the suggestions from Patton (2002), I employed the following strategies to improve the credibility of my study. First, once any round of interviews was conducted, they were

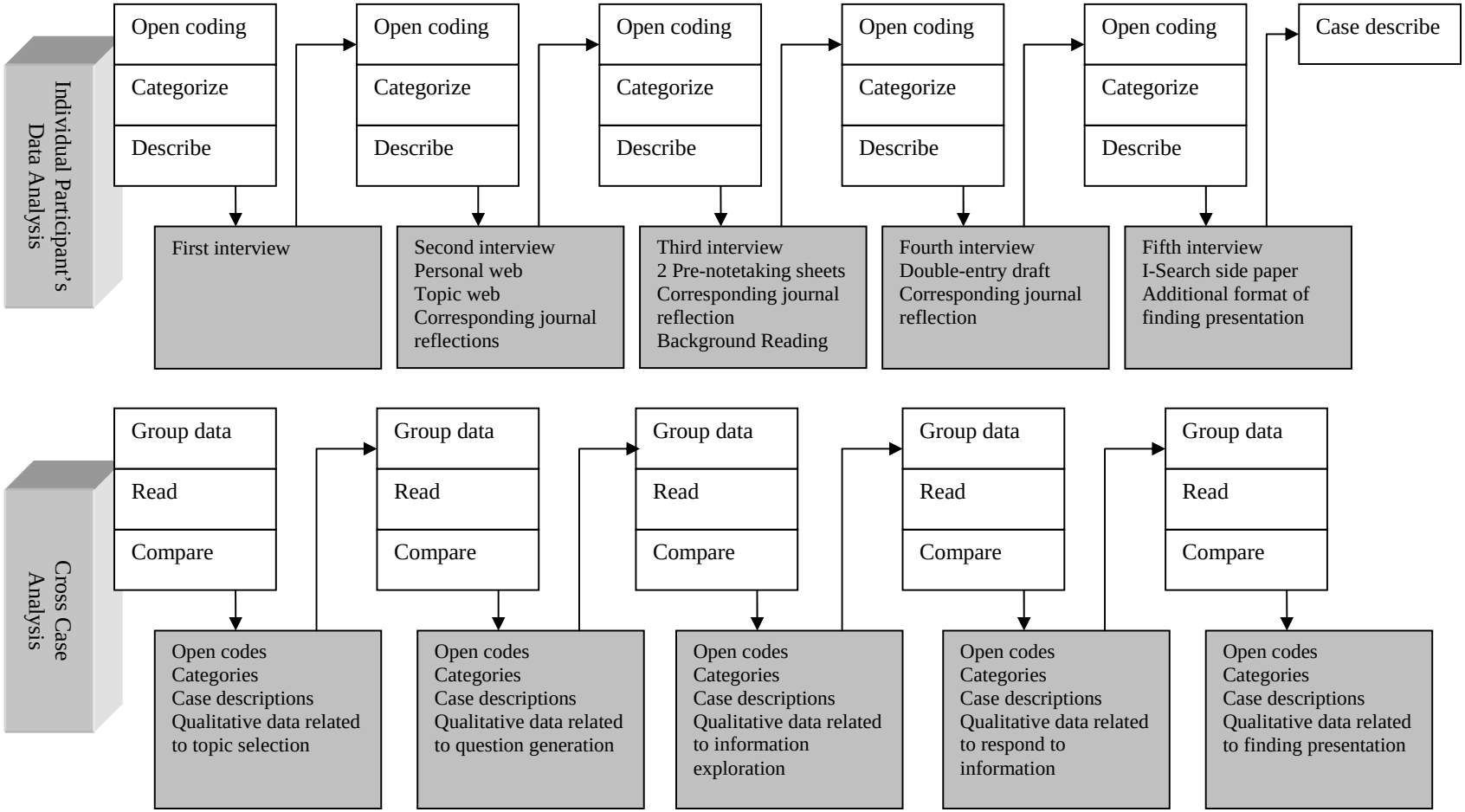

Figure 3.2. Data analysis procedure.

immediately transcribed by a professional transcriber. Once I received the transcriptions, I listened to the audio files again to compare the transcriptions and audios. Any errors identified were marked and corrected in the transcriptions. This step helped me ensure that transcriptions accurately captured what both interviewer and interviewees said.

Second, I combined multiple data sources, interviews and documents in this study. Different data sources not only revealed different aspects of the phenomena under investigation, but also provided chances to cross-check the consistency of information derived through different venues. For example, I always compared what participants wrote in their documents with what they said in the interviews. The cross-check contributed to verification of the consistency of the overall pattern across different data sources, thus helped improve the credibility of my study.

Third, one doctoral student who had experiences in qualitative analysis was invited for member checking. If there was any disagreement between myself and the member checker, I discussed the matter with the member checker until consensus was achieved.

Finally, because the researcher was the instrument in the qualitative study, my educational background, working experiences and my beliefs about learning and teaching would play a role in the design, implementation and conclusion generation of the qualitative study. I address the issue in my subjective statement (see the next section) so that readers of this study can make their own judgment on how these issues influence my study's credibility.

Generalization

Many scholars cautioned about applying qualitative findings to other contexts. The primary reason was that qualitative studies were context relevant (Merriam, 1998; Patton, 2002). Following Patton's suggestion, I provided extensive descriptions of the study's context and detailed process of data collection and analysis, as well as plenty of quotes to support my findings. These could help other people to make a professional judgment about applying the findings of this study to other similar contexts.

Limitations

There were several limitations to my study. First, because the research study was set in an online class, direct observation of at least part of the participants' learning processes, which might have added valuable insights into the finding of my study, was not available.

Second, because the study used volunteer-based sampling, my study might not have captured a variety of representative learning situations existing in the I-Search learning environment. Especially, because three of the participants chose travel-related inquiry topics, their topics might have limited the opportunity for my study to prove substantive understanding of the inquiry-based I-Search learning phenomena.

Third, my fourth research question addressed how participants responded to the information they collected. My analysis was limited to their double-entry draft entries, and might not have captured the comprehensive picture of the issue, because participants might have made meaning out of their collected information throughout most stages of their I-Search while they explored relevant information. My investigation did not include how they responded to their collected information in other stages. In addition, some

participants wrote double-entry drafts for only parts of their collected information. This might further limit the study's potential to capture the whole picture. However, I believed that what participants wrote down was important from their perspective. Therefore, it was likely that my study captured the significant thoughts from their reflections on their information.

Fourth, instructors differ in the way they teach the I-Search and support their students' inquiry learning, depending on their familiarity with the I-Search model, their teaching philosophy, and their experiences with teaching online courses. Therefore, students' I-Search learning experiences might vary, according to the instructor they have. In this regard, students' learning experiences should be adequately understood within the context of course goals, instructor, syllabus, emphasis on process, allowable breadth of topic choice, definition of a higher-order question, and online environment.

Finally, in my literature review, I proposed seven crucial aspects of inquiry-based learning which should be investigated. However, due to limited time and lack of additional researchers, I did not investigate discourse and reflection in the inquiry-based I-Search processes, although the I-Search model emphasized both of them. In this regard, my findings were not comprehensive enough to give a whole picture of the relevant issue under study.

Subjectivity Statement

My connection to inquiry-based learning can be traced back to my campus network experiences in Beijing. At that time, when the Internet was just introduced to China, very few people, including me, had enough knowledge about the Internet. I was working with campus servers, when any failure or error operation on the system might

lead to the entire campus network stopping. At the time, my duty involved establishing, expanding, and maintaining campus network systems. In my work, I encountered many different types of questions and issues with no ready-made answers in any manuals. To find answers to these questions, I had to use an inquiry-based approach. I generated questions. I looked through different resources and used all possible chances to talk with other people who had relevant experiences or knowledge. This inquiry approach was crucial to my work. These past professional work experiences made me believe that inquiry-based learning was important for a person to solve an authentic problem, to develop new knowledge, to fulfill one's goal in life, and to have a successful career.

My engagement and involvement with inquiry-based learning literature not only confirmed my personal belief in inquiry-based learning, but also added to my understanding of it, thus shaping the research perspective which I brought to the study. I had the following perspectives toward this study. First, I believed knowledge construction was one of the primary goals for inquiry-based learning and would occur during the inquiry-based learning processes. This influenced my data interpretation. For example, I regarded questions generated by participants as indications of their knowledge gap, and the responses they made to their collected information as their meaning making process where their knowledge gap was filled to fulfill the goal of their inquiry. Second, I thought inquiry-based learning was very challenging, even for adult learners. Learners would encounter a number of issues during their learning processes. Therefore, finding out what those issues were and looking for where students needed scaffolding were foci in the analysis of the qualitative data.

Chapter Summary

I used a generic qualitative approach for this study with six participants. Data generation was through in-depth interviews and documents created by participants. I employed an abduction approach, which combined inductive and deductive data analysis. Through organizing data, coding, categorizing and pattern identifying, voluminous qualitative data were transformed into findings that could answer the research questions for this study.

CHAPTER 4 PARTICIPANT PROFILES

The purpose of this study was to provide a detailed description of students' inquiry-based I-Search learning experiences as they carried out their projects. Five research questions were developed to explore the participants' learning experiences along the different stages of the I-Search processes. There were six participants, one male and five female students, who volunteered from a graduate level, online information literacy course. Of the six participants, all were Caucasian, aged from 40 to 55, with different professional and academic backgrounds, holding different perspectives about learning and inquiry-based learning, and pursuing a variety of I-Search topics (see Table 4.1 for their profiles).

Table 4.1 Participants' Profiles

Name	Current Profession	Age	Demographics	Degree
Bette	High school language arts teacher	40-45	Caucasian Female	B. S. in English
Mary	Elemental school media specialist	45-50	Caucasian Female	M. S. in Psychology
Grace	Middle and high school Spanish teacher	50-55	Caucasian Female	B. S. in Spanish
Charles	Elementary teacher	45-50	Caucasian Male	M. S. in Early Childhood Education
Emma	Physician	40-45	Caucasian Female	M. D. in Medicine
Hannah	Middle School English Teacher	50-55	Caucasian Female	M. S. in Library Media

The goal of this chapter is to provide individual case analyses for each participant's I-Search learning experiences. This chapter summarizes each participant's I-Search experiences around the five research questions. Special issues about the participant's learning experiences that are worthy of notice are also included. This chapter provides a comprehensive picture of participants' inquiry-based learning experiences, when combined with next chapter. In this chapter, individual sections describe each participant in detail, starting with Bette.

Bette

"However, this type of research is purposeful, thoughtful, and explicit. I felt like I was driving the car rather than being pulled behind it with no idea of where the car was going. I felt in control. The constant focus on narrowing down the topic and creating an essential question was difficult but much appreciated once I began to look for sources. I did not wind up with tons of sources, just germane, credible sources that gave me the answers I was looking for." - Final Reflection

Background, Learning Perspective, and Initial Responses to I-Search Project

Bette, a 9th grade high school language art teacher, was pursuing her master's degree in school library media when I interviewed her. She held a belief that successful learning needed to have a long-term impact on one's life, a usefulness. Her initial response to the upcoming I-Search project mixed intrigue with anxious feelings. She liked the idea that she could do something that really interested her, but she worried about her ability and available time for such a challenging project.

Topic Selection

After thinking through her several life aspects, such as family, career, interests, etc., she was attracted by a topic about mind/body connection. She decided to choose it as her topic due to the following reasons. As she was growing up, her dad passed on some general ideas about mind/body connections to her. She also had several personal experiences of using one's mind to control pain and maintain focus. Her experiences had reinforced her belief that the mind could control the body to some extent. However, she had not been able to find enough time to study it so far, even if she had been interested in the topic for a long time. Another reason motivating her to pursue this topic was compatibility with her belief about learning. She thought she could use what she learned from the I-Search project to release her from suffering from migraines, and help other people.

Research Question Generation

The process of generating research questions for Bette's I-Search topic proved to be very difficult, because her knowledge was limited to her personal experiences, ideas from some TV programs and conversations with her dad. She searched the Internet, using the Google search engine, for some information immediately after she decided on her topic. She also happened to find an article about hypnosis from a magazine. The article gave her an initial idea that she might focus on hypnosis. In addition, her instructor introduced a web article to her that contained good general background information.

After scanning those materials, she felt ready to create her first pre-notetaking sheet, which was designed to help people get in touch with one's knowledge about their inquiry topic, as well as generate research questions. To write about what she did not

know was difficult, because she did not know what she did not know. So she used her personal interests, common sense, and her topic web to figure out what she did not know about her topic. It was also difficult for her to write about what she wanted to know, which would later help her generate her possible questions. She employed various methods, including (a) looking at what she wrote down in the column of *What I don't Know* to decide whether this was also something that she wanted to know, (b) using some already generated questions to create another related question, (c) examining her personal interests and (d) scanning relevant materials. She reported that her whole process was more like free writing and letting things jump up, instead of systematic questioning. She also did not think about the format of questions, how she constructed her questions.

After she read her two background reading sources, she looked back at her first pre-notetaking sheet. She found that she had answered many questions that she had listed in her *What I don't Know* column, at least partly through her background reading. So she moved some of the content there to *What I Know* and, thus, her *What I don't Know* column became shorter.

Although she realized that she needed to narrow her research to one aspect of her topic after she decided her general inquiry focus, she did not know how to do that. After the online chat with her instructor, she further realized that she needed to narrow down to one essential question; big or broad was difficult to research. She looked at the list of questions she created in her first pre-notetaking sheet and thought about her general readings and where she wanted to spend her time for the research. She realized that she only wanted to know what the mind could do for the body. By knowing that, she could answer other interesting questions listed in her first pre-notetaking sheet. At the same

time, from one of her background readings on hypnosis, she found that hypnosis could greatly affect the mind. Then she thought, if her research focused on hypnosis, she could know what the mind could do. Finally, she was able to create one essential question for her I-Search, *How can the mind be used to affect change in the body, and, specifically, how can hypnosis be used to affect the body?* She did not delineate her specific sub-questions at this stage in the process. In a later phase of the I-Search which was exploration of inquiry, she thought questions in her first pre-notetaking sheet could be used as her sub-questions.

Information Exploration

Bette explored relevant information throughout her entire I-Search process. After she decided on her I-Search topic, she searched the Internet and found some websites. Most of them were written in professional terms, which were difficult for her to understand. However, she also found some articles on websites written for laymen, which she printed out for reading. Later, she found an article on hypnosis in one of her magazines and her instructor also recommended a website, where she found a good article. Both of these articles brought some good background information about her topic and gave her basic knowledge for creating her research questions.

The most important stage of her information process exploration was after she generated her essential question. At first, she looked at the Internet again. She only found one good website; the others were not verifiable. Then she went back to the university's online catalog. She typed in the key word "hypnosis" on the search line and found some good resources. She read titles and abstracts to learn about the content of the article. Then she used questions listed in her first pre-notetaking sheet to decide whether the article

could help answer one of her questions as a criterion to download the article. Her essential question also played a role, although not as much as her sub-questions, in determining which article to download. Of course, there were other factors that helped her determine which articles she should download, including (a) whether the author of an article was from a famous institution, (b) whether the article was in reputable journals or magazines, and (c) whether she understood the article.

She downloaded nine articles in total. She printed them out and read the titles and abstracts. If she thought that one particular article could help answer one of her sub-questions, she sorted it into a special stack, otherwise she put it to another stack. Finally she found seven out of the nine articles were useful, and selected four articles for her double-entry draft, which was in a two-column table format that would help students evaluate the information they found and make meaning out of it. She set aside the remaining articles that she did not read for her double-entry drafts. She highlighted and made margin comments on them for her later use if she wanted to refer back to other relevant resources.

After she generated her double-entry drafts from her most useable resources, she attended the online chatting sessions with peers and her instructor. From the chats, she thought she needed to look for more information for her I-Search, including (a) some articles about the *Stanford Hypnotic Susceptibility Scales*, which were scales to determine the extent to which a subject responded to hypnosis (Benham & Hamada, 205), so that she could use them to test some of her students; (b) materials that might not agree about the role of hypnosis to get more balanced views; and (c) more scientific data or studies.

Bette continued to look for relevant information when she was trying to finish her final I-Search product, which was a PowerPoint presentation. When she was in the middle of finishing her product, she suddenly realized that all the information she accumulated seemed only to help her answer what a mind could do through hypnosis, not how, and thus she had not directly answered her essential question. After she decided to go back to the Internet, she found two website articles that could help her directly answer her essential question.

Collected Information Responses

The process of collecting information responses helped participants make sense out of the collected information. It was also a process of constructing one's knowledge around his or her inquiry topic. Bette made a variety of responses to the information related to her topic. According to her double-entry drafts, these were her types of responses: (a) answering one of her sub-questions; (b) confirming what she believed or wanted to believe, so that she was able to be more confident about her knowledge; (c) responding to conflicting findings across different studies; (d) changing her original belief or knowledge or correcting a misconception held by her; (e) facilitating solving a myth, which had puzzled her for a while; (f) adding important new knowledge directly related to her topic, which she thought could build a foundation for further pursuance of knowledge; (g) serving as potentially useful for her final product; and (h) verifying valid knowledge, including duplicated evidence, authoritative resources, scientific experiments, unbiased analysis, and cold facts.

Findings Presentation

Format

Bette had three ideas for her final product: (a) videoing herself hypnotizing someone, or her students or her classmates; (b) testing the extent of the responses to hypnosis using the Stanford Hypnotic Susceptibility Scales; and (c) making a PowerPoint presentation about her findings. She dropped her first idea because her psychology teacher friend warned her it was dangerous for a layman to hypnotize someone. The second idea was also suspended due to the unavailability of the Stanford Hypnotic Susceptibility Scales. Later, when her psychology teacher friend gave her similar test scales, there was not enough time for her to get her students' parents' permissions and submit her assignment by the due date. Thus, she chose the third option. Her third idea was reinforced by the course project requirement to illustrate what she had learned from her I-Search. She thought it would be easy to show the knowledge she learned through a PowerPoint presentation.

Content

The content of her final product came from a mix of influential resources. The introduction part gave the background of her topic choice. She included the definition of hypnosis immediately after the introduction part because she thought giving a definition first made sense to her. She including a myth of hypnosis section because her instructor said she was not skeptical enough. Bette wanted to show her instructor that she did have a balanced view. The truth of hypnosis section was because she thought, after talking about hypnosis myths, that she needed to talk about the truth side. The long list of what the mind could do through hypnosis was what she really wanted to show in her final product

as her focus. After she finished at this point, she suddenly realized that her essential question was beginning with “how” not “what.” She realized she did not directly answer her essential question. At this point, she added information from two more Internet articles which helped her answer her essential question *How can the mind be used to affect change in the body and, specifically, how can hypnosis be used to affect the body?*

She estimated that 60-70 % of the content in her final product was from her double-entry drafts, 30-40% was from other research, such as background reading, etc. Her strategies for integrating information into her final product were as following: once she decided the content of a particular section in her final product, she looked through her double-entry drafts and other materials to find anything that could be used in that section. Of course, some sections of her final product had more direct connection with some specific resources, but, for the most part, her content in her final product was the combination of all her resources at hand.

Special Issues

Information Exploration Driven by Research Questions

One feature of Bette’s I-Search experience was her I-Search process driven by her research questions, especially her sub-questions. After she decided her research questions, she constantly referred back to her questions, not only to explore relevant information, but also to make responses to the information and make her final product. This feature contrasted vividly with her old way of doing research in which she decided her research focus at the end of her research process, according to the materials she had at hand to decide what she wanted to do with the research.

Information Exploration throughout the Entire I-Search Process

Another unique feature was information exploration throughout her entire I-Search process, although at different stages, her goals were different. At the beginning, information exploration helped her to narrow down her research to one specific focus. Then it helped her to come up with research questions. After that, it helped her to develop substantive knowledge around the topic. Finally, it helped her answer her research question. Not only were her goals different at different I-Search stages, but also the search strategies she used were different at different I-Search stages. For example, at first, she knew so little about her topic. Her search was very generic, as prescribed by the strategies used during an I-Search pre-search stage. Then when she had accumulated some basic knowledge from her background reading and decided her research questions, her information exploration was more focused around her research questions. At the final stage of her I-Search, when she had developed substantive knowledge about her topic, she was very clear about the specific types and content of materials she needed and was able to search for exactly what she wanted.

Discrepancy between Sub-Questions and Essential Question

Bette had an issue related to creation of essential questions and sub-questions. Bette developed an essential question, but did not explicitly develop sub-questions that could help her answer her essential question. Instead, she vaguely referred to the questions developed in her first pre-notetaking sheet as her sub-questions. The problem was that she developed those sub-questions basically around “what the mind can do.” But later, when she realized that she needed to develop an essential question that started with “how,” not “what, she had to recreate her essential question. Her focus shifted from facts

(what) to process (how or mechanism). She did not double check whether her sub-questions could be logically aligned with her essential question in terms of helping answer it. Thus, she had a discrepancy in the content and direction between sub-questions and her essential question. Because she had used her sub-questions in searching for information, all the new knowledge she developed from her resources aimed at answering what the mind could do through hypnosis, not how the mind could do it. She did not realize her problem until she finished her final product. She found that she could not directly answer her essential question based on the information she had collected. So she had to look for new information. This illustrated a need, not only to develop an essential question, but also need to develop specific compatible sub-questions around the essential questions.

Mary

I had great expectations for something different than I had ever done before. Indeed, every step of the process (except the reading) was totally new. – Final Reflection

Background, Learning Perspective, and Initial Responses to I-Search Project

Mary had her master's degree in counseling psychology and worked in the relevant area for years. Although she did not have a degree in education, she had experience with teaching activities related to her career. For example, she had volunteered to teach in church, private preschool and elementary school. She also was hired to teach a kindergarten readiness class for three years. At the time when I was interviewing her, she was a media clerk at an elementary school and pursuing a master's degree in instructional technology with a school library media emphasis.

She believed that successful learning was associated with students being able to demonstrate new skills, beliefs, and information added to their repertoire. She also regarded that "inquiry-based learning is that learning situation set up around the natural curiosity of the individual and is based on discovering answers to certain essential questions" (first interview).

Her initial response to the up-coming I-Search was excitement, because she could do something that had been in her thoughts for a while. She also looked forward to the benefits of going through the research process.

Topic Selection

Mary selected her topic through several steps. At first, she sought to understand the requirement of the instructor and I-Search process by reading the textbook. Then, in making her personal web, she thought of people around her and what she did on a daily basis, what she liked, and how she spent her time. Reflection on her personal life made her realize that her faith was the most important part of her life and part of her. Although every branch in her personal web could be selected as a topic, she selected three items based on whether they were appropriate for the class, time available, and importance. The first idea was to buy a camera, which was easy and practical, but she soon realized that was not what she wanted to do. The second idea was to remodel her library media center. She also realized that this was not something that had been pressing her for a long time. The third idea was the foundation of her life – faith. She wanted to know how current church organizations evolved away from the New Testament models given in Acts and early church history. She also wanted to focus on the early church history, what had happened during the time period from Paul starting churches to the death of John.

There were several reasons for her choice of the third idea. First, she felt she needed in-depth Bible study for her spiritual maturity toward supporting her church's missions. Second, she needed to teach her children to live their lives worthy of the high calling of Christ. Third, she needed to prepare for their upcoming trip to Israel. Fourth, she had been interested in this topic for a long time. Fifth, her husband encouraged her to research this topic. Sixth, she wanted to validate their family choice of attending a non-denominational congregation and validate her personal investment in her local church. Finally, she regarded faith as the foundation of her life.

Mary's early church history was a very broad topic. She did not narrow her topic effectively. Instead, she limited her research to a short period of time and key people, which was still very broad and involved many issues, events, and people

Research Question Generation

Mary decided that three questions in her first pre-notetaking sheet were her essential questions. Her instructor corrected her misunderstanding about essential questions and told her that her second pre-notetaking sheet should be the place where she would put her essential questions. After conducting her background reading, which helped her answer many of her questions, she created her second pre-notetaking sheet, without looking back to her first pre-notetaking sheet. With all the new knowledge she gained from background reading, she could better state the questions she really wanted to know. She generated three questions. Two of them were very close to her questions in her first pre-notetaking sheet, but reframed. One question was newly added. She took these three questions as her secondary questions. Then based on the three questions, she made

an effort to create an overarching question that could help answer her three questions. In this way she created an essential question that could cover her three sub-questions.

Her essential question was: *How has the addition of man-made organization taken us away from the model demonstrated by the community of the first believers (church)?* Her secondary questions were: (a*) How is the church to be governed, according to Scripture? (b) How did the early church organize? (c) How do these compare?*

Information Exploration

Mary accessed and explored information resources throughout the entire I-Search process. At the beginning of her I-Search, she used several strategies to seek adequate information, including (a) checking with her prayer partner and her pastor friend; (b) re-reading some Bible chapters; (c) getting her daughter's world history textbook; (d) borrowing a Luther DVD from her friend; (e) searching the Internet, although not finding good websites; and (f) trying to find a cassette series about the Twelve Disciples that she had heard before this assignment.

Mary had a hard time finding adequate background reading due to the following reasons. First, her knowledge was limited to help her identify bias in related resources in the university library. Second, due to the time constraints, she had to get what was available and what she considered to be reliable, for example, from a friend's library, from an encyclopedia, from her pastor's sermons, or from a textbook. Third, she tried to find a college textbook which might be a good background reading resource, but could not get it until she finished her background reading assignment. Fourth, lack of searching

skills in search databases was another factor that made her seeking general background reading difficult work.

The information she found for her background reading was not perfect for general reading in terms of adding to her general knowledge. What she found had many details and specificity. So she had to piece them together to get the big picture. Even in this case, the information she found was still useful in terms of answering her questions listed in her first pre-notetaking sheet and helping her generate her essential question.

Mary continued to explore information until the last I-Search stage. Mary used her personal Christian beliefs and Bible scripts to make a judgment about information resources she explored. Her criteria for seeking information included whether she could yet answer her essential question. One feature in her searching for information was that she carefully looked for information without bias. So she tried to cross check different resources to find discrepancies. Her strategy was if she could find three resources that said the same thing, then it must be right and reliable. Besides searching for information, her strategy of organizing collected information was to stack up her notes in the order that she wrote them with a “don’t touch” sign for her family.

Collected Information Responses

She made various responses to the information, including: (a) changing her idea or knowledge, (b) correcting misconceptions, (c) giving her fundamental knowledge for her further steps of research, (d) providing new knowledge, (e) confirming some of her ideas or beliefs, (f) corroborating with other resources, (g) helping answer her essential questions or sub-questions, and (h) bringing up a new need for further information.

Findings Presentation

Format

When she began her I-Search project, Mary thought of using a timeline to present her final product. But she revised her idea at the final stage of her I-Search. Instead of giving out specific years in the history, she adopted the idea of using generations to represent early church history. She also wanted her final product to look professional and polished, but because she did not have good technology skills, such as making a PowerPoint presentation, or CD or DVD, she finally decided to use a very traditional format, a poster.

Content

She originally planned to draw a long timeline to represent the early church history. But she ended up with a very short timeline, only till 200 AD. In addition, because she constantly looked for information that agreed with other resources throughout her exploring of relevant information, the content of her final product was basically a triangulation of all the resources.

Special Issues

Sub-Questions Could Only Partially Answer Essential Question

Mary generated three sub-questions for her essential question. However, her three secondary questions could only partially answer her essential question. To answer the essential question, she needed more sub-questions than the three she created. For instance, a sub-question about today's church organizational structure was needed. This is because she did not narrow her topic effectively. Instead, she limited her research to a short period of time and key people, which was still very broad involving many issues,

events, and people. The information gained through her three sub-questions could only partially answer her essential question. In her case, she needed more help narrowing down her topic to a topic specific enough to generate adequate essential questions, as well as keep the compatibility between the essential question and sub-questions.

Questions were Based on Incorrect Suppositions

Mary did not answer the first sub-question in her final product, because she originally thought that there was a model from the early church that was directly guided by Jesus or Paul or the other disciples. Therefore, she thought she could find out that model from the Scripture. However, by reading relevant materials, she found that Jesus and Paul did not start a church themselves. In addition, there was not a uniform model for the early church. To the contrary, there was diversity at different places. The establishing church was mainly organized in response to cultural influences. So the question seemed unanswerable to her.

As in Mary's case, the inquiry learner might generate research questions that are based on incorrect assumptions. Such an event happens when the researcher lacks substantive or correct knowledge on the topic, which hinders their ability to articulate good research questions. Therefore, in Mary's case, she would have been helped if she had modified her questions when she had gained exposure to more and more information, as the I-Search process allows. Revising research questions is part of the strength of the I-Search's inquiry learning process. It allows the researcher to modify what the researcher wants to know.

Grace

"*The most critical step -- selecting and focusing the topic.*" - Final reflection

Background, Learning Perspective, and Initial Responses to I-Search Project

Grace had been teaching Spanish in middle and high schools for 15 years. She also taught staff development courses at a technology training center at a southeastern university. She believed that inquiry-based learning was a problem solving process. Her initial response to the I-Search was not as excited as the previous two participants. She was busy with other courses at that time, but hoped to learn new things from it.

Topic Selection

Grace changed her topic within the first three weeks. In the first week, Grace created a personal web. When she examined different parts of her web, from job to family issues, she realized that her life was unbalanced. Most of her time was consumed by her job and graduate school work. She felt a need to do something for fun, so she thought of planning a trip. At first, she thought of a family trip. Then she thought that she could take her niece on a trip. Besides the reason of feeling unbalanced in her life, there was another reason for this topic. She felt overwhelmed by the upcoming I-Search project and planning a trip was very easy for her, because she had done that many times before.

In the second week, when she did not feel that overwhelmed, she decided to choose a different topic, which was writing a travel guide book for kids. There were several reasons for her to think of selecting another topic. First, writing a book was her two-year dream. Second, she felt she would gain little if she only planned a trip for her I-Search, because she had plenty of prior knowledge about it. Third, as a teacher, she knew that students could learn more, when they were required to be responsible for learning. Similarly, if she could write a book that helped students plan a trip, students would

benefit from it. Finally, when she could not find a book similar to what she wanted to write, this further reinforced her selection of her new idea.

However, at this stage, she still could not finally determine her topic. There were still several things in her mind for her I-Search topic choice. First, with writing a travel guide book for young people, the final product of her I-Search could be the first chapter of the book or outline of her book. The book might include tips for recording travel experiences with a camera or include photographic journals with writing prompts for young people to record what they did each day. Second, she had to find a market for her book. Third, she could plan a trip with her niece or have her niece plan a trip with the aid of her help, or she could come up with a list of things and could ask her niece to look at them and decide where to go.

Her criterion for choosing her I-Search topic was that it had to be useful and practical. That meant she would like to do a project that she could use. She also wanted to select a topic that could benefit her from the I-Search process.

In the third week, she panicked when that week's assignment was due. She realized that she actually had three topics: (a) planning a trip with her niece to London, (b) writing a book, and (c) getting her book published. She realized that she could not do all those things and had to narrow them down. She also thought that she could not write the book unless she planned the trip first. So she went back to her first week's idea, planning a trip but with a revision, planning a trip from a child's perspective.

Research Question Generation

After decided her topic, she created her first pre-notetaking sheet. She used brainstorming to generate material for the column, *What I Know*, and then used that

material to create her second column, *What I don't Know*. She used the words suggested by Tallman and Joyce's (2006) book to reword *What I don't Know* into higher order questions for the column, *What I Want to Know*. Her first pre-notetaking sheet was filled with basic things, such as where to stay, etc.

After she explored some information, she created her second pre-notetaking sheet. This time, she focused more on activities she and her niece would do in London and how to prepare for those activities, instead of budgeting for the London trip, etc. After she finished her second pre-notetaking sheet, she examined all questions in it. She realized that she was actually helping her niece to have a better understanding of London history and culture through the trip. Therefore she generated her essential question as *How can my niece develop a deep understanding of London history and culture?*

She thought that her essential question covered most of her questions in her second pre-notetaking sheet, which later she thought were her sub-questions. She also thought that some of her sub-questions might be discarded as the research progressed. Her sub-questions were not clearly defined until the final I-Search stage. They were: (a) *Which two books will be most useful to us while traveling? (b) Which sights and activities will interest Sophia and provide some insight into London history and culture? (c) How can we prepare so that Sophia develops a greater understanding of London history and culture? (d)How should we record our trip and new understandings?* This raised an interesting case that the essential question was clearly defined at the beginning and sub-questions were not clearly defined until the inquirer finished her inquiry process.

Information Exploration

Grace explored information from the beginning until writing her double-entry drafts. Her exploring relevant information could be classified into two processes. The first was to find out which sights in London would be interesting to a child and how. This included, (a) surfing websites where people posted their experiences of travel with kids, (b) searching company websites for possible itineraries, and (c) consulting her school specialist who had taken young students to London. The second was to prepare her niece fully to enjoy and learn from her trip. To do so, besides looking for websites for background materials, she made an effort to find some books that might provide background for her niece. She also borrowed a video about London for her niece. In addition to the above efforts, she searched the university's online catalog, suggested by her instructor, but did not find much appropriate information.

She used two methods to organize information: (a) bookmarking some websites and (b) copying the URLs of useful websites and titles of books to a Word document to keep track of the information she explored.

Grace continued to explore information related to her topic as she wrote her double-entry drafts. At first, she just looked for any information related to travel with young people in London, and wrote it into her double-entry draft. From the feedback from her instructor, she realized that the problem she encountered was because she did not explore information specific to her research questions. Later, when she felt she still explored too much information, she decided she needed to narrow down to a limited number (8) of sites in London and then around those sites to see what people did for young people and what young people liked about those sites. So at this step, she not only

limited her scope of searching information to those eight places in London, but also limited the content of the information related to her research questions.

Collected Information Responses

Grace made the following responses to the information she collected: (a) whether the information could help her answer her research questions; (b) whether it stimulated her recall of her past experience of traveling in London, especially the experiences that she had when she was a child; (c) whether the information gave her new ideas that she could adopt about travel in London with young people; (d) whether it confirmed some of her own ideas; (e) whether she could identify a need to find more information; (f) whether the information related to her niece's interest; and (g) whether the information could be used as background reading for her niece.

Findings Presentation

Format

Originally, Grace decided to make an itinerary with a list of appropriate information books as her final product. She had her itinerary finished before it was due. Then she heard her classmates discuss their products. She felt that she needed to be more creative. It happened that her niece's birthday was coming. She suddenly had an idea to create several birthday cards describing the reasons for selecting some gift items (mainly books) for her London trip.

Content

The content of Grace's final product is information about several sites she and her niece want to visit and several books she wants her niece to read to prepare for the upcoming travel, as well as books they will bring on the trip.

Special Issues

Knowledge and Inquiry

Grace already knew how to plan a trip. She also had substantial knowledge about traveling in London; she had visited London several times. She knew which parts might be interesting to her niece. Her goal for her I-Search was basically to find out which sites would be interesting from a child's perspective in London and which books could be selected to give her niece background information to enjoy her trip. Compared with her knowledge and her goal of her I-Search project, her project was not a very challenging one; her knowledge for her I-Search project was almost there. She only needed to add onto her existing knowledge structure some new information about what would be helpful for children for the trip. Because of this, her previous knowledge played a significant role in guiding her I-Search process. For example, she decided on limiting her information search to eight websites based on her own past experiences and then explored new information to confirm her own idea of a good itinerary.

Charles

"But, um, why do I want to go camping along the Blue Ridge Parkway after grad school? And we know it's for relaxation."- Interview 3

Background, Learning Perspective, and Initial Responses to I-Search Project

Charles had a variety of background experiences. His highest degree was a master's in early childhood education. He also had received education in other areas, such as public recreation and electronics engineering technology. He was an elementary teacher but he also had work experience in non-education areas, such as water safety instructor, electronics repair technician, etc.

He believed that learning was knowledge acquisition for meeting personal goals and enjoying the learning process. He regarded inquiry-based learning as a knowledge acquisition process based on discovering answers for questions. His initial response to the I-search was curiosity about the process.

Topic Selection

At first, it was hard for Charles to decide on an I-Search topic; there were so many potential choices for him. He was not used to being given the freedom to select his own topic in course work. After he narrowed down to six topics all related to his hobbies, he decided to plan a trip on the Blue Ridge Parkway (BRP). He had several reasons for choosing this topic. First, such a trip could meet his immediate need to give him refreshment and relaxation upon completion of his graduate study. Second, it could give him joy while doing his project. Third, he and his wife had talked about an extended camping excursion to include the Virginia (VA) portion of the Blue Ridge Parkway (BRP), besides the North Carolina side of BRP, which they visited often. This project gave them an opportunity to fulfill their dream. Fourth, this topic, when compared with other possible ones such as reading and bird watching, was a more doable one and more interesting to him. His criterion for selecting a topic was being able to learn something and enjoying it at the same time.

Research Question Generation

At first, Charles created the following essential question: *How can I best plan a trip to camp along the Blue Ridge Parkway (BRP)?* Then after he read his background materials, he narrowed his question to the benefits he would gain from the trip, or why he really wanted the trip. So he changed his essential question to *Why do I want to go*

camping along the Blue Ridge Parkway after grad school? He also created two sub-questions under it. But after one online chat he thought that the instructor only needed an overarching question, thus he deleted his two sub-questions. He sent his essential question to the instructor. The instructor was concerned about why he mentioned "after grad school," so he took the words "after grad school" out of his question. At the same time, he narrowed down his question scope to only the Virginia portion of BRP, because he already enjoyed the North Carolina side of BRP. So his essential question changed to *Why am I attracted to the Virginia section of the Blue Ridge Parkway as a vacation spot?*

Interesting to notice was that although Charles changed his essential question to the current one, he liked his old essential question very much. The reason he used his latest revision was because he thought that that one would please his instructor. At the same time, he regarded that his old essential question and new essential question were essentially the same. He could still do research that answered his old and new questions at the same time. He felt that his research question was not properly generated according to what he really wanted to inquire.

This was further illustrated by Charles' two sub-questions, which were (a) *Which type of travel plan would best fulfill my purpose for the trip – one that allows me to enjoy new experiences, or one that has proven in the past to refresh and relax me?(b) How can I get all the information to make this decision?* The first sub-question was not a sub-question for the essential question, but a related question. Because the essential question asked for reasons, then the sub-question should have been related to reasons for the trip.

In addition, he deleted his two sub-questions only because he thought his instructor wanted one essential question. This showed that he created sub-questions, not

because of a need for answering his essential question, but because the requirement of the instructor. All these issues illustrated his insufficient question generation.

Charles had another issue worthy of mention. The reason he wanted a trip had already been answered, which was for refreshment through the peaceful, quiet, beautiful nature environment. He had the answer to his essential question before his information exploration. Although he did find out about activities and places to stay and visit on the VA side of the BRP, the information did not impact his essential question and his one word answer – recreation. In this regard, he did not gain much new knowledge that pertained to his essential question.

Information Exploration

Charles explored information in most phases of the I-Search. In looking for background reading, he first went to his small public library. He found many books were out of date. He found one good book with pictures and nice captions and mile markers to the parkway, which was very important to him. Another background reading material was a BRP pamphlet. He planned to email people who had camped along the route and ask their opinions. He also planned to look for more books in the next step of his I-search.

At the stage of creating his double-entry drafts, Charles used several venues to explore relevant information. First, he sent out two emails to people who were familiar with camping, and got one informative reply. He also talked to his parents about their past experience of camping there. In addition, he looked in the university's catalog, but found the articles did not offer specifics on campgrounds or trails that could help address his essential question. The most important part of his information that was useful and up-dated was from the Internet.

In this process he felt his essential question guided his information searching only as it related to his topic. He also set his own criteria in the process of looking for information. That was to look for the information provided by those who shared the same camping interests with him.

His method of organizing information was as following; besides bookmarking, he used double-entry drafts to keep track of the information. He wrote down useful information when he looked through the websites, blogs, etc. Because most of his materials were from the Internet, he would read them on the screen several times to make sure he was writing what he really wanted to visit into double-entry drafts.

Collected Information Responses

Charles made several types of responses to the information he collected: (a) whether it was a place he wanted to see, (b) whether it was a place that he wanted to avoid, (c) whether he needed to correct his prior knowledge, (d) whether it confirmed information from somewhere else, (e) whether he needed more information to make a decision, (f) whether to trust someone's suggestion about a site, (g) whether to compare with their previous experience, and (h) whether it addressed his essential question.

Findings Presentation

Format

Charles's goal for his final product was to come up with a plan about where to travel and to stay, what to see, and what to do. This was basically an itinerary. To represent his final product, originally he just wanted to create a web, list sites under different campgrounds. Then he changed his mind to have a more graphic picture of his

final product. So he worked on a map and used the drawing tool in Excel to draw a map itinerary, on which he listed campground sites and mile makers along the parkway.

Content

After exploring enough information, he was ready to make his final product. At first he wrote down the campgrounds where he wanted to stay and ordered them from north to south. Then he went back to his double-entry drafts. If there was a place that was good, he would keep it, otherwise eliminate it. He listed all the sites in order from north to south. After that he calculated each site's proximity to a campground. This helped him to determine which sites to visit, when staying at a particular campground.

Special Issues

Question Generation Needed Scaffolding

Charles confronted the same issue with other participants in adequately generating his essential question. His question asked the reason for camping, which was very clear from the beginning of his I-Search, that he needed rest. What he was not sure was whether the Virginia portion of BRP could meet his need or not. So his question could be addressed as, *Whether the Virginia portion of BRP would be a vacation spot that could give him rest?*

In addition, the two deleted sub-questions could not help Charles to answer his essential question, because they were only related questions to his old research question. What's more, he liked his old research question, but felt he needed to change it to what he thought would please the instructor. He also deleted a sub-question his instructor did not think fit his essential question. All these issues illustrated that some students need more scaffolding to help them develop essential questions with appropriate sub-questions

that promote higher-order thinking and fulfill their needs on multiple levels. Understanding that some types of *what* questions can be effective as higher-order questions could have been a very effective strategy to use with Charles.

Emma

"I guess coming back from a science background, I'm used to asking questions, but not necessarily in the framework of the why, which, and how. And so, I was having a hard time understanding the difference in those and I still am not sure that I do understand why it is important to frame things in the central question format." - Interview 3

Background, Learning Perspective, and Initial Responses to I-Search Project

Emma did not have work experiences in school media. She was a physician specializing in the field of pediatric radiology. She also taught medical students and radiology residents. Emma believed that successful learning was being able to apply knowledge, not memorize unrelated facts. Her understanding about inquiry-based learning was that it was "based on questioning by the student in the framework supported by a teacher or guide, and is driven by the student's desire or need to know." Her initial response to the I-Search was excitement, both about learning the I-Search process and doing a topic of her own interest.

Topic Selection

Emma had a condition that caused narrowing of her carotid arteries, thus putting her at greater risk of stroke than the average person. To avoid this problem, she needed to control her cholesterol and fats to get her bad cholesterol (LDL) lower than 70md/dl. Therefore, through her I-Search, she wanted to know how fats worked or affected

cholesterol and how different foods affected the body. Her goal was to keep her blood fat low in her body.

Her reason for choosing this as her topic was the importance of this issue in her life. At the same time, as a physician, she felt that this topic could help her both personally and professionally. Other things that might potentially be selected as her I-Search topic, but not be selected this time, were recreational topics.

During the second week of the I-Search project, Emma changed her topic to planning a family houseboat vacation on the Suwannee River. Her reasons for shifting to a new topic were as following: she thought her original topic was too broad and complex and too close to her current profession and a classmate suggested that she consider the upcoming spring break vacation plan as an I-Search project. In addition, she read a magazine article called *Family Fun.* An article described a family houseboat trip on the Suwannee River and gave her the idea of planning her own family houseboat trip for the spring break. One additional reason for choosing this as her topic was that she and her husband loved water activities. But since they had adopted their daughter, they had not had much chance to do their favorite activities together as a family. This would be a good chance for them to do water activity together as a family and share the love of the water with their daughter. Finally, she thought that choosing a non-medical topic would be a good experience for her.

Research Question Generation

Emma struggled with generating her essential question in the required higher order format. She did not understand what a higher-order question was. She also was not used to asking questions in the framework of why, how and which. She had to look for

Internet information and ask an educator to help her develop an adequate understanding of it. When she had done these activities, she had a better understanding of it. But she still struggled with creating essential questions. On the first pre-notetaking sheet, she created one essential question and five sub-questions. The instructor regarded her questions as too factual instead of higher order, and used scaffolding to help her think about her topic from a different aspect, such as "what is really important to you about the trip?"

So in her second pre-notetaking sheet, she made an effort to create higher order questions. The method she used to generate two essential questions in her second pre-notetaking sheet was to examine her factual sub-questions in the first pre-notetaking sheet and try to phrase them into a unifying large why, how or which question. After doing so, she still thought her questions were too factual. When she finished all the background reading and reflected more on her trip, she changed her two essential questions into one *Why is the Sewanee River a good place for a houseboat vacation?* She felt satisfied with her latest version of an essential question. At this time, she did not decide on any sub-questions for her latest revised essential question.

After she finished all the double-entry drafts, she started to rethink her essential question. She changed a little bit in her essential question by adding "our family and friends" into her question. So the new question was, *Why is the Suwannee Rive a good place for our family and friends to take a houseboat trip?* The old and new questions were essentially the same. But the new one seemed more personally related.

At the stage of doing her double-entry drafts, she already had an answer for her essential question. The houseboat trip on the Sewanee River offered many aspects of a vacation that they were looking for, including: (a) being together as a family; (b) doing

things they enjoyed, such as swimming, fishing, boating, exploring; (c) having a chance to get away from the busy lives; and (d) learning interesting history, geography and nature about this area.

She explicitly defined three sub-questions for her essential question at the final I-Search stage. Two sub-questions were from her second pre-notetaking sheet. One was newly added. Her secondary questions were: (*a) Which activities will help us all enjoy the trip? (b) How will we decide which supplies to bring? and (c) Why did Stephen Foster write about the Suwannee River?*

Information Exploration

Emma used several venues to explore relevant information. She first went to the library to look for relevant information. She used the catalogue and searched with terms, such as “Suwannee River,” “Florida,” etc. She found there was not much useful information in the library. She requested three books and a video from the local library, but they were not available until after she had conducted her background reading. So she focused on Internet information, where she found many up-to-date resources. She also contacted the Suwannee River Water Management District and requested materials to be sent to her by mail. In looking for relevant information, she focused on looking for the information about the geography of the Suwannee River, the area where they would be traveling and activities that they might enjoy on the trip.

To keep track of her collected information, Emma bookmarked some web pages for her later revisit. She also kept all printed information together in a notebook. In addition to this, she regarded double-entry drafts an excellent tool to organize the important information for her.

Collected Information Responses

Emma made the following responses to the information she collected: (a) whether the information was related to her questions; (b) whether it gave her ideas about the trip, such as where to stop, activities, etc.; (c) whether it stimulated her recalling a past similar experience; (d) whether she was feeling the need for more information to answer her essential question; (e) whether it allowed her to judge whether it was a good place to visit or suitable for a houseboat to navigate; and (f) whether it gave her an idea about preparing for the trip, such as things to bring with, etc.

Findings Presentation

Format

Generally, Emma wanted her final product to include some images, maps and perhaps photographs, so she first thought about a poster. Since she could not email the poster to the instructor, she decided to change to a PowerPoint presentation. She further found she could not change her picture images to a small enough size to send it by email. Finally, she decided to use a Word document to create a handbook, which she felt would be useful and she could share it with her family and travel mates.

Content

She had decided on certain things to be included in her final product. Those were things: (a) that she wanted to think about on the trip, (b) that they needed for their activities planning, (c) that they might want to see in case they needed resources to go with this handbook, and (d) that she was anticipating about the trip. When she created her final product, she wrote down things that stood out in her mind. She did go back to her double-entry drafts. But she did not read through each entry; she just looked for the

entries that she thought had relevant information she wanted to include into her final product.

Special Issues

Incompatibility between Essential Question and Sub-questions

With careful analysis of her essential questions and three sub-questions, I found that there was a discrepancy between her essential question and sub-questions. Her essential question dealt with the reason for the travel. But her first two sub-questions dealt with planning the trip. The third sub-question addressed the historical aspect of the Suwannee River. Therefore, answering those three sub-questions could not provide an answer for the essential question. Actually, her essential question and sub-questions could be treated as three different parallel questions. One was about the reason for the trip, one was about planning the trip, and one was about the historical anecdote of the river.

Most other findings about Emma's I-Search experiences confirmed the themes discovered in the previous analysis of other participants. For example, Emma had substantive knowledge about trip planning before she undertook her I-Search. This was an easy topic.

Hannah

"I know that pre-reading is a step I have always taken when given a research paper or project. It was usually during this stage that I formed and rejected a number of approaches to my topic before coming up with my final thesis." -Side paper

Background, Learning Perspective, and Initial Responses to I-Search Project

Hannah had a A.B. degree in English. She had taught English class for 27 years, 17 years as a high school English teacher and ten years as a college freshman teacher. Her highest degree was a master's in library media (1977). Her belief about successful learning was a person who could apply his or her knowledge or skill to a real life situation or satisfy a curiosity. She regarded inquiry-based learning as a student-centered constructive approach in which students were guided to use a research process to ask and answer questions.

Topic Selection

At first, she made a web to illustrate different aspects of her life. Writing journal entries as part of the process also helped her find out what piqued her interest and engaged her curiosity. She had a process for making her choice based on her past experiences. She needed first to consider every option and then narrow down. So she considered several areas that might be selected as a topic, such as retirement planning, travel, adopting a pet greyhound, etc. Gradually, she focused on two choices. One was Chinese herbal medicine. She soon dropped this idea, although it was interesting. She found that she almost had no background knowledge about it. And she was afraid that she could not handle it. Another was getting a hot tub. There were several reasons for this topic. First, she felt that a hot tub could help reduce stress for her, which was really a problem in her life. Second, her experiences of having a hot tub in her mountain cabin made her feel that having one at her own house was a good idea. Third, her visit to her mountain cabin recently further reinforced the idea of having one at her house, thus her need to do research on it. In sum, she regarded this topic as a very practical topic.

Research Question Generation

When Hannah wrote her first pre-notetaking sheet, she used the brainstorming strategy to generate questions. Because at this step, she did not purposely generate essential questions, keeping to a focus of finding words to express what she wanted to say, she speculated on many different things. Her purpose for an I-Search was to find out what she needed to know in order to purchase a hot tub, so her questions were created for serving this goal. Generally speaking, her questions covered three aspects: product selection, cost, and maintenance.

After getting the feedback from her instructor, she realized that her focus was around the process of buying a hot tub, which was at lower level. She wanted to shift to a higher level of reasoning for her I-Search. Through her background reading, she realized that there were negative health aspects associated with a hot tub, which she thought before were insignificant. Therefore, she changed her goal to the direction of finding out the benefits and disadvantages of a hot tub, and comparing them. She generated two essential questions: (a) *How do benefits outweigh the disadvantages of owning a hot tub? (b)How can the disadvantages of a home hot tub be minimized?*

Because she wanted to emphasize the good side of having a hot tub, she decided to select the first one. She thought her essential question was at an analysis level according to the Bloom Taxonomy chart. She did not explicitly address her sub-questions for her essential question. After generating her essential question, she felt she became more focused on her topic, namely, she would only analyze the positive and negative aspects of having a hot tub.

Information Exploration

In the stage of selecting her topic, she tried to search using some search engines suggested by the instructor. She also got some good key words for seeking information. At that time, she scanned for the hot tub topic on the Internet and found plenty of resources, although she did not read them in detail.

After she had entered a more formal information exploration stage, Hannah first went to the university library's catalog, to look for information about hot tubs. But she did not find much about hot tubs, except a few medical articles about the diseases or illnesses people could get from swimming or from sitting in water, if the water was not properly sterilized. Those articles were pretty technical and written for a different kind of audience, such as researchers or medical people. Then she looked in her school's database, and found one adequate resource. She focused her search on the Internet. Besides these efforts, she interviewed one person whose family had a hot tub. She also visited several hot tub sales, manufacturers and commercial places and interviewed several salespeople.

The most relevant information Hannah found was online. In the process of looking for the relevant information she used reliability as her criterion. She made an effort to look for those which were (a) evidence-supported; (b) provided by scientists, researchers or non-profit organizations, such as government; or/and (c) information supported by other sources. The resources on many commercial sites she regarded as having strong bias. Some information about hot tubs on individual websites, although interesting, was also not regarded as reliable enough to be applied to her I-Search.

Besides the criteria, her essential question also guided her information exploration in which she focused on looking for benefits and disadvantages of having a hot tub.

Collected Information Responses

Hannah made the following responses to her collected information: (a) considering its relationship to her essential question, (b) considering whether a resource was a reliable one or not, (c) giving her new ideas about having a hot tub, (d) needing more information either for conflicting information or corrections to a particular piece of information, (e) confirming the information presented in other resources, (f) supporting her own idea or findings about hot tubs, and (g) asking more questions about hot tubs.

Findings Presentation

Format

Originally, Hannah planned to do a magazine article. But she ran into a time crunch due to her current work. So she chose a very simple format –a two column chart listing both benefits and disadvantages of having a hot tub. Then when she looked at the two column chart, she thought it was not easy for a reader to read it, because the column was not wide enough. So she ended up with a format more like an informal outline with benefits listed first and disadvantages in the later part of her chart.

Content

When she wrote the content of her final product, she looked back to each entry of her double-entry drafts to see if it fell to the benefits or disadvantage category. When she wrote all those down, she examined them and classified them into subcategories such as physical and mental benefits etc.

Special Issues

Narrow Down and Associate with Higher-Order Thinking

Hannah's case also raised another issue about narrowing down within a topic. Hannah at first was very glad that she narrowed down to a doable topic, which was about hot tubs. Then through doing pre-notetaking sheets, she realized that there were still many aspects of her topic she had not considered. Finally, she narrowed down to one aspect of her topic - purchasing a hot tub, which was a very specific focus. With the scaffolding help from the instructor, she realized this was a lower level question. Therefore, she shifted to analyze the benefits and disadvantages of having a hot tub. For the former one, she only needed to find out about cost, type of product, etc., but for the latter one, she needed to search for reliable information about good and bad sides of having a hot tub. The change of focus led to exploring two entirely different types of information and kept her at a higher level of reasoning activity. Narrowing down not only to a well defined focus, but also associating the focus with higher-order thinking was a critical step for her successful I-Search research.

Chapter Summary

This chapter described each participant's I-Search experiences around the five research questions, as well as special issues about each participant's learning experiences that are worthy of notice. Table 4.2 provides an overview about participants' I-Search projects.

Table 4.2 Overview of Participants' Projects

Name	Topic	Essential Questions	Secondary Questions	Final Presentation Format
Bette	Mind/body connections	How can the mind be used to affect change in the body and specifically, how can hypnosis be used to affect in the body?	N/A	PowerPoint Presentation
Mary	Early Christian Church history	How has the addition of man-made organization taken us away from the model demonstrated by the community of the first believers (church)?	(a) How is the church to be governed, according to Scripture? (b) How did the early church organize? (c) How do these compare?	Poster
Grace	Plan a London trip with her niece	How can I help my niece develop a deep understanding of London's history and culture?	(a) Which two books will be most useful to us while traveling? (b) Which sights and activities will interest Hannah and provide some insight into London history and culture? (c) How can we prepare so that Hannah develops a greater understanding of London history and culture? (d) How should we record our trip and new understandings?	Birthday gift cards
Charles	Blue Ridge Parkway camping	Why am I attracted to the Virginia section of the Blue Ridge Parkway as a vacation spot?	None	Itinerary map
Emma	Family houseboat trip on the Suwannee River	Why is the Suwannee River a good place for our family and friends to take a houseboat trip?	(a) Which activities will help us all enjoy the trip? (b) How will we decide which supplies to bring? (c) Why did Stephen Foster write about the Suwannee River?	Handbook
Hannah	Hot tub	How do benefits outweigh the disadvantages of owning a hot tub?	None	Chart

CHAPTER 5 FINDINGS

In the last chapter, I described the qualitative analysis findings for each participant around the five research questions I had proposed. In this chapter I describe the themes and categories that emerged from the constant comparative methods of analyses of all the participants. I defined theme as happening to more than one participant. I compared the categories of all the six participants. I looked for similarities, differences, and patterns in order to isolate the themes. In this analysis process, new themes, categories and hierarchies of coding emerged after data reorganization. I also identified special issues that I thought would contribute greatly to the overall understanding of students' inquiry-based I-Search learning experiences, even if the issue was only supported by one participant's case. The rational under this was that my study only had six participants. What happened to one participant might happen to other students, thus, is worthy of attention. The new generated categories led to the overall findings. The results are reported according to the five research questions. The research questions and overview of findings are illustrated in Figure 5.1.

Q1: How Do Students Choose their I-Search Topics?

Although all participants used personal webs and topic webs to help elicit an I-Search topic, there was evidence that they employed a variety of strategies to decide on a topic for their I-Search projects.

Q1: How do students choose their I-Search topics?

- Long-term interest
- Usefulness or practicality
- Pressure reduction
- Convenience

Special issues
- Prior knowledge
- Narrowing down within a topic

Q5: How do students present their I-Search findings?

Format
Individual issues
- Technology skills

Context issues
- Time
- Influence from other people

Content
- Two step method

Q2: How do students generate their I-Search questions?

Essential questions
- Two step method

Sub-questions
When they were explicitly posed
- Vaguely posed at beginning
- Explicitly posed at beginning
- Clearly posed at the end

Methods
- Personal interests
- Questions scaffolding
- From *What I Don't Know*
- Other generated questions
- Condensed several questions into one question
- Impression from scanning materials

Special issues
- Challenges
- Factual vs. higher-order
- Lack of new knowledge gained through a research question
- Incompatibility between essential question and sub-questions
- Question was based on incorrect suppositions

Q3: How do students explore information?

Multiple resources
- Internet information
- Library resources
- People's lived experiences
- Multiple Types of Resources

Multiple Criteria
- Reliability
- Camping philosophy
- Bible and personal belief

Question as guidance
- Sub-questions
- Essential questions

From generic to specific

Organize
- Bookmark
- Word document
- Print out and/or sort

Special issues
- Not guided by question
- Too much information
- Exploring information throughout I-Search process

Q4: How do students respond to their collected information?

Responses Related to Research Questions

Confirm knowledge

Activate prior knowledge

Change knowledge

Enrich knowledge

Identify knowledge gap

Validate knowledge
- Authority resources
- Duplicated evidence
- Methodological validation
- Conflicting findings

Special issues
- Difficult in writing double-entry drafts
- Different types of responses

Figure 5.1. Research questions and overview of findings.

Long-Term Interest

Two participants selected their topic because they had been deeply interested in a particular topic for a long time. In this case, it was more like a topic selected them rather then they had to select a topic for an assignment, an event promoted by the I-Search authors as one of its strengths. For example, after Bette selected a topic about mind/body connections, she said, “I went to another deeply intriguing topic – the mind/body connection. I have grown up considering that idea.” Mary also had the same situation, where her topic about the early history of the Christian church was one that “I have been passionate about this for a long time.”

Usefulness or Practicality

Another method used by four participants was to consider what the result of their I-Search projects would be, whether it would be useful or practical that they could apply to their life or solve a real life problem. For instance, Hannah, when she had to select between Chinese traditional medicine and hot tubs, asked herself, “Should I go with the interesting, but basically non-useful topic [Chinese herbal medicine] or the practical topic [hot tub]?” When she finally decided to research hot tubs, she gave the reason, “Because, I’m thinking well, maybe I will be able to have a tangible result with the hot tub, because I would like ... I really would like to have one in my home.” Grace, whose topic was to plan a trip with her niece, said, “I wanted to research something that would be useful. I don’t want to plan a trip that I can’t take.” Bette expressed her preference for a useful result for her I-Search, claiming, “If I’m going to invest this amount of time, I wanted to walk away with something that I would think about and use forever. You know, it had to have a permanent impact on me.” Mary chose a religious topic because she want to use the result of her project to “help prepare me in training our children and in the children’s ministry leadership in our church.”

Stress Reduction

Three out of six participants felt pressure due to their work or graduate study. Therefore, they naturally selected a topic that aimed at helping them release some of the pressure. For example, one important reason for Hannah to buy a hot tub and select it as her I-Search topic was related to the pressure. She said, “My topic of writing about hot tubs chose me because this was one of the stress reducers that could have an immediate impact on my life.”

Charles expressed a similar meaning in his final reflection,

> I’m tired. I have been for a while, and get progressively more tired each day. I find rest and a renewal of strength when I camp with my family. For these reasons, my topic for this I-search chose me. Just the thought of a Blue Ridge Parkway camping trip has offered me some relief from the stress of graduate school and teaching at this point, but it also offers me something to really look forward to when the grad school studies have finally come to an end.

Bette also thought about stress reduction when she considered her topic. She realized the career-related stress:

> I moved on from there to my career’s topic. It was interesting that the first thing that came to mind was stress. That is definitely something I associate with a career. The word “stress” just seemed to pop up almost by itself.

She was curious to know, “whether the mind can consistently clear itself of stress.”

Convenience

Convenience referred to participants selecting their topic because it was a doable and convenient topic. For instance, Charles used it as a criteria, when he determined his topic, “Blue Ridge Parkway thing was more … a doable thing right now.” Grace selected her topic, also

because it was a convenient choice. She said in her interview: “I was feeling pretty overwhelmed and planning a trip was something easy for me to do. It was something that wouldn’t take much time. Wouldn’t … you know, I could do it in a hurry.”

Special Issues

Prior Knowledge

Participants’ prior knowledge about their topic may or may not have changed their decision to select a particular topic. For example, while admitting that she knew very little about mind/body connections with the comment, “I just know extremely little about this topic,” Bette still selected it as her topic.

However, Hannah dropped her idea to do her I-Search on Chinese traditional medicine because she knew so little about the topic. She said, “One of the topics [hot tubs], umm, was a topic that I had some general background knowledge about, you know, a pretty good bit of general background knowledge.” She continued:

> When I started to make my web [about traditional Chinese medicine], I really realized that I had very little background knowledge about that topic.… So, I think that that … well, I know that that’s why I kind of decided to go with the hot tub one, because I felt like, you know, the first … the other one, the traditional Chinese medicine, I was afraid I wouldn’t be able to handle it … So, I kind of dropped that one and went with the hot tub one.

But prior knowledge about a topic did tend to influence one’s perception of a topic, whether difficult or easy. Bette felt overwhelmed by her topic, even panicky:

> I knew from my previous web that I was really interested in the mind/body connection, but I was completely overwhelmed by where I could go from that initial interest. I just

> know extremely little about this topic. So little in fact that I stared at the first topic web I attempted for so long that I had to walk away from it initially. I was in a panic.

Similarly, because Mary knew little about her topic, she also regarded her topic as a difficult one, "I picked the hardest one and I picked the one that was going to be the most time consuming and the most difficult to get resources."

Different from Bette and Mary, Grace felt her topic about planning a trip to London was fairly easy, because she was already knowledgeable about it:

> I have traveled fairly extensively in Western Europe in the past. I have honed the skills of finding the best prices on transportation, convenient lodging, entrance to sights, and other logistics- related topics…. I have lots of prior knowledge about travel resources." She continued, "Planning a trip was something easy for me to do."

What's more, if one had plenty of prior knowledge about a topic, then the project would probably not bring much knowledge for the participant. This was even realized by one participant herself. For example, Grace wrote in her second reflective journal entry, "I have lots of prior knowledge about travel resources and am not sure that I would be able to gain what I need from the I-search experience in order to prepare myself for teaching this process to children."

Narrowing Down Within a Topic

Another issue was narrowing down within a topic. When participants initially selected a topic, they had only a general idea about what they might do with their topic. Their topic choices were usually very broad. Narrowing down the topic to a more specific, clearly defined focus was a necessary step. This step was important, because otherwise their topics were still too broad to conduct good research. As the data showed [see later sections in this chapter], this step could

influence not only participants' generating their essential or primary questions, but also participants' exploration.

One participant realized this, but did not know how to narrow down her topic. For example, Bette realized the need to focus immediately after she determined her topic, "Obviously, I am on a roll now – I just pray I figure out how to focus in on one particular area. I feel sure that my topic is too broad. I will need help narrowing my focus."

One participant did not realize her topic was too broad until she encountered a problem. For example, Grace did not realize this issue until she felt overwhelmed by her broad topic. She said in her third interview:

> I'm going to have to say, I had somewhat … you know, I kind of panicked. I got to that … day when I hadn't done it. It was due at six o clock that night and it was, you know, three o clock that afternoon and I had to do research and I said, I can't do all of this. I said there's no way. It's way too broad. Planning the activities is all I can do. Um, so, I knew that I was going to narrow it down to that before I even started.

One participant, although she could narrow down her topic to a specific focus, could not convert her focus to higher-order thinking activities. For example, Hannah originally decided to research buying a hot tub, a specific focus. However, it only involved fact-seeking, instead of higher-order reasoning. From the feedback from the instructor, she changed to a focus more associated with higher-order thinking. She wrote in her fourth reflective journal:

> I started out by thinking that I would research the process of buying a hot tub—what to look for and where I would put one. When ____ [instructor's name] looked at my second web, she immediately saw where I was headed and suggested that I focus in more on the

> stress-related aspect and trying to find a higher reasoning approach to my topic, than just telling how to.

She continued her fourth reflective journal, “I am thinking now that I will do an analysis of the benefits and drawbacks of owning a hot tub for my essential question.” When she was asked to make a comment about her new focus, she said it belonged to the analysis level according to Bloom’s Taxonomy:

> Well, according to the chart that was in the book, analysis, which is pretty logical to me, would be a more higher … would be a higher level of reasoning, than just coming up with … how to put in a hot tub.

Q2: How Do Students Generate their I-Search Questions?

Qualitative data illustrated a wide variety of methods were employed by participants, to create their essential questions or primary questions and sub-questions or secondary questions.

Essential Questions

Two-Step Method

After choosing their topic, all participants employed a two-step strategy to generate their essential question(s). The first step for participants was to determine a particular focus or aspect of their topic. If at the topic choice I-Search stage, participants had already narrowed down their topic to a well defined focus, then they would select that focus. The second step was to generate essential questions either directly from their narrowed topic, or generate question(s) to cover aspects of their narrowed topics in the way to help them answer several questions they wanted. For instance, Bette determined to use hypnosis as her focus, when she saw an article about hypnosis. She said, “I read this article and began to think that maybe I should concentrate simply on hypnosis. It seems to cover a lot of what I am interested in.” Then she made an effort to

generate the essential question that would help her answer questions she wanted to know. She said:

> When I did the first pre-notetaking sheet I was just trying to come up with a bunch of questions I'd like to know. . . . I didn't consider that these … from these, these would be the essential questions. I took it in its pure form, what do I want to know? So, I came up with every question that I'd want to know. And then after the talk, I realized that really what we were supposed …well, I think that's what we're supposed to be doing. What we're supposed to be putting in those are a few big questions that we want to find the answers to, not every single question we want to find the answer to, but the big ones that would perhaps cover these questions, a big question that I would still find out a lot of this information by asking this one big question. So, after the chat, I came back and I looked at those and I thought, okay, I need one question that will give me a lot of this, one question that will cover all of that.

Finally, she created her essential question: *How can the mind be used to affect change in the body and, specifically, how can hypnosis be used to affect change in the body?*

Hannah had narrowed down her topic to a well-defined specific focus, "I decided to focus in on how the benefits of having a hot tub might outweigh the disadvantages." Different from Bette, who wanted her essential questions to cover much of what she wanted to know, Hannah directly generated her essential question around her focus: *How do the benefits outweigh the disadvantages of owning a hot tub?*

If, at the previous I-Search stage, a participant did not narrow down his or her topic to a well defined specific focus, then the first step was that he or she had to determine a narrowed aspect of his or her topic, although the aspect might be still broad. The second step was, as

described previously, to generate a question either directly around the focus or aspect or try to cover some other questions. For example, Mary's early church history was a very broad topic. She did not narrow her topic effectively. She just limited her research to a short period of time and key people. She said, "I think that I can narrow down the time period at least and some key people." She then created her essential questions around the broad topic, but with time and people limitations, using an approach to cover some other questions. She said, "So I tried to think of a way to state my query so that my other questions would support/answer it." In short, participants first needed to determine a focus, then generate essential question(s) around the focus, after narrowing it.

Secondary or Sub-Questions

Compared with generating essential questions, participants utilized more diverse strategies to create their sub-questions. Three participants did not explicitly pose their sub-questions at the second stage of their I-Search. Two out of six participants posed their sub-questions at the end of their I-Search. Of course, no matter at which stage the sub-questions were created, various strategies, such as personal interests, brainstorming, etc., were used to generate them. I addressed this from two aspects: when the sub-questions were posed and what methods were used to generate them.

When Sub-Questions were Explicitly Posed

Vaguely Posed Sub-Questions at Beginning. Bette did not clearly define her sub-question for her essential question at the second stage of her I-Search, as evidenced by her second pre-notetaking sheets. She regarded that questions under the heading, "what I want know," in her first pre-notetaking sheet could be roughly treated as sub-questions. She said in the third

interview, “If you go back … I don’t know if you have it with you today, the original one [pre-notetaking one], these were all sorts of sub-questions.”

Another piece of evidence that supported my observation that Bette did not explicitly define her sub-question at the beginning for her essential question was that some of those questions were not related to her focus of hypnosis. For example, one question was about training to use different mind control body techniques. She said that she did not look for much research for this question, “Um…I…I found that in a couple of different articles how does one go about being trained. And also found that in a website but it really wasn’t a focus for me anymore.”

Hannah also did not clearly write down her sub-questions in her I-Search documents, probably because her essential question was pretty straightforward, with those sub-questions existing in her mind to guide her exploring relevant information. She reflected in the fifth interview:

> Um … I didn’t really put them [sub-question] down. I just put my essential question there. Um, but I guess my sub questions would be, what are the benefits and what are the disadvantages? Where, basically what I was looking at are my sub questions.

Similarly, Grace also did not develop her sub-questions when she generated her essential research question. When asked whether she developed sub-questions for her overarching essential question by the time of the third interview, she answered: “No, I haven’t done that yet.” But she did use her pre-notetaking two questions roughly as her sub-questions. Those questions were changed at the end of the I-Search [see below].

Explicitly Posed Sub-Questions at the End of I-Search Process. At the end of the I-Search process, Grace clearly posed her sub-question in her final I-Search paper. Those questions were

questions in her second pre-notetaking sheet with tiny modification. In the final interview, she talked about it, “Yeah, I just felt like that was…you know, as I was—as I was doing my research, I realized my sub-questions were not very well phrased.” She pointed to one sub-question, “I changed the questions just a little bit.” She also mentioned another modified sub-question, “These two [in pre-notetaking sheet two] I kind of combined into one question. But they…they’re basically the same.”

Similarly, although Emma did not mention any sub-question when she generated her essential question at the second stage of her I-Search, in her side paper, she used questions on her second pre-notetaking sheet as her sub-questions, which were once created as her research essential questions, but were discarded after she generated her essential question about the reason for her houseboat trip. In addition to this, she also added a new sub-question. This indicated that she also clearly defined her sub-questions at the end of her I-Search.

Explicitly Posed Sub-Questions at Beginning. The reason why participants, like Bette and Grace, did not explicitly pose their sub-question at the beginning of their I-Search might be that they did not have a clear picture about what specific things they should look for at the beginning, even if they had a clear idea about their essential questions. Different from Bette and Grace, Mary was quite sure about what specific things she would like to know so she could answer her essential question. Thus, she was able to define her sub-questions and then use them to generate her essential question. In the third interview, she said, “It felt like that because I had these things I want to know. And so, I knew those … knew these are the questions I want to answer, but to get the overarching question, I said, what … question would these things answer?”

Methods to Generate Sub-questions

Participants illustrated diverse strategies to create their sub-questions.

Personal Interests. Personal interests were a natural resource that helped participants in generating their questions. For instance, Bette pointed to one question in her first pre-notetaking sheet and said in her third interview, "I'd be interested in knowing which ones worked the best." This way, she used her personal interests to create one sub-question.

Using Question Scaffolding in the Textbook. Grace talked about using questions scaffolding in the textbook to create her questions in the third interview, "Then I tried to make my higher order question using some of the question words [the textbook] suggested … what, which. You know, so, I took my 'What I don't Knows' and changed them into … and really it was a matter of organizing."

From What I don't Know. Another strategy used by two participants to create their sub-questions was to use questions they had written in their *What I don't know* column on their pre-notetaking sheet. For example, Charles said, "A lot of *What We Want to Know* is based on *What We Don't Know*." Bette further illustrated this process in her third interview:

> And trying to decide is that something I want to know? Is it just something I don't know or is it something I really want to know? There were a few … like I don't know the experts, but here I kind of tweaked it a little bit.

From Other Generated Questions. Bette used already generated questions in her pre-notetaking sheet to create new ones. She said, while pointing to those questions in her first pre-notetaking sheet:

> Umm, these kind of … they [questions in *What I don't Know* column] were kind of together. Long term effects kind of go with the whole concept of how they … how do they compare? You know? Long term, short term, traditional versus uh, these alternative

techniques. How do they compare? What are their long-term, short-term effects? They just seemed to work hand in hand.

Condense Several Questions into One Question. Two participants also made an effort to compact several questions into one question. For instance, Mary wrote in her fourth reflective journal, “My secondary questions condensed and grew out of some of my previous column two and three questions.” Very similarly, Charles described this compacting process in the third interview, “We’ll find out what we don’t know and then just try to put several of those into one question and put them down.”

Impression from Scanning Materials. One participant, Bette, also used materials she scanned before to help her generate questions. She talked about how she had created one question about the impact of positive thinking in the third interview:

> What I was doing then is thinking about the scanning, and somewhere along the way, I remember reading something about placebo effect, and I also was thinking about my own experiences with it.

Special Issues

Challenges

The process of generating research questions was regarded as the most messy and challenging step in the entire I-Search process by two participants. There were two reasons that made participants feel generating their research questions was very challenging. One was too little prior knowledge about their topics. For example, Bette said in her second interview:

> That one’s worrying me a little bit. Because I feel like you have to know more than just, oh, I’m interested in it to do it. And I don’t know more. And I don’t even know what I

> don't know. So, how do I ask essential questions about it, if I don't even know what I don't know?

Another reason was that participants did not know what an essential, higher order question was and how to generate it. For example, Emma said in her third interview:

> I've had a difficult time with the essential question, understanding what that is. So, I found a couple of good resources on the web. One is called Writing Essential Questions and uh, … I don't know the exact … I can send you the web address for it. But it's very good. It has lots of things about, um, what those essential questions are and how to help students with it and, um, so that helped me think about it in a different way. I also talked with a friend who is an educator and she helped under … helped me understand that.

She continued in her interview:

> I … I guess coming back from a science background, I'm used to asking questions, but not necessarily in the framework of the why, which, and how. And so, I was having a hard time understanding the difference in those and I still am not sure that I do understand why it is important to frame things in the … in that central question format. Um, I … I guess I'm used to look … finding out what or how. And that's what my web, I think …this was more of a factual web looking for these types of facts. Um, but putting altogether, you know, why format, I still will need all these facts, but it will … I guess it's … that's what the critical thinking issue is … understanding that.

Because of it, she said: "defining the essential question, I think, was the hardest."

Factual Question vs. Higher-Order Question

Participants would often generate factual questions instead of higher-order questions. Two participants' cases illustrated this. For example, Emma created fact seeking questions in her

two pre-notetaking sheets, *Where can we stop on the river for food, fuel? How will we decide which supplies to bring?* She said in her interview after she got feedback from her instructor about her questions: “So, I had a lot of factual questions there.”

Hannah had a similar problem. Before her question was transformed into a higher order one, she also created lots of fact-seeking questions in her second pre-notetaking sheet. One such type of question was, *Which hot tub manufacturers have the most reliable product?*

Lack of New Knowledge Gained through a Research Question

One participant also created questions which did not help him generate much new knowledge about his topic. For example, Charles’ essential question was about why the Virginia portion of the Blue Ridge Parkway was a good place for him and his wife’s vacation camping. The reason about the camping was quite pre-determined, because they wanted relaxation. In this regard, this question would bring no new knowledge for him. He said in the interview: “But, um, *why do I want to go camping along the Blue Ridge Parkway after grad school?* [This is his essential question.] And we know it’s for relaxation.” Although he did find out about activities and places to stay and visit on the VA side of the BRP, the one word answer to his essential question did not change—recreation. He did not find anything that would change his mind—however, he did gain new knowledge, but it was not impacting the essential question. So in this case, there was almost no new knowledge gained that pertained to his essential question

Incompatibility between the Essential Question and Secondary Questions

There was also another issue worthy of discussion which was the inconsistency between participants’ essential questions and their sub-questions.

Essential Question and Sub-Questions Pointed to Different Directions. Some of the sub-questions could not provide the answers for essential questions. For instance, what Bette wanted

to research was about what ways the mind could affect the body. She said, “If I analyzed my questions and I thought about my general sources and where I wanted to spend my time, I wanted to know just what can the body do specifically.” But her understanding of higher order questions indicated her question should begin with *how*:

> Any kind of essential question I create needs to start with a how. Because that is the pu—any time you have a how question you’re talking about process and method. And in most things if you can understand the process of it than you’ve got the--you’ve figured it out.

She created her essential question beginning with how: *How can the mind be used to affect change in the body and, specifically, how can hypnosis be used to affect change in the body?*

However, what she really wanted to find out was what the mind could do on the body. Her first sub-question in her first pre-notetaking sheet was around what the mind could do. Therefore, her restructured essential question and first sub-question were not compatible to each other. What’s more, her search of relevant information was guided by her sub-questions. The result was that although she gained substantive knowledge, she found out that she could not directly answer her essential question when she wrote her final product. She found that all she wrote in her final product PowerPoint presentation from slide one to slide 21 was just “what the mind can do,” not how the mind was affected through hypnosis, which was her essential question. She said in her final interview:

> And now if you’ll look here where it has a listing of the various…um…parts of the body that it can actually help…I think it…yeah, I mean, I go on for quite a while there because that to me was the heart…of what I really wanted to show…. And then it hit me after I had done all of these, I thought…I remember thinking it very consciously, well this is all great, but to me this is all more about…hypnosis. And isn’t it—wasn’t my question

> supposed to be how…uh, exactly—the word—that word *how* kept reverberating in my head. How does hypnosis do it, not just *what* it does but *how* does it do it. So then after I had done these…I thought…I have to get into the nitty gritty, I have to get into—that's why I call it the nuts and bolts, of how it actually does it. Because I wasn't sure if I had actually…addressed it…my essential question.

She had to search for new information to help her answer her essential question. She said:

> That's when I decided I needed to do something else. I found this website, I stumbled into it, and the way they described it, the logic of it, made a lot of sense to me.… So I thought, I'll have to put that in there. And that…that made me feel good at that point, that I had really addressed this question…that was, you know, the whole reason for the research.

This illustrated that the answers to her sub-questions addressed what the mind could do, not how mind can do through hypnosis. Therefore, she had an inconsistency between her sub-questions and essential question.

Emma's I-Search experience also had the same issue. Her essential question was *Why is the Suwannee River a good place for our family and friends to take a houseboat trip?* This question was also concerned about the reason for the upcoming houseboat trip. She had three sub-questions: *(a) Which activities will help us all enjoy the trip? (b) How will we decide which supplies to bring? (c) Why did Stephen Foster write about the Suwannee River?* The first two questions were actually about planning the trip and the third question was about an historical anecdote about the river. None of them helped address the reason for the trip, which would answer her essential question.

Sub-Questions Could Not Fully Support the Essential Question. Another situation related to participants' inconsistency between the essential question and the sub-questions was that their sub-questions could only provide part of the answer for their essential question. Mary's case illustrated this situation. Her essential question was: *How has the addition of man-made organization taken today's church away from the model demonstrated by the community of the first believers?* Her secondary questions were: *(a) How is the church to be governed, according to Scripture? (b) How did the early church organize? (c) How do these compare?* Just by analysis of her questions, it is not difficult for us to see that her sub-questions could not provide a full answer for her essential question. She needed a sub-question about the organization of today's church. Mary also partly realized this problem, when she pointed out that her essential question was too big, "I fear that my essential question leaves too many open areas to explore."

Question was Based on Incorrect Suppositions

Mary's I-Search experiences also brought up another issue. She originally believed there was a perfect model for church organization that was established by early believers and Bible scriptures. Today's church should follow that model instead of today's organization form. She said in her second interview:

> We just have churches the way they are now. And this is not what they had in the beginning. Many times, there … we have a man-made religion and a man-made building. It was nothing like what it was intended to be.

She further wrote in her background reading learning log that she believed that the model was described in Bible: "The Bible has a lot to say about community and shows a good example of how the church should be."

Therefore her research questions including essential and secondary questions were generated around finding out what the model was and how the current church organization should reflect the early church, if at all. But her research informed her that not only there was not an ideal uniform early church model in the early Christian history, but on the contrary, there was a diversity of early church models and Paul and other disciples and early believers did not purposely establish any church. She wrote in her side paper:

> I discovered that the primitive church was very diverse and considering the relatively primitive times, it makes sense to me that separate house churches dominated until the 300's AD. I was relieved to find out that Jesus did not "establish" a church, nor did Peter or Paul. In fact, the need to establish a line of succession to the apostles came about in reaction to the loss of the apostles and the intrusion of false teachers, which were rampant in the Greco-Roman Empire.

Therefore her research questions needed changing due to her new background knowledge on her topic. This raised an issue that inquirers could generate research questions based on inadequate preliminary knowledge. They should be allowed to revise their questions once they gain sufficient, accurate knowledge and then continue to conduct their inquiry based on newly generated questions, as suggested by the I-Search process according to the Tallman and Joyce (2006) text.

Q3: How Do Students Explore Information Related to their I-Search Topics?

Qualitative data analysis showed that the six participants utilized a diverse combination of strategies to explore and collect information related to their inquiry topics.

Combination of Multiple Resources

Participants usually explored relevant information through various venues. The most common venues used by participants were Internet information and library resources, as well as interviewing people. The types of information included website articles, library books, magazine, journal articles, and other multiple-media types of information, such as DVDs and tapes.

Internet Information

All six participants explored the Internet when they did their projects. Four participants relied more on it, two less. For example, Emma, after finding that the library did not have what she wanted, went to search Internet relevant information. She said:

> My first step was to go to the library. And I went to the library and used the library catalogue and I searched with the terms Suwannee River and Florida and I found several items. But there wasn't much in the library. I couldn't find much there. Um … and I couldn't find … and I guess I couldn't really find much at the library, so then I went to the Internet and um searched there. And I found more up to date information there.

Hannah, Charles, and Grace encountered a similar situation, when library books or articles could not meet their needs for their I-Search projects. Hannah said, "I really didn't find anything specific in books and so, um, at least not on the kind of information that I was looking for. So I pretty much depended on my Internet sources."

Charles talked about his background reading:

> I tried to find some books first of all … going to the library in Winder, Georgia. And most all of the books we found were either old, out of date type books or we did find one book that did have some very good pictures in it and a little bit of written information.

So, like Emma, he turned to the Internet, "I turned to the Internet and found a wealth of reliable information."

Grace also stressed that she found much useful information through her Internet searches. She said in her third interview:

> I started out just doing an intermittent search. I looked for books. I looked for, um … articles. I did go to … _____ [the course instructor] had suggested that I go to [the university's online catalog], but there wasn't much of anything in there about taking children to … you know, travel with children. Most of what I found was um, was through an Internet search. Um, I found, um, several, uh, travel websites that have logs on them that people can post to. I guess message boards that people can post to about and did some searches for children and kids and you know, those kind of key words.

Different from the above four participants, Mary and Bette did not heavily rely on Internet information. However, searching the Internet was an important part in their exploring relevant information. Mary said, "Dr. _____[course instructor] is very nice in giving me some websites, but I … I explored many websites, but I did not find a good general background information like I was looking for."

Bette did not find adequate Internet information like Mary, but she found some useful information at the end of her I-Search project:

> They—one was a website, um…that I found called *How Stuff Works*. So it's a generic website, but it had on there…um, a detailed description of hypnosis and how it's supposed to work. Which, you know, that's right along the lines of what I wanted to find out.

Library Resources

Almost all participants also explored information in libraries. Of course, some participants used more libraries than others. Bette and Mary were two participants that mainly utilized library resources for their projects. Bette said, “Everything that I’ve got now, with the exception of the Medline Plus website that Dr. ____ [course instructor] gave me and the original magazine article that I found, the rest came from [the university’s online catalog].”

Mary ended up borrowing some books from her pastor’s church library. She said in the fourth interview:

> I had a very difficult [time] searching the web and [the university’s online catalog], uh…I found all kinds of current opinions but I wasn’t looking for opinions. I was looking for historical information, historical fact. So I did a lot of searching and a lot of—especially on [the university’s online catalog], um…and I finally made this appointment with this pastor. In his church library he had these six sources.

Although she did not rely primarily upon library resources, Grace checked out some books from the library recommended by some Websites as good background reading for her niece for their upcoming traveling in London. She talked about her exploring relevant information for her project: “I also went to the library and checked out some of the books that I had seen recommended.”

Like Grace, both Charles and Hannah used a few library resources in their projects. Charles borrowed one book from library for his background reading [see the quote in previous section]. Hannah found some articles in [the university’s online catalog] about diseases people can get from dirty water, which had some relationship with her topic, she said:

> I also went through…of course I searched [the university's online catalog] first thing. That was the first place that I looked. So the databases that are available through, um, [the university], that was the first place I looked because I felt like that would be the most...reliable source of information. Um…I didn't find too much using [the university's online catalog] because, um, I guess hot tubs are too frivolous for people to write about. But there were some, like some medical articles about some of the, um…the diseases or, um, illnesses that you can get from swimming in, or from sitting in water that's not properly, um, sterilized, so they were pretty technical. Um, probably written more for a different kind of audience.

People's Lived Experiences

The third information resource utilized by three participants was people's experiences. Charles contacted people who had experiences of camping in the Virginia (VA) part of the Blue Ridge Park (BRP). He wrote in one of his journals:

> My first choice in finding information to help me answer my essential question was direct personal interviews with campers who are familiar with the VA portion of the BRP. I sent two emails, one to an acquaintance we made on the NC [North Carolina] portion of the BRP, and one to someone who runs a camping information website. I also tried unsuccessfully to find an email address for a blogger whose writings and pictures were very helpful to me. I did receive a very informative email from the camping website host, but have yet to hear from my camping acquaintance. He is a retired University of Florida professor who checks his email at the university, apparently on an infrequent basis.

Different from Charles, Hannah conducted several face-to-face interviews to get useful information for her project. One interview was made with a person who had a hot tub. Others were with hot tub salespeople. She said in her fourth interview:

> I interviewed someone who actually has a hot tub and asked them some questions about the, you know, what they saw as the main reason why they got a hot tub in the first place and how they use it, and just a lot of questions about how easy they are to take care of, and…um…you know, if there are any significant problems. You know, did you get tired of it after awhile and, you know, not use it as much, and it was very enlightening and it was kind of fun.

She continued to say in her fourth interview:

> My husband and I visited several hot tub, um…manufacturers, or, you know, sales, commercial places and interviewed, um, some of the sales representatives and this was, um…this was the most interesting interview because this person seemed to really…to really be trying to do more than just sell you the tub. They seemed to really know a lot—a lot about the tub that they were selling and so, um, I tried to write down as many of them as I could of the advantages, um, that he had about this particular hot tub.

Like the other two participants who interviewed people, Grace interviewed a media specialist in her school for possible sights in London that children would enjoy visiting. She said, "I also mentioned my search to the media specialist at my school. She had been a chaperone on a student tour of Europe several summers ago and had some suggestions for sights to visit."

Multiple Types of Resources

Besides different venues to obtain relevant information, participants also used a variety of information formats. From the above quotes, we could see that they used Internet articles, blogs,

library books, articles, and interviews. They also used other multi-media information, such as DVDs and tapes, as illustrated by Mary, Grace, and Emma. For example, Mary used DVDs to get some background information. She wrote in her second journal reflection, "A friend gave me the Luther_DVD to watch for some background as well."

Grace also watched a video. She said in her third interview, "I watched a video that I had about London. I got a video over at Steves' video about London and watched it. That's kind of what I did." Like both Mary and Grace. Emma also checked out a video and used it as related information for her project. She wrote in her side paper, "The first place I began to search was at the local public library. I searched for resources on the Suwannee River and found only a few sources, including three books and a video to check out."

Using Different Criteria to Accept Information

Reliability

Participants also employed different criteria to evaluate the information. Reliability was one criteria used by three participants. For example, Bette looked for the authority of the article author and who published the resources to make her judgment whether the information was reliable or not. She said in the fourth interview:

> I looked to see what magazine the article is in when I'm on—in [the university's online catalog]. That's important to me. Um…if it's something—say it's an article in *People* versus an article in, um…*Scientific Mind*, there's obviously going to be more weight in the *Scientific Mind* article because…you've got to figure the editors are scientists. Or at the very least their writers are scientists. And I've always thought, and it's a completely very subjective opinion, but I've always thought that scientists try to keep the emotion and, um, stuff like that out. And they just focus in on the cold hard facts, you know. So I

> give more weight to what they have to say than somebody like me who's just hanging out, saying, well let's talk about ____ hypnosis and let all our feelings get involved in it, you know.

Different from Bette, Mary tried to accept things which were accepted or agreed by three resources. She said in her fourth interview:

> Yes, um hmm. Dr. ____ [the instructor] told me that one good way to do that was make sure there are three resources that say basically the same thing and it might would then be trustworthy. So I'm trying to keep that in mind in looking for three things that tell me the same information.

Hannah seemed to consider not only author, resources, but also whether the information was supportive of each other as criteria for reliability. She said in her fourth interview about the resources of a piece of information,

> Um, yeah, I did want to try to find sources that would be, um, reliable sources. Um… of course nine tenths of the sources that I found on the Internet were commercial sites of companies that wanted to sell you a hot tub. So, obviously they are going to have a very strong bias, um, towards their information. So I really wanted to…I really worked…hard to try to find, uh, sources that I felt like would be reliable.

She continued talking about reliability, but focused on the information provider:

> Something that I could look at and say, oh well that's authoritative, you know. Because these people, um you know, these are doctors or these are scientists. And so, as I went through this, um, I wanted to pick out the things that—the reasons why it was recommended as a health benefit.

In her final side paper, she also talked about how she treated the information provided by some individuals:

> A lot of the information was based on the idea that you shouldn't allow yourself to be pushed into buying something without having a chance to research it first—pretty common-sense advice—but the author, who said he/she was a former spa salesperson, did not want to sign his opinion or give any references for his statements. So I did not include this source in any of my notes. I found several testimonials like this, but there was no way I wanted to use them without source information that would show their bias.

Finally, she talked about the supportive information in her fourth interview:

> Um…I did find several, um, when I'm—when I was doing the health benefits. They would talk about sort of the same kinds of things. Like the health benefits, um, seemed to support each other. I didn't find anything that flat contradicted what somebody else said about it. So I pretty much felt like, you know, that this information was…pretty reliable just because it was, um, so supportive of, you know, of each other.

These data showed that different people had different meanings for what was a reliable resource that could be used in their projects.

Camping Philosophy

It was interesting to notice that Charles utilized a special criterion in looking for information. He would accept and trust the information, if he believed that the providers have the same camping philosophy as he did, which was to camp at places that could offer beauty and tranquility. He said in his fourth interview, "I would say the relationship would probably be that they [information he collected] were—we—we sought out sources that had the same…camping philosophy as—as—that we have or whatever."

Bible Scripts and Personal Belief

Besides reliability as a criterion, Mary also used her personal Christian beliefs and Bible scripts to make a judgment about other information resources she explored. She wrote in her double-entry draft journal reflection about this:

> I have a particular definition of the church as a body of believers rather than a fancy, chandeliered building. In fact, I believe the Holy Spirit dwells in the earthly "temple" (body) of each believer. Although "It's not a religion, it's a relationship," may be a worn cliché, it is one of the beliefs that drives my current quest. Therefore, I critique possible resources in light of this thought and my belief that, "All Scripture is God-breathed and is useful for teaching, rebuking, correcting, and training in righteousness, so that the man of God may be thoroughly equipped for every good work."(II Timothy 3:16-17, NIV)

Based on the above discussion, the decision processes for each participant, whether to accept a particular piece of information, were based on a variety of criteria, including reliability and personal preferences or beliefs.

Using Research Questions as Guidance

Participants claimed that their research questions, either essential or sub-questions, guided their process of exploring information.

Sub-Questions

Bette particularly confirmed that the questions in her first pre-notetaking sheet, which she later used as the basis for her sub-questions, mostly guided her exploring relevant information. She said in the fourth interview:

> After I had, um, pulled out—after I printed out about nine or ten articles, I looked at them. I looked at the titles…and I read the abstracts. And then, I went…I sorted through

> my mind, even though I had narrowed down all those essential questions from that first pre-notetaking…uh, sheet to just the two on the second one, they're still rumbling around in my head. And so I…'cause I felt like I had to have some criteria…to read the article, not just 'cause, oh, it looks cool and I wanna read it, obviously I would have read them all. But I was trying to sort them by those…previous essential questions, which now I'm using more or less like sub-questions. And I thought, ok, after reading the title and the abstract, I asked myself, 'Could this possibly have something in it to answer one of my sub-questions.' And if I thought it did, then I put it the—um, in that—in a particular stack. And if I thought, well it was more just a chatty…if I couldn't see a possible answer to one of the sub-questions and it's just a chatty informational…general thing that I already have lots of information about that, I put it in a different stack.

She further pointed out: "Um, the relationship is that the pre-note…um…taking sheets, especially the first one really, um…totally—well 90 percent guided…um…this—the search, and then what I chose to put in this double-entry draft."

Essential Questions

Hannah also described how her essential question guided her searching relevant information in her fourth interview:

> Well, because I used my question, which was to, um, do the benefits of owning a hot tub outweigh the disadvantages? And so, I used that question to help me look for things that I felt like might be benefits and things that might be disadvantages. And with benefits I kind of mentally, I guess, discovered or realized that that's gonna be physical—there are gonna be physical benefits and there are gonna be mental or psychological benefits and when I was thinking about drawbacks of hot tubs, um…I knew that they could cause

> some health problems, but I have never, you know, researched those or looked into that a great deal, and so I knew I needed to find something about that. I thought…taking care of a hot tub, having time to do the maintenance that you have to do to take care of one could be possibly be a drawback. Um…the fact that it might be dangerous, the fact that a hot tub could actually be dangerous was something that I kind of…stumbled on as I was doing my research so that, you know, that would definitely be a disadvantage. Um…so that question was just, you know, everything that I looked for was to support…trying to answer that question.

Not like the above two participants who could specifically describe how the questions guided their exploring information, Mary said, "I was looking for answers that would support my essential question."

Emma wrote in her double-entry draft about how her questions guided her exploring information:

> One thought I have had while reviewing sources is: What is my essential question? Am I answering it? I decided to print out my Essential Question and rewrite the sub-questions. I put them all in front of me as a reminder. I felt that would help me think about the questions in relation to the resource that I was reviewing in order to help me evaluate whether the resource was helping find the answer to my questions.

From Generic to Specific

Qualitative data also showed a trend that two participants often used a more generic searching strategy at the beginning of their I-Search. With the progress of I-Search, they were clearer about what type of information they needed for their I-Search, so they tended to use more specific searching strategies. Bette's case clearly illustrated this trend. At the beginning, Bette

only had the interest, but did not know much about her topic. She used a general term, "mind/body connection," to search the Internet to get an initial idea about her topic. She wrote in her second journal:

> I felt the topic had chosen me, but I could not seem to go anywhere beyond that initial idea. After a few days, I decided to "Google" the key word phrase "Mind/Body Connection". I was surprised by the amount of websites that I was offered. I went to several of them and read what was there. I printed off a few articles and read those. Many of the websites felt contrived and insincere and a few spoke in language that I didn't understand. One website – familydoctor.org – gave me access to a few articles that helped me begin to get an idea of where this search could go.

Later, after she determined the focus of hypnosis, her search was more specific around hypnosis, instead of a broad term "mind/body connection." She said in her fourth interview about her search in [the university's online catalog]:

> And I put in the key word…um, hypnosis. I had decided to focus in on that particular technique. And I put that in and luckily…um, I did not come up with like a zillion sources, but the ones that came up were generally pretty good. So that helped me out a lot.

After she finished her double-entry drafts, she had gained substantive knowledge about her topic. She realized there was a gap in her collected information. This time, instead of looking for hypnosis, she searched for studies that supported with more scientific data about hypnosis. She said in her fourth interview: "as I was creating the, um, double-entry…draft, I found some areas that I needed more information on." She continued, "I think I may go back to the journals

that I got bogged down in and see if I can find a few that have…some really weighty…percentages or statistics or something."

Hannah also used this strategy. At the beginning, when she tried to determine her topic, she looked for what was available for a particular topic. She said:

> And actually, after class Thursday night with Dr. _____, I actually went and did a little search with one of the search engines she had mentioned to us in her class, just to see …. Just for kind of an experiment to see what it would pull up. And it pulled up, you know, some stuff that I kind of put down as possible sources. I didn't actually go through and do a lot of reading in any of them. But, I just thought, well, you know, there's a lot of stuff out there about hot tubs. So, I thought well, you know, maybe … and I was getting some good key words to use to look it up. Right now, I will probably go with that topic unless something just really changes.

After she did her double-entry drafts, she felt she needed to do some further research on more specific details about what she already found. She said in the fourth interview:

> I need to do a little bit more researching, um, for some more specific details. I think that some of my details were not…I was thinking about them and I was talking about hot tubs with my husband, I was thinking I need to go back and maybe…make some of my details more specific.

From the above discussion and quotes from Bette and Hannah, we can see that both of them employed a generic to specific strategy in their I-Search process.

Using Multiple Methods to Organize Collected Information.

Besides using diverse methods and strategies to search information, participants also used various ways to organize and keep track of their collected information.

Bookmark

Because the Internet was one of the major information resources for participants, bookmarking proved useful for keeping track of web pages they visited and for later revisiting as one of the common ways to organize information. For example, Emma said in the fourth interview, “I created a folder on my favorites in the computer. And then I could just put Suwannee River there and I could go back to the ones that I liked and click those there.”

Similarly, Grace also mentioned her way of keeping track of information in her second interview:

> I have been bookmarking websites. I don’t know if that’s allowed in the first … but I’ve been bookmarking websites because, you know, I want to be able to come back to them once I .. I know we’re not supposed to take notes, but I have a little folder that I fixed up when I find possible sorts of resources, I stick them in there so I can come back to them later.

Charles also said in his fourth interview: “We would find sites every once in a while and either bookmark them and know that we want to come back to them later on and read … more information for the double-entry draft.”

Print Out and/or Sort

Printing out and/or sorting relevant resources was also another common way to organize and keep track of useful information. Bette printed out some articles from [the university’s online catalog] and sorted them according to whether they could help answer one of her research questions. She said:

> After I had, um, pulled out—after I printed out about nine or ten articles I looked at them. I looked at the titles…and I read the abstracts…. But I was trying to sort them by

> those…previous essential questions, which now I'm using more or less like sub-questions. And I thought, ok, after reading the title and the abstract I asked myself, could this possibly have something in it to answer one of my sub-questions? And if I thought it did then I put it the—um, in that—in a particular stack. And if I thought, well it was more just a chatty…if I couldn't see a possible answer to one of the sub-questions and it's just a chatty informational…general thing that I already have lots of information about that, I put it in a different stack.

Mary also sorted her materials: "I have the books stacked up in order with notes with them…um…right next to my computer, and the sign on it that tells no one to touch it." Emma just printed out and put them together: "Well, the others I got the information from the library and then I had my brochures and I put a notebook together that … where I kept everything that I had printed out or any printed material."

Word Document

Different from the above participant who printed the material out and sorted it, Grace used a word document to save all the links of useful websites, as well as keep short notes about the web page or sites: "Each time I saw something I liked, I copied the URL and pasted it in a Word document with a notation about the idea. I now have four pages of possible resources and some annotations."

Special Issues

In summary, participants generally used three types of resources: the Internet, the library, and people's experiences in their I-Search projects. Two participants would use "from generic to specific strategy" to search related information. In addition, different participants employed different criteria to make judgments whether a particular piece of information was acceptable or

not. Five participants thought their research questions guided the process of their information searching. Besides this, participants could also use different ways to organize their collected information. There were special issues related to participants' experiences of exploring information for their I-Search projects.

Not Guided by Research Questions

As we could see, five participants, such as Bette and others, used their research questions to guide their information exploration. However, not every participant used his/her research questions to guide this process. For instance, Grace realized that what she collected was not directly related to her research question. She said:

> And then I did write down things that related to my topic, but just didn't necessarily relate to my essential question. You know, they related to travel with children in London, but they may not have related to…developing a deep understanding of culture.

The problem with this is that the search for information might include any related peripheral information, not necessarily addressing the research questions. Different from Grace, Bette's exploration is guided by her research questions, more specifically, her sub-questions. She described her later research as being very:

> Purposeful, thoughtful, and explicit. I felt like I was driving the car rather than being pulled behind it with no idea of where the car was going. I felt in control. The constant focus on narrowing down the topic and creating an essential question was difficult, but much appreciated once I began to look for sources. I did not wind up with tons of sources, just germane, credible sources that gave me the answers I was looking for.

This vividly contrasted with her old way of exploration without the guide of research questions:

> In the past, I would be given a broad topic and then I would dive right into research on that broad topic. It was a nightmare! I would wind up with literally tons of sources and no clue what I was supposed to do with them. After reading all of them repeatedly, I would decide on a focus based on where I had the most information. It was an onerous process that I absolutely hated. I would not have a thesis until the end of the research process.

Another participant, Emma, added a new sub-question, *Why did Stephen Foster write about the Suwannee River?* But there was not a clue, not only in her double-entry drafts or in the first to fourth interviews, that she had searched for information for this sub-question. This might indicate that this question was generated based on the information she collected, instead of using that question to guide her exploring relevant information.

Too Much Information

Previous discussion showed that narrowing down a broad topic to a specific focus was a crucial step in the learning processes. One reason was that participants generated their essential question around their focus. So if essential questions were generated around a clearly defined specific focus, then the research questions and their sub-questions will not be unmanageable. Otherwise, the research questions might be too broad and need too much information for answering the questions. For instance, Mary wanted to narrow down within a topic:

> I was afraid that I would not be able to narrow it down, because it seemed so huge as a historical topic. But I think that I can narrow down the time period at least and some key people and come up with a good basis of information.

Although limiting the scope of her topic to a short period of time, and some key people, Mary's focus was still too unwieldy. The early Christian history involved people, cultures, events, etc. Her essential question generated around this focus needed too much information for

her to grasp what she wanted. To answer her essential question, she needed more information than could be generated through research on her three sub-questions. This was the reason that her sub-questions could not fully answer her essential question.

In another example, Grace's focus was helping her niece to understand London culture and history. But her focus was not narrow enough; London history alone was already a very big topic. As discussed in a previous section, at first she did not use her question to guide her information exploration process. If later, she used her essential question to guide information exploration, she still had to search too much of the broad topic. Consequently, she was finally forced to narrow down to eight sites in London. She said:

> Well, I had, um, I had started out…just looking for…you know ways to…to, well…how people had traveled with children and what they found beneficial and what the kids liked and what they learned from. And that was really what I was looking for, but then I realized that my search was way too broad and I was going to have to come up with a list of places. And I kind of had some in mind after doing my preliminary research, so I made a list of about…eight places that I thought we would want to visit. And then began to look for…where kids—where people have gone with kids for those.

Both Mary and Grace's cases illustrated that if a question was generated around a focus that was broad and not narrowed down effectively, then even if the inquirers used their questions to guide their information exploration, they might still collect so much information that the inquiry task would be unmanageable.

Exploring Information throughout the I-Search Process

Qualitative data also showed that all participants explored relevant information for their I-Search projects throughout most of the steps of their I-Search process. Bette even searched for

additional information for finishing her final product. This showed that exploring information was not just one step in an inquiry cycle, but a constant action across different inquiry-based learning phases.

Q4: How do Students Respond to their Collected Information?

The previous section described how participants searched for resources, decided which article or books were relevant to their topics, etc. This section describes their responses to relevant information and provides a detailed picture how they made meaning out of their resources by responding to the information. If participants' research questions indicated a knowledge gap needed to be filled in order to finish their I-Search projects, then their making meaning out of their collected information would help them eliminate their knowledge gap. The qualitative data illustrated that six out of seven of participants' responses could be classified into knowledge construction types of responses.

Responses Related to Research Questions

The first type of response was when participants realized that a particular piece of information could help address their research questions, including essential questions and sub-questions. For example, when Bette saw a research study comparing brain activities between hypnotized and non-hypnotized volunteers when exposed to painful heat, she wrote in her double-entry draft that the study informed one of her sub-questions listed in her first pre-notetaking sheet:

> This statement about a study caught my eye because it informs one of my essential questions about the science behind the idea of hypnosis. I came into this topic very interested, open, but a little skeptical, because all I knew about it was hearsay and personal experience. I wanted – no, needed to read about ways that hypnosis and the

> mind's ability to affect the body had been proven scientifically – ways that could not be set aside as just emotional silliness. The article goes on to state that the fMRI conclusively noted significant differences in the two groups. These differences were scientifically explained. That was huge to me!

In another resource, when she saw a statement about medical uses of hypnosis, she wrote that the statement addressed her essential question:

> This section informs my essential question - how can the mind affect the body through hypnosis. My list of positive affects of hypnosis is growing and being solidified by duplicate evidence.

Similarly, Charles also wrote in his double-entry draft reflection, "When I look at the information I gleaned from Vicki's albums, I am more ready to answer my EQ about why I am attracted to the VA portion of the BRP as a vacation spot."

After she saw mental benefits of having a hot tub, Hannah wrote in her double-entry draft:

> I know this information comes from a spa dealer. The website has a great deal of information about the how-to's of hot tubs—and sells the products to help the owner do these things. But this piece of information answers my question I have about year-round use of a hot tub. I'm going to check it against the observations of _____, whose family owns a hot tub.

After getting feedback from her instructor about her double-entry draft assignment, Mary revised her double-entry drafts, to focus more on how the information could be used to address her research questions. For example, she found that "Ignatius, Clement and Polycarp advocated a growing network of church relations between cities and within regions, in contrast to the lack of

links during Paul's time. These networks become pivotal for church organization in the next generations." She wrote in her double-entry draft reflection column:

> I see that the hierarchy is starting to form at the suggestion of these three men. There doesn't seem to be any basis in any of the earlier accepted gospels or apostolic letters, but these men's ideas appear to be in response to the culture and impending false teachings. My questions are getting answered as to how leaders guided the organization of the early church. This is exactly what I needed to know in answering my essential question. I wonder if reading the complete works of these three would reveal further details.

Confirm Knowledge

The second type of response was related to confirming or supporting one's own idea or knowledge about his or her topic. Take Bette as an example. After finding many studies supporting hypnosis as a way to treat a number of problems, she wrote in her double-entry draft, "I read that statement and felt reassured that I would find plenty of proof to support my ideas about the mind's ability to affect the body."

Mary, after reading a journal article, wrote, "This writing gives further credence to the authority of Scripture in the life of the early church. Therefore, it is appropriate for me to assume the Bible is a good authority on the beginnings of the early church."

Grace also commented on the content in a book, *Kidding around London: A Young Person's Guide to the City*, "This book confirms several of my conclusions about sights we should see."

Similarly, Hannah, after she read a study report about using hot tubs by people with hypertension, wrote in her double-entry draft that the study "supports my finding that few studies have been done on the advantages or risks of hot tubs."

Activate Prior Knowledge

This type of response was related to participants activating their prior knowledge about their topics by recalling their past relevant experiences. In most cases, the activating process helped them to make decisions related to their projects. For instance, Emma recalled her past experience and wished her upcoming trip would provide the same enjoyable experiences:

> As I look at photographs of the river and read about the geography, I am reminded of summer vacations. My family and I spent summer vacation at my maternal grandparents' home in Central Florida, not too far from the Suwannee River region. As a child, I enjoyed boating and fishing and exploring the area by boat. Perhaps I am hoping to have a similar experience with my own family.

Similarly, Grace, after reading a website and recalling her past trip to London, wrote in her double-entry draft:

> This site indicates that the Cabinet War Rooms stop was one family's favorite. I really enjoyed it when I was there. The sound effects and displays make you feel like you're really in London during the war. There are lots of interactive displays. I think the bookstore had some information for kids, too.

The Cabinet War Rooms site was finally selected as one that Grace and her niece would visit.

Change Knowledge

Change knowledge referred to a type of response where participants reported that the information changed their original idea about their topics or corrected a misconception they had about their topics.

For instance, when Bette read about the relationship between hypnosis and memory, she wrote in her double-entry draft:

> I was surprised to read this statement. It does not jive with what I thought I knew about hypnosis. I thought hypnosis could be used successfully to refresh really old memories – to help the subject in some way. This article denies that myth.

Mary, after she read about the house church in the material, she discovered that she had a misconception that house churches were the main church bodies at that time, and wrote, "I was mistaken about the preponderance of house churches. Seems that the rural and small town folks may have missed the first surge of the church."

In another place, Mary wrote in her double-entry draft learning log reflection about how the material changed her belief about church organization:

> Again, I found myself changing some judgmental attitudes, when I realized that we can't just "get back to the Bible," (actually, I read about such movements in history and how they were ineffective) and throw out all means of organization.

Enrich Knowledge

Enriching knowledge referred to materials that added new knowledge or ideas into one's repertoire about his/her topic. Bette planned to write a list of benefits about hypnosis, based on a resource that gave her what she wanted to know. She wrote, "I became excited when I read this. I have been trying to create a list of ways that hypnosis and the mind affect the body in a positive way. This statement was followed by a long list of benefits."

Mary, after reading a book, *Church History in Plain Language*, wrote in her double-entry draft:

> I'm learning more of the theological language. Key words and people are clearly given in this resource that was given to me by a trusted pastor friend. The information in this volume fills in all the gaps I had in this time period of church history.

She continued to write in her learning log:

> I made the biggest learning leap with this resource. It was readable to the layperson and brought me to the understanding that power and the politics of the eastern Roman Empire brought about the greatest change in the early church.

Grace wanted to help her niece better understand London culture and history, but there was too much information about it. When she read about a family who brought their children to London and focused on one dynasty while they traveled in London, she adopted this idea, and wrote: “This might be a good idea – Henry VIII or Victorian England. Maybe Hannah would like to choose a focus?”

Emma responded to an article about a family houseboat trip description, writing, “This article is a description of a weekend trip the author, his family and a photographer took on one of Miller’s Marina houseboats. It gives me an idea of the accommodations. ”

Hannah also responded to a piece of information about the benefits of a hot tub in her double-entry draft learning log:

> I never thought about the fact that I would need to rehydrate after getting out, but it makes sense. Your body loses moisture when it sweats, so you would lose moisture as your body heats up from the water in the hot tub.

Identify Knowledge Gap

Knowledge gap refers to participants realizing that they needed to know more about their topic to carry out their projects. For example, after seeing a picture of Yankee Falls Trail, Charles wanted to find out more about it. He wrote:

> The picture of the Vicki’s husband and dog on this peaceful looking trail on the BRP was enticing to me. I now need to try to find the specific point along the BRP at which this

> trail is located. Vicki had several pictures of falls following this picture, but I am not sure if they were taken on this trail. Captions under some pictures in this album indicated that she traveled to Otter Creek during her vacation, so I need to find out if Yankee Falls is closer to Otter Creek than Sherando Lake.

Grace saw a website recommending a book titled, *Tower of London*. She felt she needed to look further for more information about the book, "For me, this sight epitomizes early English history. Will look on Amazon to see if the book might be helpful for providing background and helping Hannah develop a picture in her mind."

When Bette discovered *The Stanford Hypnotic Susceptibility Scales,* she wanted to know more about them. She wrote:

> Devised in the late 1950s by Stanford University psychologists A.M. Weitzenhoffer and E. R. Hilgard, these scales determine the extent to which a subject responds to hypnosis. As soon as I read about these, I was intrigued. I would like to try to find more information on these scales. Perhaps I could test some of my classmates and see how they score. Results indicate an individual's ability to respond to hypnotic suggestion. This could be something I could use for my final product.

Validate Knowledge

This type of response referred to what participants thought about whether to accept a specific piece of information as valid knowledge. Qualitative analysis showed that participants utilized different criteria about it. This corroborates with participants using different criteria to explore information. But this section provided a more detailed picture.

Authority Resources

Participants thought about who provided the information, when they were determining whether a specific piece of information was valid and reliable. For example, Bette tended to accept resources from experts or prestigious organizations. When Bette read about a research report that hypnosis could help heal bone, she wrote in her double-entry draft:

> This statement attracted my attention because it notes that a doctor at Harvard University – one of the most prestigious universities in the country – had proof that the mind, through hypnosis, can heal broken bones faster. Wow! Her credentials put more authenticity into her findings.

She further said in her double-entry draft learning log reflection, "When a professor of psychiatry at Stanford University says this, I tend to believe it."

Hannah also paid attention to where the resource came from. She wrote in her double-entry draft "reliable source—university and government sponsored." In another place, she wrote:

> Reliability—this association has a vested interest in making sure that spas and hot tubs are used safely—members are people who sell hot tubs and if hot tubs are dangerous, these people can be held liable. Therefore, they want to make sure that owners know how to safely use their hot tub.

Duplicate Evidence

Duplicate evidence or statements agreed upon by different resources, tended to be accepted as valid knowledge by participants. Bette wrote in her double-entry draft:

> This statement attracted my attention because I felt that I needed to find out the truth of hypnosis in order to find out how it can affect change on the body. The phrase, "researchers with very different theoretical perspectives now agree," was very reassuring

> to me. The phrase assured me that the following information was probably true because people with different points of view all agreed – not much chance that bias or agenda would influence the ideas.

She even made a conscious effort to find things agreed upon by different resources. She wrote in her double-entry draft:

> I am constantly on the look-out for agreement between articles about the various affects of the mind on the body. Already, some things are being repeated – pain relief of some sort has been mentioned in everything I have read. Also, the mind's ability to help with burns has been mentioned in everything I have read. Also, the effectiveness of hypnosis on IBS [Irritable Bowel Syndrome] has been mentioned in all of my readings.

In another place where she found the benefits of hypnosis, she said, "My list of positive affects of hypnosis is growing and being solidified by duplicate evidence." In her learning log journal reflection, she said, "Duplication indicates validity to me."

Mary also sought information that was agreed upon by different resources. She wrote in her double-entry draft:

> This is an even-handed explanation of the history of the Bible from a totally unexpected source. I thought journalistic articles would be anti-Bible and offensive to my personal beliefs, as many so-called documentaries on TV are. But this is a very surprising, non-radical, current description of the known historical evidence. The same names and dates occur in this history as I have found in other more dated sources. I do not feel offended at this article, in fact, it corroborates with the history I've found in other sources I expected to trust.

Like Mary, Grace also noticed that some recommendations repeated among resources. For example, she read that Theatre Museum is a good sight for kids. She wrote, “Confirms earlier recommendations I’ve read.”

Finally, Hannah sought information that supported other information. When she saw the benefit of having a hot tub in a resource, she wrote in her journal, “reinforces observations made by other sources of the effects of hot water and water massage on the body.”

Similarly, Charles wrote in his double-entry draft about Vicki’s pictures and captions:

> The information that I gathered from this resource confirms that which I got in the email from Cliff_____, although Vicki did not have any pictures or information about Peaks of Otter, the other VA BRP campground in which I am interested.

Methodological Validation

Bette was the only participant who considered the methodologies by which conclusions were drawn by her sources, when she regarded whether a particular information piece was valid knowledge or not. Bette said, “I am always thrilled to have hard, cold medical/scientific proof back up a theory or idea.”

Conflicting or Inconsistent Findings

It was normal for inquirers to encounter contradicting information in different materials. The reaction to those contradictory findings indicated one’s attitude to valid knowledge. Bette’s response was first worry. Then she tried to find the reason for the contradicting findings. She wrote:

> The different findings from one article to the next caught my eye and worried me somewhat – I wanted incontrovertible proof of pain control by the mind using hypnosis.

However, the different machines used (PET vs. fMRI) may have something to do with the different findings.

She further gave reason for those differences. She described her reaction in her interview:

Well I—when I read about the contradictions? Oh, yeah, it ticks me off. I go, come on now just…I don't understand how it could be, if it's the same PET scan or the same fMRI that they're using, why would in one patient—one subject, the activity be one way and then they're doing the same thing. But then I assume, because it's two different—completely different studies…maybe they have a different setup. You know, you have to have everything exact in a study to duplicate—everything duplicated to get realistic results. And maybe one group of scientists and another group of scientists, when they create these studies to test the theory of hypnosis, they aren't doing the exact same things with their people. And so when that happens, the results are bound to be a little bit different. I mean that's the only reason that I can think for the contradiction. But they both—both studies from one to the next, it contradicts itself, um…use that as reason…as proof that something is definitely happening in a hypnotized brain. Um…one says…that…the activity in one area of the brain is decreased so that another area of the brain can…dominate it and control it. And one says that that original area of the brain is increased because it's doing the work. So both studies still use what they come up with, their proof, to support the claim that hypnosis can, um, and the mind can affect the body.

Hannah also encountered an inconsistent suggestion about how often to drain a hot tub. Her response was to find more information and to trust a more reliable resource. She wrote in her double-entry draft:

> One thing I wondered about was how often to drain a hot tub. The dealers say every three to four months, depending on the amount of use. This website recommends monthly cleanings. The next reference calls for cleaning and refilling every two months. I need to check around some more to see if there is a consensus, although I would probably trust the health department more than a dealer.

Special Issues

In summary, participants made meaning out of their collected information which would finally help them to fill the knowledge gap for answering their research questions and finishing their I-Search projects. Their making meaning of their collected information could be represented as making various responses, when they read through their information. Usually, those responses were hard to capture, because they often happened in inquirers' minds, which were invisible to other people. Fortunately, the I-Search model provided double-entry draft reflections that could capture participants' responses to the information they found. Therefore, the double-entry draft provided a venue for us to understand this aspect of the learning experiences.

Difficulty in Writing Double-Entry Drafts

However, the double-entry draft was not a familiar tool to most participants. Four out of six participants felt challenged writing double-entry draft reflections. For example, Mary wrote in her journal reflection:

> Even with the great examples and the Tallman text, I found myself having a hard time distinguishing the thoughts that belonged in the responses and those that belonged in the learning log [journal reflection accompanying the drafts]. I checked myself with the

> questions given when doing each chart, but found myself cutting and moving ideas between the two. With more practice, I think this part will be easier.

Grace also expressed this sentiment similarly. When asked what challenged her, she said:

> Probably trying to understand how to do a double-entry draft. You know, I read that book backwards and forward. I looked for examples…um…and had difficulty finding them. She [the instructor] sent us some examples later but Amy's research question was really so far from what mine was that…um…you know, it didn't—it wasn't particularly helpful to me. It would have been helpful if I'd seen several _____ examples, and then I said, seeing an example of a bad one would have been helpful. So it just took me awhile to figure out what—what I needed to put in my double-entry draft.

Hannah also felt frustrated with the double-entry draft assignment, especially with the learning log reflective part. She said in her interview:

> Well, journal five was my frustration with that process of being, you know, of not feeling like I didn't do it right. And so I just said, um…that…um…I wasn't sure exactly what I was supposed to do, actually until I, you know, finished it all up. Um, I started out doing my log all in one entry, then I felt like I was trying to write my paper…um, when I did that, so I went back and I…looked at the example that was online and…it made more sense. Ok you're putting the learning log after each source. Um…but I know that the learning is supposed to be the basis for the final product, but I couldn't hit a happy medium. When I went back and put a log under each source I felt like I wasn't reflecting enough on the information. Part of the problem, it seemed to me, was that I had already reflected on the data in the second column of my note taking.

Although not like Mary, Grace, and Hannah, who had to revise their double-entry drafts from the feedback of their instructor, Bette also felt double-entry drafts were difficult, when she began to work on them. She said in her interview, “Once…the…in the beginning it was difficult, ‘cause I wasn’t sure what to put in it.’” These may indicate that more scaffolding was needed.

Different Types of Response

All participants made most of these types of responses to their information findings. But some participants made more of one type of response than the other. For example, Emma seldom made knowledge validation part of her response. That might indicate she did not consciously make an effort to distinguish reliable information from non-reliable information. She also seldom made knowledge change response. This may be because planning a trip was a topic with which she was very familiar, thus she did not need to undergo knowledge change; she only needed to find information to add to her existing knowledge structure. This was very similar to Charles and Grace, whose topics were also centered on planning a trip.

Bette’s case illustrated a different story. She made a variety of response types, especially when she attended to validation of her new knowledge findings. She consciously thought about whether a particular piece of information was acceptable or not by considering its source, its methodology and other resources agreeing with the evidence. Also, she made many knowledge change responses that indicated she was undergoing knowledge structure change about her topic. Maybe by examining how participants made various types of responses, we could have a better understanding of how they constructed their knowledge in the process of inquiry-based learning process. This aspect needs further research and confirmation.

Q5: How Do Students Present their I-Search Findings?

The participants were given freedom to choose the best presentation format that fit their projects. Qualitative data analysis showed that there were different issues affecting how participants decided to present their I-Search findings, particularly, the format of their final products and content of their final products.

Format of the Final Products

Individual Issues

Each participant had personal factors that helped determine the format of their final products. The study showed that participants' technology skills made a difference in what formats they selected. For example, Mary described why she used a poster to present her findings in the fifth interview:

> Um…I had in my mind that this final product would be very polished. And, um…done very professionally, and I'm disappointed that I didn't have the time to do it in what my vision was. Um…if I actually use this…it might—um, it might be alright like it is, but it would also look very much nicer with a background color. And, you know, I would love to do a PowerPoint, but I,—you know, or do a movie like ____ [a name of her classmate] does. And I just don't have the skills to be able to present it in that way, so, uh, probably a little, uh…disappointment in my lack of technical skills.

Emma also encountered the same issue of lack of technology skills to make the format she wanted. She wrote in her final reflection:

> I wanted my final product to include some images, maps, and perhaps photographs, so at first I considered making a poster. Since I wouldn't be able to email that easily, I considered PowerPoint presentation. I knew that I wasn't technically savvy enough to

> make the images files small enough to send by email, so I finally decided to make a handbook as a MS Word document.

Context Issues

Context issues referred to contextual factors, such as time, influence from other people, and other necessary conditions for a specific format. For example, Hannah wanted to present her final product in a more impressive format then an informal outline, but she ran out of time when she did her final product. She said in her final interview:

> Well originally I had planned to do a magazine article report on it, but what happened was I ran into a time deadline. I ran into a real time crunch. So what I ended up doing was, I made a chart of the pros and cons of hot tubs.

The format of Grace's final product was influenced by other people. She said in her fifth interview:

> And honestly I had—I had already done an itinerary that I got to class on Saturday before it was due. I was finding that a lot of other people were saying, I'm gonna do a letter to somebody, I'm gonna do, um…you know a website, I'm gonna do so and so. And I thought—and then I realized this is one of my…my, um, big six things that I have to present for my portfolio and I didn't want to just stick a table up there, you know. So part of birthday cards had to do with…you know deciding I needed to be a little more creative…in order to…um…I mean I know a lot of people are gonna stick tables up there, but I wanted to do something a little bit more…more creative than that.

The format of Bette's final product was influenced by multiple issues, including other people's influence and available time. She wrote in her final reflection:

> I had a lot of thought about my final product. In the beginning, I wanted to videotape myself hypnotizing someone or using the Stanford Scales test on someone. I was immediately thwarted in my desire to hypnotize someone [by] both my own good sense and the kindly warning of another. I was a little wary of that particular type of product anyway, because in many of the professional websites I visited, there were prominent warnings about the risks involved when a lay person attempts to hypnotize someone. The final nail in the coffin for the idea came when I mentioned the idea to my psychology teacher friend. He flatly told it was a bad idea and explained that I could run into some mental issues that I would not know how to handle. The idea that I could harm someone stopped me cold in my tracks.

She continued to write about how lack of time influenced the format of her final product in her reflection:

> My second idea was to test a few of my students' ability to be hypnotized. That idea was thwarted when I couldn't get my hands on the Stanford Scales. Mr. Wilson gave me his test just two days before spring break. I knew I would have to have parental permission to do something like that and there was not enough time. Also, after some deep thought, I decided that testing the hypnotizability of someone did not really reflect what I had learned from my research. As a result, I came to the conclusion that a PowerPoint presentation would be a much more effective medium.

Content of the Final Products

Two-Step Method

Qualitative data showed five participants used a two-step strategy to write the content of their final product. They first decided what they wanted to write in their final product, then they

went back to look up relevant information in their double-entry drafts and other materials, and triangulated the information into their final products. Take Bette as an example, who wrote in her final reflection:

> The PowerPoint presentation took me all day to create, because I wanted to truly reflect what I had learned about my topic. I went back and forth looking between all of my double-entry drafts for pertinent information for the presentation.

She further gave a concrete example about how she decided she wanted to write about the myth of hypnosis, then tried to triangulate related information:

> After I had read her [the instructor's] comments about my double-entry drafts and realized that I really was a little biased, I'm not quite as balanced as I would like to have been, I decided, well ok, I have to address that…you know. She had said I need to be little bit more skeptical. She didn't say that flat out, but that's how I interpreted her comments. Um, so then I thought, ok, let me go back in here and find out the things from these various sources that I could highlight as…myths, things people think about hypnosis that just simply aren't true. And then I just—once I decided on that, the myth and the truth, I just went from—back and forth, there was no rhyme or reason to it, I just jumped back and forth from each source looking for things that I could say, Ah ha, now see this is a myth, let me put that here. And then—so I did that for a few, a couple of the slides for the myths.

She continued to describe the triangulating process in her interview: "I used a…piece from this source, a piece from that source, and a piece from that source and compiled it all together."

Hannah also employed the same two-step strategy. She described this process in her interview:

> Actually what I did was I had advantages and disadvantages in my two columns, and I started with my first reference and I filled in my chart from the references and just went through each reference to find where it would fall, an advantage or a disadvantage, and then when I had them all down, I thought, okay, I can divide the advantages into physical and mental, and the drawbacks of hot tubs. It would really be logical to do health and safety issues with maintenance issues.

Similarly, in my fifth interview with him, Charles also described how he constructed the content of his final product:

> Okay, the first thing I would do is write down the campgrounds that I do want to see from north to south. Yeah, those are the campgrounds that we knew that we would be staying at. Then after that, we [he and his wife] would find out which trails are close to this [each campground]. Then … we'd go back to the double-entry draft. And um …well, if they said enough that was good, we knew that's where we wanted to go. … and then if the double-entry draft had information that was negative, we would eliminate that and just not put that here at all.

Finally, Emma also first determined the things she wanted to include into her final product, then went back to look through her double-entry drafts. She said in her interview:

> Um…well I did go back, I think, and look through the double-entry draft and think, you know, what's important to me about these areas. You know, what of the, um…but I think I thought more about what things stood out in my mind and tried to go back and find those. I didn't go back and look at each double-entry…area, because I knew that there were some that were less—had less information. And I knew there were some that had

more specific information. So I—there were certain things that I—I think I decided that I wanted to have certain things in there and then I went back to find those…those things.

Mary did not mention directly that she went back to her double-entry draft when she created her poster. She did mention that the content of her poster originated from her resources that supported each other. She said in her interview: “So actually what I was finding is that all five of these sources, the events—the main events of history that were happening that I report on here is mentioned in all five of these sources.” Therefore, from this perspective, the content of her poster was a compilation from her resources.

What about Grace? Basically, her final product was quite simple, a list of sites and books for her niece. She had already decided what they would be when she read her resource materials. So she did not need to go back to look for her double-entry drafts when she did her final product.

Chapter Summary

This chapter provided a detailed picture of how the six participants carried out their I-Search projects around five research questions. Qualitative findings illustrated that participants employed a variety of strategies and/or a combination of some of them to decide on a topic for their I-Search projects. They also utilized multiple methods to generate their essential questions and sub-questions. In addition, they employed different ways and criteria to explore relevant information and made various responses to their collected information. Individual and contextual issues and two-step methods influenced the format and content of participants’ final products. The findings also showed that multiple instructional interventions were needed to support students’ learning along different I-Search stages. The next chapter will discuss how to scaffold these six students’ inquiry-based I-Search learning, based on the findings of this study. Future research directions will also discussed in the next chapter.

CHAPTER 6 DISCUSSION AND IMPLICATIONS

This dissertation study provided a detailed description of six participants' inquiry-based, I-Search processes based on five aspects of their learning experiences: selecting a topic, generating research questions, exploring relevant information, responding to related information, and presenting final products. In this chapter, I discuss my findings, compare them to the literature to evaluate the importance of these experiences to inquiry-based learning, and discuss the implications for practice and research.

Finding Discussion

Topic Selection

Summary

My first research question is: *How do students choose their I-Search topics?* Data analysis revealed that this was a complex decision making process, in which participants employed multiple methods and combinations of these methods to determine an I-Search topic, including: (a) long-term interest, (b) usefulness or practicality, (c) foundation, (d) balance, (e) stress reduction, (f) doable, and (g) other people's suggestions. The findings indicated that participants' prior knowledge might or might not influence their topic choice, but they did influence participants' perceptions of their topics, be it a difficult topic or easy one. It was also noticeable that narrowing down a topic was an important and challenging step for most participants.

Discussion

Current literature does not have many empirical reports about how students select their topics when given full freedom to do so. Most relevant studies only investigate how students learned particular curriculum content through inquiry methods (e.g., Benson, 1998; Williams & Linn, 2002). Thus the findings in this study can contribute to filling the gap in relevant literature.

Without many empirical reports of how students select their inquiry topics, researchers recommend some features of a topic that can foster meaningful learning. For example, Tallman (1995b) points out that topics with strong personal interests can help students produce higher quality research products and engage in high-order thinking skills. Polman (2002) also suggests that authentic topics with practical use can offer meaningful learning opportunities and contribute to individual development. The multiple strategies used by the six participants indicate that when students are given full freedom to select their topic, they will select a topic with personal interest or having practical use. This shows the benefits of inquiry models, such as the I-Search model, in which students are allowed to select their own topics.

The study also reveals that participants' prior knowledge may or may not influence their topic choice, but prior knowledge did influence their perceptions of their topics, be it a difficult topic or easy one. These findings confirm that students' prior knowledge could influence their inquiry-based learning (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998). It is also noticeable in this study that narrowing down participants' broad topics to a well defined focus was a challenging step for most participants. Grace did not realize this was a necessary step. Hannah narrowed her topic to a focus, but needed scaffolding to transfer to a focus that required higher-level reasoning. Mary did not narrow down her topic enough to produce a good focus. This study covers the issue of narrowing topics that I could not find in a literature review. In this

regard, the findings contribute to the literature and understandings about the importance of the topic choice process.

I-Search Question Generation

Summary

My second research question is: *How do students generate their I-Search questions?* Qualitative data analysis revealed that the six participants generally used a two-step method to generate their essential or primary research questions. The first step was to determine a focus within the selected topic. The second step was either to generate the essential questions around the focus or to generate essential questions to cover several other questions.

Participants' generation of their sub-questions proved to be a very complex process. Three participants did not clearly generate their sub-questions at the beginning, but let the research progress make their sub-questions gradually emerge, while one participant was very specific about what her sub-questions should be. Participants also utilized a wide range of methods to generate their sub-questions, including: (a) personal interests, (b) questions scaffolding, (c) other already generated questions, (d) *What I don't Know* column questions from their pre-notetaking sheet, (e) consolidation of several questions into one question, and (f) impressions gained from scanning materials.

Two participants felt this step was very challenging. Problems that participants experienced in this step included: (a) creation of factual questions instead of higher-order questions; (b) research questions that did not bring participants much new knowledge; (c) incompatibility between essential questions and sub-questions, and (d) questions that were based on false assumptions and needed revising.

Discussion

The findings of this study about students' question generation confirm the relevant literature in the following respect. First, King (1995) finds that when students are asked to pose a question, they often pose factual questions. Both Hannah and Emma posed factual questions in their pre-notetaking sheets. Second, students often ask incorrect or inadequate questions, because of their incomplete relevant knowledge (Zuckerman, Chudinova, & Khavkin, 1998). Mary's case illustrates this situation. Her questions were designed to find a church organization model from early Christian church history and the Bible that today's church could follow. But after exploring related information, she realized that such a model did not exist in early church history.

The findings in this study also expand our knowledge base in the current literature by providing a detailed picture about how students generate their questions. Especially, this study delineates that students utilize different sets of methods to create their essential questions and sub-questions. This finding is in accordance with the different natures of these two types of questions proposed by researchers. For example, Hakkarainen and Sintonen (2002) point out that in inquiry-based learning, there should be two types of questions. The primary question, or essential question, set the inquiry goal and is usually a higher-order question. It cannot be answered by finding the answer directly in resources. The secondary questions or subordinate questions, which are more specific and answerable, are posed to help answer primary questions. Therefore "the inquirer tries to answer the big question through using his or her existing knowledge and new information obtained in the form of answers to a series of subordinate questions"(2002, p. 28). We can see that these two types of questions serve different purposes in inquiry-based learning. Students' generation of research questions involves creating two sets of questions. This finding implies that different instructional supports may be needed to help

students pose these two types of questions. Current literature emphasizes the generation of essential questions in the higher order format, but ignores the support necessary to help students to create their sub-questions (King, 1995), which don't have be to be posed in a higher-order format, but need to be compatible to the essential question(s). The finding that participants may generate incompatible sub-questions gives new evidence about the problem. It promotes the suggestion that instructors provide more real class instruction for students in creating relevant sub-questions that support and make answerable higher-order essential questions.

This study illustrates an interesting issue. One participant, Charles, asked a higher-order question that began with why: *Why am I attracted to the Virginia section of the Blue Ridge Parkway as a vacation spot?* But he thought that he already had the answer to this question. That meant his research question would not bring him any change in that answer. Whatever new knowledge about the VA section of the Parkway that he would find he would not use to answer his essential question. His situation seems to be in conflict with what the literature proposes. For example, King, Staffieri, & Adelgais (1998) point out the relationship between different types of questions and knowledge construction. They stress that factual questions could simply help questioners to restate knowledge, while higher-level questions (why-, which-, how- questions) could elicit a higher level of cognitive activities that involve analysis, comparisons, and transformations of information or ideas, thus, promoting a high level of knowledge construction. In Charles' case, the instructor's suggestion that he form his question in a higher-order format using how, why, or which, did not provide him with a new researchable question answering his needs. This suggests that prompting some student researchers to create a higher-order question might not work to their benefit. They may need to change to a different topic or we could consider how much new knowledge would be gained through the essential question and what

format would be most effective for the student researcher's needs, instead of just assessing its format.

In short, the overall findings about students' question generation in this study imply that creating questions is a not just a single act, but consists of a number of intellectual operations and involves various factors that might influence the question generation. Only scaffolding students to create higher-order questions is not enough at this step. The other issues needing consideration include students' prior knowledge, new knowledge that could be gained through posing a particular type of question, different natures of the two types of questions, and compatibility between essential questions and their sub-questions.

Information Exploration

Summary

My third research question is: *How do students explore and collect information related to their I-Search topics?* The findings illustrated that participants also employed diverse strategies to explore relevant resources for their I-Search projects. The three most common venues for resources were the Internet, library and other person's lived experiences gained through interviews. Their information was also in different formats, including journal articles, web pages, maps, books, tapes, digital video disks, and video. They also used different methods to organize their information, including bookmarking Internet pages, printing out and/or sorting resources, and using word documents to save short notes and links for information.

Data also illustrated that participants used different criteria to choose a resource for their topics. Reliability was the number one criterion, although reliability had different meanings for different participants. Another criterion was the participant's personal preferences, such as personal camping philosophy and personal belief.

Qualitative data showed that exploring information was not just one step in the process, but iterative throughout most stages of the I-Search. In this process, some participants used generic to specific strategies to search for relevant information. Without an effectively narrowed topic, participants might also be tempted to collect too much information thinking that all of it would help them answer their research questions. The qualitative analysis also revealed that some participants needed scaffolding to use their research questions to guide their information searching.

Discussion

The findings of this study about students' information exploration confirm relevant I-Search literature that students are able to use multiple resources (Jensen, 1989; Persky, 1992; Tallman, 1995b), as well as students showing some ability to triangulate evidence (Rubin, 2002). The study shows that participants hold different understandings about what criteria determine a reliable resource. In addition to using reliability as a criterion, participants also used other criterion, such as personal preferences and personal beliefs (see Charles and Mary's case description) to make a judgment about a resource. This has not been previously investigated in the relevant literature. This finding is important, because it indicates the instructor might need to help students to reflect on the impact of the new information resources from their own personal belief and preference in their process of searching information.

Most participants explored relevant information throughout the entire I-Search process. This is in accordance with what researchers have found that information seeking "is an iterative, recursive process in which a person may return repeatedly to the exploration phase, refine his or her question many times, and conduct many seemingly unrelated searches as he or she modifies the question or discovers new interests" (Wallace, Kupperman, Krajcik, & Soloway, 2000, p.

78). The findings further reveal that participants' exploring information might have different goals at different stages of the I-Search process. For example, at the beginning of the I-Search, Hannah looked for information for her tentative topic to see what information she could use if she selected a particular topic and what key words she could use. After Hannah determined her topic and generated her essential question, her search was more focused around answering her question. Associated with this throughout their information exploration is that participants used different strategies at different stages of their I-Search. For example, Bette's search was more generic, when she had relevant little knowledge about her topic. She used more specific search strategies, when she gained substantive knowledge and was sure what she wanted for her projects. The literature confirms that when students have little background knowledge, they would use a generic learning strategy. When students have substantive knowledge, they would use a more specific learning strategy (Prawat, 1989). These findings provide additional insights into students' information exploration experiences.

The findings of this study on students' information exploration also revealed an interesting phenomenon that without a sufficiently narrowed topic and effective essential question, participants could be tempted to collect too much information thinking they needed it to answer their research question. Both Mary and Grace's cases illustrate this situation. This finding confirms that identifying a well defined specific focus is important in inquiry-based learning (Magnusson & Palinscar, 1995).

Finally, the findings also reveal that participants, like Grace, may not be able to consciously use their research question to guide their information exploration process, even after they have generated a research question. This finding is consistent with researchers' (Abbas, Norris, & Soloway, 2002, as cited in Quintana, Zhang, & Krajcik, 2005) findings that middle

school students generated search terms that did not match their research question when they looked for information. One critical feature of information exploration in inquiry-based learning distinguished from general information seeking is that the former is centered on research questions to find information, while the latter depends on topic key words to gather information. Without the guidance from a research question, the exploration of information for inquiry-based learning becomes aimless, and subject to gathering interesting but diversionary pieces of information that does not match research questions. Wallace, Kupperman, Krajcik, and Soloway (2000) point out that searching information in inquiry-based learning should not be separated from question posing and question refinement. This finding indicates scaffolding is needed to help students explore information around their questions.

In short, findings about students' exploring relevant information delineate that it is a complex learning phenomenon involving students' prior knowledge, personal preferences, different stages of inquiry-based learning, and the research question and its modification. Those are the issues we need to consider when scaffolding students' during this step of inquiry-based learning.

Information Responses

Summary

My fourth question is: *How do students respond to their collected information?* Participants in this study made meaning out of their collected information through making a reflected response to their collected information. These were recorded in their double-entry drafts and in their journals. Most of the responses could be classified as knowledge construction responses. The first type of response was when participants realized that a particular piece of information could inform their research questions. The other responses included: (a) confirming

knowledge, (b) activating prior knowledge, (c) changing knowledge, (d) enriching knowledge, (e) identifying a knowledge gap, and (f) validating knowledge. Although participants did not have difficulty making responses to their collected relevant information, four of them felt confused about what they were supposed to write in their double-entry drafts and learning log journal reflections. One participant seldom made knowledge changes or validated her information findings.

Discussion

The overall findings about this aspect of students' learning verify that inquiry-based learning is essentially a knowledge construction process (Beyer, 1979; National Research Council, 1996; Zuckerman, Chudinova, & Khavkin, 1998). For example, Edelson (2001) proposes an inquiry model called Learning-for-Use framework. His framework illustrates that inquiry-based learning is also a knowledge construction process. More specifically, his model includes two aspects of inquiry-based learning. The first aspect includes three steps mainly related to experiencing the need for new knowledge, knowledge construction and refinement. The second aspect addresses a series of cognitive processes along with the above three steps of knowledge production (Edelson, 2001).

Traditionally, literature emphasizes knowledge change responses. This can even track back to Dewey, who proposes that one's knowledge or idea is formulated in the form of hypothesis and then tested against new data or information. The result is to confirm or modify the hypothesis (Dewey, 1933). Later, Beyer's inquiry model for social studies continued to emphasize this type of response by asking students to test and modify their hypothesis against their collected information (Beyer, 1971, 1979). Today's literature still emphasizes this type of response. For example, a typical science inquiry model would ask students to modify their

initially constructed models or explanations (Hakkarainen, 2004; White & Frederiksen, 1998; Zuckerman, Chudinova, & Khavkin, 1998). In short, relevant literature underscores that students can change their knowledge, when faced with new information or data. The findings of this study expand the horizon of current literature by empirically delineating various other types of responses, when students encounter new information. The various types of responses demonstrating knowledge change response cannot stand alone and be responsible for knowledge construction, but they are collectively associated with other types of responses.

The findings also raise another interesting phenomenon worthy of discussion. Emma seldom made a valid knowledge response, which may mean that she did not consciously evaluate the information she collected. This is in accordance with what Davis (1995) has found that college students have difficulty evaluating the quality and credibility of diverse resources in their information exploration. Emma also seldom made a knowledge change response. These findings indicate scaffolding is needed to foster these two types of responses.

The overall findings in this step indicate that students make a wide range of different types of responses, when they confront their collected information. Knowledge change response is only one of them. This may imply that scaffolding should be more diverse to support various types of responses besides knowledge changes.

Final Products Presentation

Summary

My fifth research question is: *How do students present their I-Search findings?* There were two types of factors that influence participants' choice of format for their final product. Individual issues included the level of participants' technology skills. Contextual issues included available time and influence from other people. Participants wrote the content of their final

products by employing a two-step method. First, they determined what they wanted to say with their final products and, secondly, they synthesized the information in their double-entry drafts and some other materials they explored during their I-Search process.

Discussion

Current literature does not have many studies that show how students determine the format and content of their findings. Tallman (1995b) finds that high school students, who are not good at reflective thinking and unable to write their journals in their own words, would have trouble writing an I-Search paper. But the current study does not show that the six participants had any difficulty finishing their I-Search paper or creating their final products. However, the findings illustrate that there are different factors, especially participants' technology skills and available time that limited the choice of format of participants' final presentation. This implies that support with some technology skills instruction should be available to students to facilitate selecting a format that best fits their projects. In addition, enough time should be allocated to students to help them present their findings.

In summary, the findings from this study illustrate that students' inquiry-based I-Search learning is a multifaceted process that can be complex for learners, due to a range of interrelated activities and different strategies for performing those activities. Students need scaffolding almost every step of the I-Search process. In the next section, I will suggest instructional interventions that could help students' learning based on the findings from this study.

Practical Implications

Knowledge Construction Scaffolding

The findings in this study illustrate that inquiry-based learning is essentially a knowledge construction process. This is accordance with relevant literature (Beyer, 1979; National Research

Council, 1996; Zuckerman, Chudinova, & Khavkin, 1998). Based on both above theoretical support and my study's findings, I suggest consideration of the following support mechanisms.

Consider Students' Prior Knowledge

This study finds that students' prior knowledge influences students' topic selection and perceptions of their topic. This finding confirms that students' prior knowledge influences their inquiry-based learning, as stated in the literature (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998; Scardamalia & Bereiter, 1992). The finding suggests that when students make a decision about their topic, the instructor needs to encourage students to think about how much knowledge they have about their topics, and compared to their prior knowledge, how much knowledge they need to know in order to complete their inquiry tasks. The instructor should not encourage students to take a task, where they will not bring much new knowledge once they finish their projects.

Students' prior knowledge also influences their question generation. For example, Mary generated her question based on incorrect suppositions. Her case illustrates that students should have enough adequate knowledge for them to generate appropriate questions, or spend extra time gaining enough background knowledge to discover and correct their erroneous suppositions. Researchers (Dillenbourg, Eurelings., & Hakkarainen, 2001; Tallman & Joyce, 2006) suggest that learners read relevant materials before letting them generate their research questions. This is a good strategy to help students to generate good research questions. However, as Mary's case illustrates, she even had difficult identifying appropriate background materials, due to her limited prior knowledge about her topic (detailed description, see ch4, section Mary). This situation implies that instructional support is needed for some students to build adequate background knowledge for their topics.

Encourage Multiple Responses

Participants made meaning out of their collected information. This process is partly revealed through analysis on how they responded to the information in their double-entry drafts in this study. Qualitative data in this study shows that participants made a wide range of responses to their obtained information. Most of them were knowledge construction type responses. These illustrate how participants constructed their own knowledge through inquiry-based learning.

My study also shows that some participants seldom made knowledge change responses. This type of response could foster knowledge reconstruction, which is emphasized by most current inquiry-based learning models. For example, Zuckerman, Chudinova, and Khavkin (1998) proposed that students should constantly check and revise their model about a natural phenomenon, when they find new data that cannot support their theories. Encouraging students to make this type of response can help students make thoughtful efforts to change their own knowledge and be more reflective during this process.

Another type of response that some participants seldom make is to consider under what condition to accept information as valid and reliable knowledge. This corroborates with findings reported in literature that students do not critically evaluate their information in their inquiry-based learning (Change, Sung, & Lee, 2003; Hoffman, Wu, Krajcik, & Soloway, 2003; Wallace, Kupperman, Krajcik, & Soloway, 2000). This study shows the need to prompt students to make knowledge validation type responses as they construct new knowledge about their topic. Reflecting on the credential of the resources can help students do more critical analysis on the validity and reliability of their information.

An issue related to encouraging students to make reflective responses to their information findings is associated with writing double-entry drafts. My study shows that students are confused about how and why to write double-entry drafts, even if some of them read the textbook explanation several times. They feel hindered in expressing freely their responses to their information findings. The instructor should make an effort at this particular I-Search step to provide more examples of both exemplar and non-exemplar double-entry drafts to give students concrete ideas on what double-entry drafts are supposed to look and what purpose they serve. Even modeling the process of writing a double-entry draft would be very helpful for the students to understand the process.

Narrowing Down within a Topic Scaffolding

This study reveals that, although selecting a topic is not a problem for participants, further narrowing down within a topic to a clearly defined specific focus associated with higher-order thinking is a challenge for most participants. As my findings showed, this step not only influences essential question generation, but also influences later information exploration. Some participants know the need to further narrow down their topic, but do not know how to do that. For example, Bette wanted to narrow her broad topic of mind/body connections, but she did not know how to do that until she read an article about hypnosis and determined to focus on it. In cases such as this one, the instructor could facilitate students' ability to think about different approaches that could be taken for their topics and to select one clearly defined focus from many possible approaches. This suggestion is also recommended by other researchers. For example, Magnusson and Palinscar (1995) use a metaphor of map-making to illustrate how to identify a topic focus. They suggest at first the general terrain should be identified and represented before any specific focus is determined. This is also consistent with what is proposed by Tallman &

Joyce (2006), which is scaffolding students to find the breadth of the topic and then identify a focus.

Grace did not realize her need to further narrow down her topic. The instructor should work with students to remind them to examine whether they need to narrow down their topic to a suitable focus. Some participants, although they could select a specific focus for their topic, did not have a focus that would lead to higher-order thinking activities. For example, Hannah originally decided to research about how to buy a hot tub, a specific focus. However, her focus required fact-seeking, instead of higher-order reasoning. Using the instructor's feedback, she changed to a focus requiring more higher-order thinking. When an instructor meets such a situation, he or she could scaffold students to shift to a focus involving more higher-order thinking activities. In summary, narrowing down within a topic is a critical step in the inquiry-based learning (Magnusson & Palinscar, 1995), and should be explicitly emphasized and taught to students during students' learning.

Question Generation Scaffolding

Middle and high school students have difficulty generating adequate research questions, when they conduct their I-Search projects (Tallman, 1995b; Zorfass & Dorsen, 2002). This study confirms the literature and further finds that generating research questions is difficult, even for adult students. The following are some suggestions for scaffolding students to generate their questions.

Scaffold Differently to Generate Essential Questions and Sub-Questions

The findings of this study show that participants use different approaches to generate their essential questions and sub-questions. The literature tells us that essential questions and sub-questions serve two different goals in the inquiry-based learning process (Hakkarainen &

Sintonen, 2002; Tallman & Joyce, 2006). The primary question, or essential question, sets the goal for inquiry, and should be in the format of a higher-order question (Hakkarainen & Sintonen, 2002). The sub-questions should be designed to help answer the essential questions (Tallman & Joyce, 2006). Both qualitative findings and the literature indicate these types of questions should be scaffolded differently. For example, emphasize higher-order questions when students generate their essential question, but emphasize how sub-questions could be used for helping answer the essential question.

Consider How Much Knowledge Could Be Gained through Research Questions

Researchers have found a relationship between questions and knowledge construction. King (1995) found that different levels of questions were associated with different levels of knowledge construction. Namely, higher-order questions could lead to higher levels of knowledge construction. Hakkarainen and Sintonen (2002) further found that the more a student was able to generate specific sub-questions, the more he/she could construct knowledge. With literature suggesting that teachers should scaffold students to help them generate good research questions that support constructing new knowledge, Charles' case, as I discussed previously, further illustrates that we need to use knowledge construction, or ask how much knowledge could be gained, as a criteria when we evaluate students' research questions. Assessing the format of a question is not enough.

Allow Change to Research Questions

This study also illustrates that some questions might change after participants have adequate knowledge about their topics. Even if they gain enough background knowledge to define their question in more specific terms through background reading, it still happens that questions sometimes need changing. Participants' original questions might be insufficient or too

briefly answerable. When exposed to more information, they want to revise their research questions. For example, Grace reformulated some of her sub-questions at the end of the I-Search process based on what she discovered. This is also confirmed by other study findings that students may change their research questions as they explore more relevant information (Persky, 1992). The instructor might encourage students to rethink their research questions, especially their primary question, as they master more relevant knowledge.

Emphasize the Need for Compatibility between Primary and Sub-questions

The findings from this study also show that participants could generate essential questions and sub-questions which are not compatible to each other. For example, Bette's essential question and sub-questions pointed in different directions. It is essential to keep compatibility between the two types of questions (Tallman & Joyce, 2006). Therefore, the instructor needs to help students generate related primary and secondary questions. When students change any of them, the instructor should require students to revise their other type of questions appropriately, if applicable.

Information Exploration throughout the Entire Process

The findings of my study also tell us that most participants explore relevant information throughout the entire process, or at least most I-Search phases. This is confirmed by the literature (Wallace, Kupperman, Krajcik, & Soloway, 2000). As Hannah and Bette's cases illustrate, usually, at the very beginning, the inquirers might look through to see what is available for their topics to determine whether their topics are doable or not, or to determine where they will go if they start to work on their projects. After they decide on their topics, they may need to further narrow down to a specific focus. To do so, they have to look at more specific information related to their focus. From the above description we can see that a generic to specific strategy is a must

as the research progresses. Although inquirers do not literally have to follow all these steps, they should be aware of the different goals for each step of inquiry. They should be able to purposely use different strategies to meet various goals, especially when they encounter a topic for which they do not have much prior knowledge. Based on the findings from this study, I suggest that the instructor should emphasize the entire process of exploring relevant information. The instructor should also scaffold students in setting different goals at different stages of inquiry. In addition, the instructor can suggest different search strategies for different students, according to their prior knowledge about their topics and the stage of their inquiry. This instructional intervention is in accordance with what other researchers (Quintana, Zhang, & Krajcik, 2005) suggested, which is to help set search steps for students, as well as help them reflect on their previous searches, "in order to determine what their subsequent searches should entail" (p237) in their inquiry-based learning. Finally, the instructor should foster reflection on one's personal beliefs and preferences and their influence on information exploration.

Information Exploration for Answering Research Questions

One different feature of exploring information for inquiry-based study is that after questions are generated, the exploration should be constantly focused on answering those questions, instead of finding everything related to the students' topic. Qualitative analysis from this study shows that some participants, like Grace, were not able to refer consciously to their research questions, when they searched for relevant information. Therefore, as Tallman and Joyce suggested (2006), the instructor needs to guide students to connect their information with their research questions to make their search more purposeful and meaningful, instead of collecting any interesting information.

A Revised I-Search Model and How to Scaffold Students' I-Search Learning

Based on the findings, I suggest a revision to Tallman and Joyce's (2006) I-Search process in the following ways. Figure 6.1 is the graphic representation of the revised I-Search process and scaffoldings. The yellow parts represent the revised I-Search process. The blue part represents the possible scaffoldings associated with each step. As the figure shows, the first step of Tallman and Joyce's (2006) original I-Search model is selecting a topic. This will be kept unrevised. However, it is necessary to promote students to think about what a good research topic is for their needs and for the goals of the research experience. In this study only one student picked a topic requiring a challenging research component; others chose them for convenience and ease of finishing the project, or because they already knew a considerable amount about their topic. The findings demonstrated the difference in quality of their learning experiences.

The second step is to generate a research question. Based on the findings, I add narrowing down a topic to a well defined focus between topic selection and question generation. Although narrowing down the topic is mentioned in Tallman and Joyce's (2006) book, it is too easily combined within the step of generating a research question and needs separate emphasis on its own. According to the findings, this step is better isolated as an independent step before students generate their research question. One strategy to help students narrow down to their topic is to ask them to draw a topic web that requires students to think about different angles that they can use to approach their topic. Although the Tallman and Joyce process has them draw a topic web, the emphasis is on what they know about the topic, not what I'm suggesting. Have them think about whether they have narrowed their topics enough to make their inquiry task manageable.

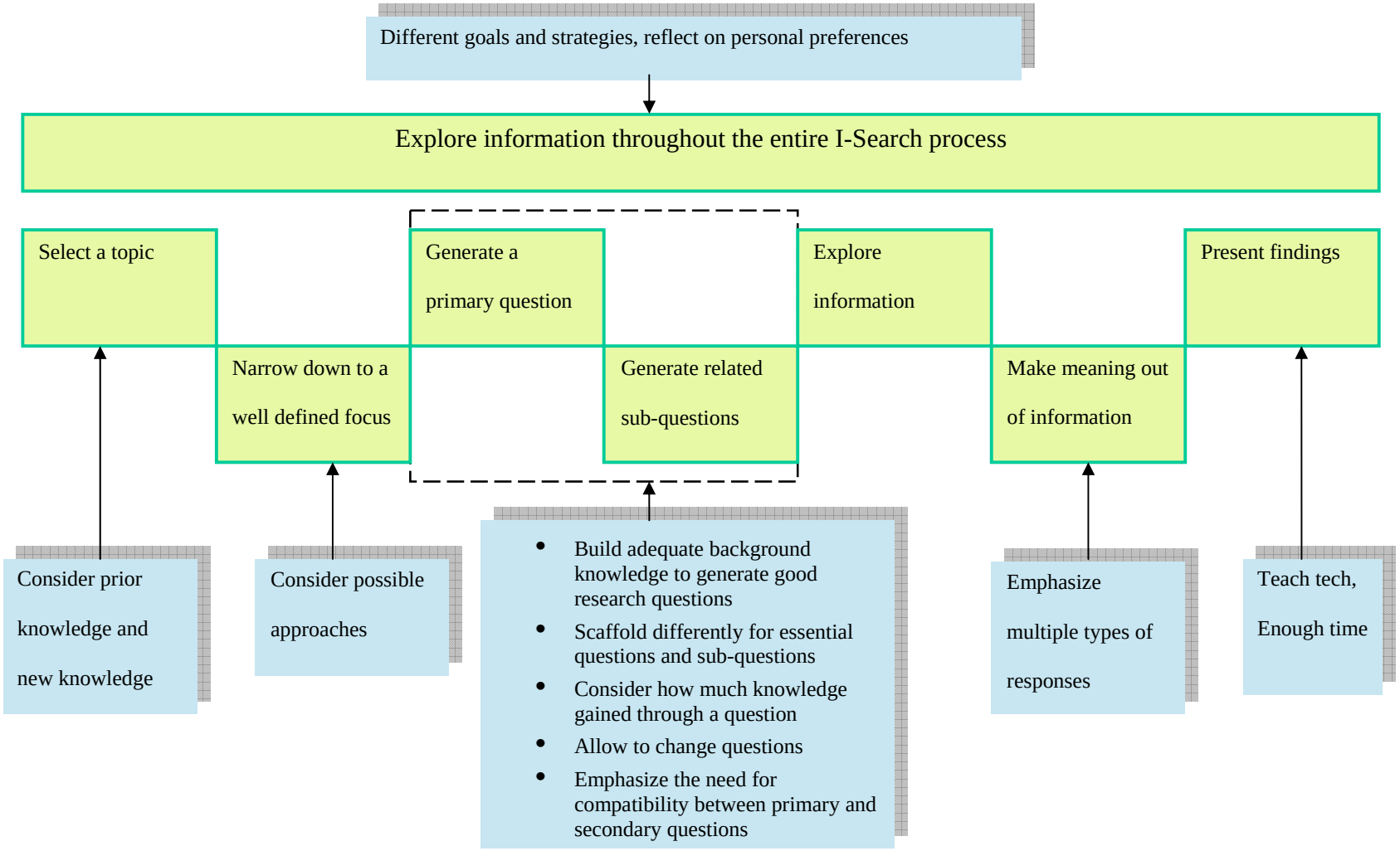

Figure 6.1. Revised I-Search model and instructional interventions.

Then the third step for the revised model is to generate the research question. Tallman and Joyce's (2006) model underscores this step by including a second pre-notetaking sheet exercise where students translate what they do not know into higher-order questions they can use for their essential question. They have not emphasized the separate creation of sub-questions within the essential question. I am proposing more scaffolding for creating higher-order essential questions. According to the qualitative findings, at this step, it is important to scaffold generating the essential question and related sub-questions as two separate steps and emphasize the different nature of the two types of research questions. Providing different criteria for students to think about good sub-questions that will help them answer their essential question will be a good teaching strategy at this step. In addition, making questions public and asking for peer critical review could also be a good way to improve the quality of each student's research question and sub-questions.

In Tallman and Joyce's (2006) I-Search model, after students generate their research question, students are asked to explore relevant information and respond to their collected information through doing double-entry drafts. According to the findings, it would be better to separate them apart as two steps. In the step of exploring information, instructors should emphasize the process of information exploration throughout the research experience. For example, at the beginning, exploring information should emphasize finding an adequate topic, identifying useful keywords, and becoming familiar with different searching engines. After students generate their research question, exploring information would address the information needed for answering their research questions. This could be done through asking students to write a comprehensive research plan for conducting their inquiry.

The next step in the revised I-Search model is to make meaning out of students' collected information by making various responses to it. During this step, the instructor could show students seven types of responses to their information gathering, including (a) relationship of information to research questions, (2) confirmation of new knowledge, (3) activation of prior knowledge, (4) change in knowledge, (5) enrichment of knowledge, (6) identification of knowledge gap, and (7) validation of knowledge. The instructor should especially emphasize how students can reflect on their information to help them change their knowledge, and evaluate their information through thinking about authority of resources, duplicate evidence, methodology and conflicting findings.

The final step of the revised I-Search model is the presentation of findings. At this step, the instructor could teach students any necessary technology skills that would help them find the best format for presenting their findings. It is also important to give students enough time to reflect on their overall I-Search experience and present their findings. Table 6.1 illustrates specifically how to implement some of the scaffolding and some issues students might have at different steps of their I-Search process.

Research Implications

This study provides a detailed description about students' inquiry-based I-Search learning experiences as they carry out their projects. As discussed in previous sections of this chapter, some of the findings confirm findings in relevant literature, and some add new insights into the literature base. At the same time, the findings of this study also reveal further research directions worthy of addressing in future studies. As a basis for further research, I suggest researching the following instructional intervention model as to its efficacy in giving students adequate and successful scaffolding in future I-Search teaching-learning episodes.

Table 6.1 Implement Scaffoldings

Phases	Original I-Search Strategies	Issues	Implement Scaffoldings
Decide on a topic	Create personal web, topic web and corresponding reflective journals	Students might select a topic that would not gain much new knowledge for them	Ask student to think about what is a good topic in their reflection A good topic should have the following features: • Does not have strong prior knowledge about it • Has strong personal interests • Requires research • Is doable • Addresses meaningful problem with personal or social significance (Zorfass & Dorsen, 2002) • Links to one or more desirable student outcomes
Narrow down the topic	Topic web with prior knowledge focus; pre-notetaking sheets and background reading	Students do not know how to do it or do not realize the necessity to do it. Weak, or non-existent emphasis on narrowing topic	Remind the importance of narrowing down a topic. Use topic web or other strategies to think about possible methods to approach his or her topic. Ask students: • What are the possible ways to approach your topic? • Is the focus specific enough to make inquiry task manageable? • Can the focus be associated with higher-order reasoning?
Generate question	First and second pre-notetaking sheets	Students could confuse the purpose of the two pre-notetaking sheets Students have difficulty in generating research questions	Give examples of the first and second pre-notetaking sheets. Explain the different purpose for essential question and sub-questions. Ask students to reflect on their question and critically comment on peers' questions according to the following guide: A good essential research question should: • Help develop new knowledge around one's topic • "Reveals the student's passionate interest" (Zorfass & Dorsen, 2002, p. 15) • "It is researchable by gathering information from varied resources and materials" (Zorfass & Dorsen, 2002, p. 15) • Should not just be a personal reflective question • Should not be an embedded personal assumption • The answer of a primary question should be through manipulating information and be supported by reasoned evidence. • Can be changed when exposed to more information A good sub-question should:

			• Serve the goal for answering primary question • Be more specific and answerable than essential question • Be compatible and directly related to essential question
	Background reading	Students might not be able to find adequate background reading	Help students find resources by asking them to provide a research plan (see below)
Explore infor-mation	None	Students might not use research question to guide their search for information. Students may collect too much information	Ask students to provide a search plan including: • Search goals and strategies at different stages of I-Search • Where to look for information • Keyword and search engines to be used • Interview questions if wanting to interview people • How question should guide one's information search. • Strategies to make sure one's collected information is relevant, current and reliable. • How they will reflect on personal preferences and their impact in looking for information
Make meaning out of informa-tion	Double-entry drafts	Students are confused about the double-entry drafts and what they should look like Students are confused about how much is enough to put into their double-entry drafts	Give double-entry draft examples Model the process of creating a double-entry draft Tell students there are seven types of responses students could make Tell students this is a knowledge construction process Tell students to consciously make knowledge changes and validate their responses
Presentin g findings	I-Search paper and additional format for presenting findings	Students might give up the best format because of lack of technology skills to create it.	Teach different technology skills Give enough time

This study finds that students either do not realize the need to narrow down a broad topic, or have difficulty doing so. This step is important as this study shows; it will not only influence questions generation, but also influence the exploration of relevant information. Therefore, it will improve the current inquiry instruction if *narrowing down a topic* is explicitly added into an inquiry model. However, it is not clear what students' experiences will be like if they follow the revised inquiry model, which needs further investigation.

An issue related to scaffolding students' questions generation is that one pragmatic practice to scaffold students' question generation is to ask students to create questions beginning with how, why and which, or according to Bloom's Taxonomy. Admittedly, some higher-order questions do begin with these particular words. But, in some cases, students just reworded their lower-level questions to transform them into so-called higher order questions. This study suggests a need to consider how much new knowledge would be constructed through such a re-generated research question. My suggestion is to consider which word to begin with in a question might not be enough to make a sound judgment about whether it is a good research question or not. This idea needs further research.

One significant difference between information exploration in the inquiry-based learning process and general information seeking is that the former is often guided by research questions, while the latter is mainly related to how to use key words or other search strategies to find information. Therefore, a search guided by research questions is one feature of an inquiry-based learning information exploration worthy of further research. However, my study reveals that either sub-questions or the essential question guided participants' search for information. A more detailed picture of the cognitive processes involved in the interactions between inquiry-based questions and information exploration still remains unclear and needs further effort to address.

This study does not investigate two important aspects of inquiry-based learning. One is reflection. The I-Search model requires students to write reflective journals along their research process. Reflection is regarded as a critical element in the current inquiry-based learning community (Loh et al., 2001). How the reflective journals help students' inquiry-based I-Search learning remains to be discovered. The second is discourse. This online course provided rich opportunities for discourse to occur among instructor and students. How the discourse influences the inquiry-based learning is an important topic worth of further exploration.

Conclusion

Inquiry-based learning is important because it fosters higher order thinking and meaningful knowledge construction. However, current literature lacks substantive knowledge about students' inquiry-based I-Search learning experiences. The weakness in the literature will hinder further relevant research and practice. This qualitative study aimed to fill the gap in the literature by investigating students' learning experiences under a particular inquiry model, the I-Search. It is my hope that the findings of this study can shed light on the relevant literature and provide a guideline for further study into inquiry-based instruction.

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APPENDICES

APPENDIX A: CONSENT FORM

Inquiry-based Learning: A Study of I-Search Project

Consent Form
(For Student Participants)

I _____agree to take part in a research study titled *Inquiry-based Learning: A Study of I-Search Project* conducted by Doctoral student Jing Lin Ph. (706) 389-6399, supervised by Dr. Tallman Ph. (706) 542-4031 in the Department of Educational Psychology and Instructional Technology at the University of Georgia. I do not have to be in this study if I do not want to be; I can stop taking part at any time without giving reason and without penalty. I can ask to have information related to me returned to me, removed from the research records, or destroyed.

The following points have been explained to me:

- The purpose of this study is to investigate adult students' inquiry-based learning processes as well as identify the conditions that can best support their inquiry-based learning.

- If I volunteer to take part in this study, I will be asked to do the following things:
  1) Participate in five interviews (approximately 1 hour for each interview) with the researcher. The interview will be scheduled at a time and place agreeable to both the researcher and myself. During the interview, I will be asked to answer several open-ended questions. The interview will be tape-recorded. After the interview, the tape will be made into a written record that uses made-up names. If I request it, I will receive a written copy of the interview.
  2) Provide my I-Search documents including, webbing documents of choosing my topic, project final report, my I-Search journals for my project and final reflection.
  3) I understand that my data will be used in conference presentations and publications. My confidentiality will be protected

Please note that Internet communications are insecure and there is a limit to the confidentiality that can be guaranteed due to the technology itself. However, once I receive the completed surveys, I will store them in a locked cabinet in my office and will destroy them and any names and contact information that I have by_____ If you are not comfortable with the level of confidentiality provided by the Internet, please feel free to print out a copy of the survey, fill it out by hand, and mail it to me at the address given below, with no return address on the envelope.

- There may be some benefit to me for agreeing to take part. I will be given an opportunity to reflect orally on my online learning experience and what can best help me in my learning process. This kind of reflection may influence changes

and potential improvements in my online inquiry-based learning skills.

- There may be some benefit to others resulting from my participation. The results of the study may contribute to the understanding of inquiry-based learning and teaching. It may influence educational researchers to research topics related to inquiry-based learning. Highlights of this study may inform educational practitioners the critical issues in inquiry-based learning environments. In short, findings of this study may serve to refine inquiry-based learning and teaching practice and improve the relevant research.

- No discomfort or stress is anticipated during the interview.

- No risks are expected. Participation in the project will have no affect on my course outcome or grade. The course instructor will only have access to the analysis and results after grades have been reported for the term.

- Any information obtained about me as a participant in this study, including my identity, will be held confidential. My identity will be protected with a made-up name, and all data, including audiotapes, will be kept in a secured, limited access location by the researcher for 24 months. Then tapes will be erased in January 2008. My identity will not be revealed in any publication of the results of this study. Pseudonyms will be used in any writeup of the study.

- The researcher Jing Lin will answer any further questions about the research, now or during the course of the project, and may be reached at: (706) 389-6399.

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

__**Jing Lin**_____ _____
_____

Name of Researcher Signature

Date

Telephone: (706)389-6399

Email: linjing@uga.edu

Address: UGA, 614 Aderhold Hall, Athens, GA, 30602

_____ _____
_____

Name of Participant **Signature**

Date

Please sign both copies, keep one and return one to the researcher.

Additional questions or problems regarding your rights as a research participant should be addressed to the IRB chairperson in the Human Subjects Office at the University of Georgia, 612 Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411. Telephone: (706) 542-3199; E-Mail Address: IRB@uga.edu

APPENDIX B: INTERVIEW PROTOCOL

First-time interview with student participants through email

- Tell me your past work experience and academic background related to school media.
- What does successful learning mean for you?
- What does unsuccessful learning mean for you?
- What do you think inquiry-based learning is?
- How would you describe your response to the I-Search project?

Second-time interview with student participants on topic choice

Topic choice

- Describe the process of how you chose your topic.
- What are the alternative choices do you have in mind for your I-Search topic?
- What issues influence your choice of an I-Search topic?
- Who, if anyone, influences your choice of an I-Search topic?
- What is the goal of your project?

Growth of understanding of the inquiry focus

- Tell me what you know about your inquiry topic at this point in time.

Other questions

- How do you plan to finish your I-Search project?
- Other questions are generated according to students' webbing documents sent to me.

Third-time interview with student participants on question generation

Background reading and question generation

- Tell me in detail how you conduct your background material reading.
  Probe: steps students go through for selection and reading; which materials.
- Tell me how you generate your questions.
  Probe: alternative questions in mind but decide not to use them; how did you decide which of the questions you should ask; sources of question generation; who helped you in generating your questions? Refining questions from start
- There are some differences between your first and second pre-note taking sheet. Can you explain the differences to me?
  Probe: what do the differences mean for you? What has led to the differences?

Growth of understanding of the inquiry focus

- Tell me what you know about your inquiry topic at this point in time.
- What is the new understanding you have gained since I interviewed you last time?
- How did you gain the new understanding of your topic since I interviewed you last time?

Other questions

- If you made any change in your plan since our last interview, how will you finish your project?

Fourth-time interview with student participants on exploring and collecting information and responding to the information

Explore and collect information

- Describe how you search information related to your I-Search project.
  Probe: criteria of what to look for; where to look; types of information; steps in your search; type of technology used; suggestions from peers or instructor in your search for relevant information.
- How did you select the information among all pieces of information you have searched?
- How did you organize and keep track of the information that you thought would be useful?

Response to the collected information

- Here are your double-entry drafts; can you explain further your responses to these pieces of information?

Growth of understanding of the inquiry focus

- Tell me what you know about your inquiry topic at this point in time.
- What is the new understanding you have gained since I interviewed you last time?
- Describe how some of the information listed in your double-entry draft improved your understanding of your topic.
  Probe: change your perspectives, discard your old point of view; enrich your original understanding.
- What are some of the other pieces of information not listed in your double-entry draft, but still influencing your understanding of your topic?
- How did your new understanding influence the way you conducted your project?
  Probe: new plan; new direction of seeking information

Fifth-time interview with student participants on presenting I-Search products

Presentation of final I-Search product

- How did you decide on your presentation format?
- Here is your final I-Search report, and here is your double-entry draft. Can you describe how you transform different information and reflections into your final I-Search product?

Growth of understanding of the inquiry focus

- Tell me what you know about your inquiry topic at this point in time
- What is the new understanding you have gained since I interviewed you last time?
- How did you gain the new understanding of your topic since I interviewed you last time?

Other questions

- Describe your perceptions of different I-Search strategies.
  Probe: pre-note taking; double-entry draft; learning log; reflections
- Recall the whole process of finishing your project. What were the challenges you faced in your I-Search project?
  Probe: resolve the challenges.
- Recall the whole process of finishing your project. What were the most helpful aspects in the I-Search model for your inquiry-based learning?
- What are the things that are most helpful in facilitating your I-Search processes in the class?
  Probe: peer interaction, online discussion, etc.

APPENDIX C: CODE MATRIX

Topic Selection

Themes	Description	Participants	Example Quotes
Long-term interest	Select the topic because it is participant's interest for a long time	Bette Mary	I went to another deeply intriguing topic – the mind/body connection. I have grown up considering that idea. - Bette
usefulness or practicality	The result of the research is practical that can be used in real life setting	Bette Grace Hannah Mary	I wanted to research something that would be useful. I don't want to plan a trip that I can't take. - Grace
Pressure reduction	The topic is chosen for pressure release	Charles Hannah Bette	My topic of writing about hot tubs chose me because this was one of the stress reducers that could have an immediate impact on my life. – Hannah
Convenience	The topic can be finished within easy or in a relatively short time, thus it is a convenient choice	Charles Grace	Blue Ridge Parkway thing was more something that …a doable thing right now
Special Issues			
Prior knowledge	Prior knowledge about the topic can influence the topic choice and feeling about it.	Bette Mary Hannah Grace	I have lots of prior knowledge about travel resources and am not sure that I would be able to gain what I need from the I-search experience in order to prepare myself for teaching this process to children. – Grace
Narrowing down within a topic	Narrow down a broad topic to a more specific focus	Bette, Grace Hannah	Obviously, I am on a roll now – I just pray I figure out how to focus in on one particular area. I feel sure that my topic is too broad. I will need help narrowing my focus. – Bette

Questions Generation

Themes	Description	Categories	Description	Participants	Example Quotes
Essential Questions					
Two-step method	Participant first decided a focus and then generated questions around it, either directly around the focus or to cover other questions	Cover other questions	The essential question is generated so that it can cover many questions that the inquirers want to know	Bette, Mary, Grace	So I tried to think of a way to state my query so that my other questions would support/answer it. - Mary
		Direct generation	The essential question is created directly from the focus	Charles, Emma, Hannah	Finally, after finishing the background reading reflecting more on our trip and thinking about why questions about the trip, I finally decided that my overarching essential question was: *Why is the Suwannee River a good place for our family and friends to take a houseboat trip?* - Emma
Secondary Questions					
When sub-questions were explicitly posed	At what phase of the I-Search were the sub-questions explicitly posed	Vaguely posed at beginning	Sub-questions were not clearly posed at the beginning of I-Search	Bette, Grace, Hannah	Um … I didn't really put them [sub-questions] down. I just put my essential question there. Um, but I guess my sub-questions would be, what are the benefits and what are the disadvantages? Where, basically what I was looking at are my sub-questions. - Hannah
		Clearly posed at the end	Sub-Questions were clearly defined near the finish of an I-Search project	Emma, Grace	Yeah, I just felt like that was…you know, as I was—as I was doing my research, I realized my sub-questions were not very well phrased. - Grace
		Explicitly posed at beginning	Sub-questions were explicitly defined at the beginning of I-Search	Mary	It felt like that because I had these things I want to know. And so, I knew those … knew these are the questions I want to answer, but to get the overarching question, I said, what … question would these things answer? –Mary
Methods	Ways to create sub-question	Personal interests	Generated from personal interest	Bette	I'd be interested in knowing which ones worked the best. – Bette
		Questions scaffolding	Using question scaffolding terms from text to generate questions	Grace,	Then I tried to make my higher order question using some of the question words ____ [the author of the textbook] suggested .. what, which. You know, so, I took my what I don't knows and changed them into … and really it was a matter of organizing. - Grace
		Other generated	Generate new questions from other already	Bette	Umm, these kind of … they [questions in *What I don't Know* column] were kind of together. Long term effects

Themes	Description	Categories	Description	Participants	Example Quotes
		questions	generated questions		kind of go with the whole concept of how they … how do they compare? You know? Long term, short term, traditional versus uh, these alternative techniques. How do they compare? What are their long-term, short-term effects? They just seemed to work hand in hand. - Bette
		From *What I Don't Know* in pre-notetaking sheet	Generate questions based on questions listed in pre-note sheet column *What I Don't Know*	Bette, Charles	A lot of *What We Want to Know* is based on *What We Don't Know*. – Charles
		Condensed several questions into one question	Question is generated from condensing several questions together	Charles, Mary	My secondary questions condensed and grew out of some of my previous column 2 and 3 questions. -Mary
		Impression from scanning materials	Questions were generated from reading materials	Bette	What I was doing then is thinking about the scanning and somewhere along the way I remember reading something about placebo effect and I also was thinking about my own experiences with it. – Bette
Special Issues					
Challenge	Challenges	Little prior knowledge	Little prior knowledge made it difficult to generate research question	Bette	That one's worrying me a little bit. Because I feel like you have to know more than just, oh, I'm interested in it to do it. And I don't know more. And I don't even know what I don't know. So, how do I ask essential questions about it, if I don't even know what I don't know? - Bette
		Understand about research questions	Don't understand about essential questions or higher-order question	Emma	I was having a hard time understanding the difference in those and I still am not sure that I do understand why it is important to frame things in the … in that central question format.
Factual vs. higher-order	Students would post factual questions instead of higher-order question			Emma, Hannah	*Where can we stop on the river for food, fuel?*- Emma
No new knowledge	A question would not bring new knowledge			Charles	But, um, *why do I want to go camping along the Blue Ridge Parkway after grad school?* [This is his essential

Themes	Description	Categories	Description	Participants	Example Quotes
pertained to research question	for the participants				question.] And we know it's for relaxation. - Charles
Incompati-bility between essential question and sub-questions	There is inconsistency between essential question and its sub-questions	Different direction	Primary questions and sub-questions aim to find out different things	Bette, Emma	And then it hit me after I had done all of these. I thought…I remember thinking it very consciously, well this is all great, but to me this is all more about…hypnosis. And isn't it—wasn't my question supposed to be how…uh, exactly—the word—that word how kept reverberating in my head. How does hypnosis do it, not just what it does but how does it do it? - Bette
		Sub-Questions Could Not Fully Support the Essential questions	The answers from sub-question cannot provide the full answer of the essential questions	Mary	I fear that my essential question leaves too many open areas to explore. – Mary
Based on incorrect suppo-sitions	Questions are generated based on incomplete knowledge			Mary	See analysis in chapter 6

Information Exploration

Themes	Description	Categories	Description	Participants	Example Quotes
Multiple resources	Participants use multiple resources to find information	Internet information	Resources from Internet	Bette, Mary, Emma, Charles, Grace, Hannah	didn't find anything specific in books and so, um, at least not on the kind of information that I was looking for. So I pretty much depended on my internet sources. – Hannah
		Library resources	Book, articles from library	Bette, Mary, Grace, Charles, Hannah, Emma	Everything that I've got now with the exception of the Medline Plus website that Dr. ____ [instructor] gave me and the original magazine article that I found, the rest came from [University's online catalog]. – Bette
		People's lived experiences	Interviewing people to collect relevant information	Hannah, Charles, Grace	I interviewed someone who actually has a hot tub and asked them some questions about the, you know, what they saw as the main reason why they got a hot tub in the first place and how they use it, and just a lot of questions about how easy they are to take care of and…um…you know if there are any significant problems. You know, did you get tired of it after awhile and, you know, not use it as much, and it was very enlightening and it was kind of fun. - Hannah
		Multiple types of resources	Book, video, etc format	Mary, Grace, Emma	A friend gave me the Luther DVD to watch for some background as well. – Mary
Multiple Criteria	Participants use diverse criteria to select relevant information for their inquiry	Reliability	Whether the resource can be trusted	Bette, Mary, Hannah	Yes, um hmm. Dr. ____ [instructor] told me that one good way to do that was make sure there are three resources that say basically the same thing and it might would then be trustworthy. So I'm trying to keep that in mind in looking for three things that tell me the same information. - Mary
		Camping philosophy	Whether the information provider had the same philosophy with that of the inquirer	Charles	I would say the relationship would probably be that they [information he collected] were—we—we sought out sources that had the same…camping philosophy as—as—that we have or whatever. - Charles
		Bible and personal belief	Use Bible and personal belief as criterion to judge other resources	Mary	I have a particular definition of the church as a body of believers rather than a fancy, chandeliered building. In fact, I believe the Holy Spirit dwells in the earthly "temple" (body) of each believer. Although "It's not a religion, it's a relationship," may be a worn cliché, it is one of the beliefs that drives my current quest. Therefore, I critique possible

Themes	Description	Categories	Description	Participants	Example Quotes
					resources in light of this thought and my belief that, "All Scripture is God-breathed and is useful for teaching, rebuking, correcting, and training in righteousness, so that the man of God may be thoroughly equipped for every good work."(II Timothy 3:16-17, NIV) - Mary
Question as guidance	Participants use their research questions to guide their information searching process	Sub-questions	Sub-questions guided the information search	Bette	And I thought, ok, after reading the title and the abstract, I asked myself, "could this possibly have something in it to answer one of my sub-questions?" And if I thought it did, then I put it the—um, in that—in a particular stack. – Bette
		Essential questions	Essential questions guided the information search	Mary, Charles, Emma, Hannah	I was looking for answers that would support my essential question. – Mary
From generic to specific	Participants' strategies change from generic to specific			Bette Hannah	I think I may go back to the journals that I got bogged down in and see if I can find a few that have…some really weighty…percentages or statistics or something. – Bette
Organize	Participants use various methods to organize and keep track of their information	Bookmark	Bookmark website or webpage	Emma, Grace, Charles	We would find sites every once in a while and either bookmark them and know that we want to come back to them later on and read … more information for the double-entry draft. - Charles
		Word document	Use word document to collect information	Grace	Each time I saw something I liked, I copied the URL and pasted it in a Word document with a notation about the idea. I now have four pages of possible resources and some annotations. -Grace
		Print out/stack	Print out information and or sort them	Mary, Emma, Bette	Well, the others I got the information from the library and then I had my brochures and I put a notebook together that … where I kept everything that I had printed out or any printed material. - Emma
Special issues					
Too much information	Essential question has too broad a focus and requires too much information to address			Grace, Mary	Well, I had, um, I had started out…just looking for…you know ways to…to, well…how people had traveled with children and what they found beneficial and what the kids liked and what they learned from. And that was really what I was looking for, but then I realized that my search was way too broad and I was going to have to come up with a list of places. And I kind of had some in mind after doing my preliminary research, so I made a list of about…eight places that I thought we would want to visit. And then began to look for…where kids—where people

Themes	Description	Categories	Description	Participants	Example Quotes
	the question				have gone with kids for those.
Not guided by essential question	The search for information is not guided by participants' research question			Grace, Emma	And then I did write down things that related to my topic but just didn't necessarily relate to my essential question. You know, they related to travel with children in London, but they may not have related to…developing a deep understanding of culture. -Grace
Exploring information throughout I-Search process	Explore information throughout most of the I-Search process			Bette, Mary, Grace, Charles, Emma, Hannah	See individual profiles

Response to Collected Information

Themes	Description	Categories	Description	Participants	Example Quotes
Question-related	Participants realize whether a piece of information can inform their research questions			Bette, Charles, Hannah, Mary	This section informs my essential question - how can the mind affect the body through hypnosis. My list of positive affects of hypnosis is growing and being solidified by duplicate evidence. - Bette
Confirm knowledge	Confirm or support participants' own knowledge about the topic			Bette, Mary, Grace, Hannah	This writing gives further credence to the authority of Scripture in the life of the early church. Therefore, it is appropriate for me to assume the Bible is a good authority on the beginnings of the early church. - Mary
Activate prior knowledge	Active prior knowledge related to their topic by recalling participants' past experiences			Grace, Emma	This site indicates that the Cabinet War Rooms stop was one family's favorite. I really enjoyed it when I was there. The sound effects and displays make you feel like you're really in London during the war. There are lots of interactive displays. I think the bookstore had some information for kids too. - Grace
Change knowledge	Change participants' original knowledge or correct a misconception			Bette, Mary	Again, I found myself changing some judgmental attitudes when I realized that we can't just "get back to the Bible" (actually, I read about such movements in history and how they were ineffective) and throw out all means of organization. - Mary
Enrich knowledge	Add new knowledge into inquirers' repertoire			Bette, Mary, Grace, Emma, Hannah	I became excited when I read this. I have been trying to create a list of ways that hypnosis and the mind affect the body in a positive way. This statement was followed by a long list of benefits. –Bette
Identify knowledge gap	Need for further information			Grace, Charles, Bette, Hannah	For me, this site epitomizes early English history. Will look on Amazon to see if the book might be helpful for providing background and helping Hannah develop a picture in her mind. –Grace
Validate knowledge	Consider whether accept information as valid knowledge	Authority resources	Consider where the information come from	Bette, Hannah	When a professor of psychiatry at Stanford University says this, I tend to believe it. – Bette Reliable source—university and government sponsored. – Hannah
		Duplicated	Whether the	Bette, Mary,	Duplication indicates validity to me. - Bette

Themes	Description	Categories	Description	Participants	Example Quotes
		evidence	information is supported by other resources	Grace, Charles, Hannah	
		Methodo-logical validation	What methodology led to the conclusion	Bette	I am always thrilled to have hard, cold medical/scientific proof back up a theory or idea. - Bette
		Conflicting findings	How to deal with contradiction	Bette, Hannah	You know, you have to have everything exact in a study to duplicate—everything duplicated to get realistic results. And maybe one group of scientists and another group of scientists, when they create these studies to test the theory of hypnosis, they aren't doing the exact same things with their people. And so when that happens, the results are bound to be a little bit different. I mean that's the only reason that I can think for the contradiction. - Bette
Special issues					
Difficulty in writing double-entry drafts	Participants had difficult in writing double-entry drafts			Mary, Grace, Hannah, Bette	Even with the great examples and the Tallman text, I found myself having a hard time distinguishing the thoughts that belonged in the responses and those that belonged in the learning log. I checked myself with the questions given when doing each chart, but found myself cutting and moving ideas between the two. With more practice, I think this part will be easier. -Mary
Different types of responses	Participants made various types of responses			Emma, Charles, Grace, Bette	Emma - not much knowledge change response, Bette – many types of responses See individual profiles

Findings Presentation

Themes	Sub-Categories	Categories	Description	Participants	Example Quotes
Format					
Indi-vidual issues	Participants' personal factors helped participants determine the format	Technology skills	Participant's technology proficiency	Emma, Mary	I wanted my final product to include some images, maps and perhaps photographs, so at first I considered making a poster. Since I wouldn't be able to email that easily, I considered a PowerPoint presentation. I knew that I wasn't technically savvy enough to make the images files small enough to send by email, so I finally decided to make a handbook as a MS Word document. - Emma
Context issues	Contextual factors that helped participants determine the format	Time	Available time for creating format	Hannah Bette	Well originally I had planned to do a magazine article report on it, but what happened was I ran into a time deadline. I ran into a real time crunch. So what I ended up doing was, I made a chart of the pros and cons of hot tubs. - Hannah
		Influence from other people	The format determination is influenced by other people	Grace, Bette	And honestly I had—I had already done an itinerary that I got to class on Saturday before it was due. I was finding that a lot of other people were saying, I'm gonna do a letter to somebody, I'm gonna do, um…you know a website, I'm gonna do so and so. And I thought—and then I realized this is one of my…my, um, big six things that I have to present for my portfolio and I didn't want to just stick a table up there, you know. So part of birthday cards had to do with…you know deciding I needed to be a little more creative…in order to…um…I mean I know a lot of people are gonna stick tables up there but I wanted to do something a little bit more…more creative than that. - Grace
Content					
Two step method	At first determine content, then go back to check double-entry drafts and other materials and triangulate from them to support content			Bette Charles Emma Hannah Mary	Actually what I did was I had advantages and disadvantages in my two columns, and I started with my first reference and I filled in my chart from the references and just went through each reference to find where it would fall, an advantage or a disadvantage, and then when I had them all down, I thought, okay, I can divide the advantages into physical and mental, and the drawbacks of hot tubs it would really be logical to do health and safety issues with maintenance issues. –Hannah

APPENDIX D: COURSE SYLLABUS

EDIT 6360
Information Literacy
Spring, 2006 Online

Instructor: Dr. _____

Virtual Office Hours: Tues. and Thurs. @ 7:00 to 7:30 pm ET

Course Goals:
Students will demonstrate a working knowledge of the research process through study and completion of an I-Search project, collaborative planning units with classroom teachers integrating information literacy strategies, and planning curriculum with teachers.
This class will concentrate on the integration of technology and information literacy skills and strategies through the research process.

Course Objectives:
The student will demonstrate an understanding of the technology and information literacy strategies underlying the research process.
The student will demonstrate and document the process of collaborative planning through the creation of two units with classroom teachers.
The student will identify and integrate a number of technology and information literacy skills and strategies within the two curriculum units.

Essential Questions:
What does it mean to be information literate?
How do LMS and classroom teachers instruct students to become information literate?
Why is process significant when teaching information literacy?
How do LMS and classroom teachers assess information literacy?

Textbooks

Required:
Joyce, M., & Tallman, J. (2006). Making the writing and research connection with the I-search process. NY: Neal-Schuman. (Not available from publisher until early February)

Recommended:
Duncan, D. & Lockhart, L. (2000) I-search, you search, we all learn to research. NY: Neal-Schuman. 1-55570-381-X. Recommended for students with elementary concentration.
Koechlin, C. & Zwaan, S. (2003). Build your own information literate school. Salt Lake City, UT: Hi Willow Research and Publishing. [available at: sales@lmcsource.com or 800-873-3043] Recommended for students with secondary concentration.

Additional Supplemental Resources:
Note: Required readings from these resources will be available through the university library's e-reserves. These would be valuable resources for your library but are not required for you to purchase.

Harada, V. H. and Yoshina, J. M. (2005). Assessing learning: Librarians and teachers as partners. Westport, CT: Libraries Unlimited. 1-591-158-200-8
Harada, V. H. and Yoshina, J. M. (2004). Inquiry learning through librarian-teacher partnerships. Worthington, OH: Linworth Publishing. 1-58683-134-8
Pappas, M. L. & Tepe, A. E. (2002). Pathways to knowledge® and inquiry learning. Greenwood Village, CO: Libraries Unlimited. 1-56308-843-6 (pbk).
Rankin, V. (1999). The thoughtful researcher: Teaching the research process to middle school students. Englewood, CO: Libraries Unlimited. 1-56308-698-0.

ACTIVE LEARNING
This is a course that reflects the *active* versus the *passive* approach to learning, actively engaging students in the construction of their own knowledge. One goal of this course is to model both the constructivist and authentic learning theories in a distance-learning environment. The role of a student in this learning environment is to gather, evaluate, and use information to construct her or his own knowledge. One role of the instructor is to design an initial learning environment and outcomes that enable students to develop a personalized learning plan within the course framework. The instructor also acts as a facilitator, coach, and tutor. As a scholar, you, the student, must reflect, construct knowledge, and communicate that knowledge to fellow students and the instructor.

Topical Outline

I. Information process models
II. Inquiry learning
III. The I-Search process
   Students will experience the I-Search process by researching a topic of their choosing
IV. Collaboration and curriculum design
   Working with a classroom teacher, students will design curriculum units that incorporate information and technology literacy skills.
V. Assessment of information literacy

Major Assignments

Process Models Comparison Project
Develop a comparison chart of two information process models and write a 2-page essay with your conclusions. Your conclusions should include citations to a minimum of two scholarly articles regarding these models.

I-Search Research Project

You will complete an I-Search research project of your choosing as explained within the topic choice section of the of the Joyce/Tallman I-Search text. You will use and reflect on the information literacy skills and strategies suggested by the I-Search text for your own search, keep a reflective journal of the research process, carry out an I-Search as described in the Joyce /Tallman text, choose a format for presentation, and submit the final I-Search product to your classmates and me as an attachment to a WebCT message.

Curriculum Units Project
You will originate and plan two curriculum units together with classroom teacher(s). Use the Collaborative planning worksheet you developed for the curriculum mapping exercise in 6320. Keep a journal of the planning process with the intention of submitting it as your final product. Include in the journal a detailed draft of the units with unit goals, learning objectives, teaching pedagogies, information and technology literacies, classroom teacher instructional responsibilities, media specialist responsibilities, student responsibilities, resources needed, student assessment instruments, and unit evaluation instruments.

ALL ASSIGNMENTS SHOULD BE SENT TO ME AS AN ATTACHMENT TO A WEB CT EMAIL MESSAGE. Be sure to include your name on each page of the assignment and paginate. A header or footer will work best for this information.

Other Course Expectations

Chats
Students will participate in at least one weekly chat.

Chats will be held on Tuesdays and Thursdays, from 7:30 to 8:30 pm. Chat participation is required. Topics and questions listed on the calendar for each week will frame our discussions in the chats.

These chats will be held in Chat Room 1 and archived. The archived version will be posted on our web site so students can review the chat later.

Virtual Office Hours will be held in a chat room for 30 minutes prior to the start of our weekly chats. Individual chats can be arranged for students who want a private chat; or, you are always welcome to call me on the telephone. Please do not call before 9:00 am. Evenings are a good time to call me because I am always up and working until at least 11:00 pm. We may need some one-on-one time as you work through the I-Search process. Start with an email message but we can always move to a telephone conference when needed.

Forums
Forums will be used as a posting place for weekly journals and any discussion those journals might illicit. Forums will be created and students placed in forums as small groups to cut down on the number of messages that are posted in each forum. These forums and the posting of assignments provide students with a way to share their new knowledge and to engage in peer interaction about assignments. Students are encouraged to comment and raise questions.

Style Manual
Students will use the Publication Manual of the American Psychological Association (5th ed.) for the format of papers and reference citations. If you do not own this style manual, references to several useful sites can be found on the course pathfinder.

All academic work must meet the standards contained in A Culture of Honesty. Students are responsible for informing themselves about those standards before performing any academic work. The link to more detailed information about academic honesty can be found at: http://www.uga.edu/ovpi/honesty/acadhon.htm

The course syllabus is a general plan for the course; deviations announced to the class by the instructor may be necessary.
Questions:

Communication and Learning Environment **WebCT**

This is a web based course but we will hold 1 meeting on the campus, Saturday, January 14th. The common thread of communication is our WebCT web site. You should visit this web site frequently. Course documents will be posted in this environment.

Chats will be held on Tuesday and Thursday evenings, 7:30 – 8:30 pm ET.

Other Course Documents

Assignment Descriptions
Course Pathfinder
Assessment checklists
Course Calendar

Course Evaluation and Grading Scale

Weekly Chats 65 points (32%)
Process Models Comparison Project 30 points (15%)
I-Search Project 60 points (29%)
Curriculum Units Project 50 points (24%)

TOTAL POINTS: 205

Grading Scale

90 – 100% = A
80-89 % = B
70-79 % = C
60-69 % = D
Below 60% = F

APPENDIX E: COURSE CALENDAR

EDIT 6360 Calendar
Spring 2006

Chats will be scheduled on Tuesdays and Thursdays from 7:30 to 8:30 pm ET, with one exception – Week 2. Chat days in that week will be **Wed**. and Thurs. Students are required to join at least one chat time during the week.

Week	Dates	Assignments	Topics, Questions	Readings
1	Jan. 9		Introductions/On-campus meeting on Jan. 14th Time: 9:00 to 10:30 am Site: TBA	
2	Jan. 16 Chats: **Wed., Jan 18** & Thurs., Jan. 19		Topic: Information Process Models Questions: How does an information process model differ from the way you have gathered and used information for past research projects? How do information process models differ?	Thomas, N. P. Information Literacy and Information Skills Instruction. Chapters 3 & 4. Available in Library e-Reserves. Harada, V. & Tepe, A. (Nov/Dec 1998). Pathways to Knowledge®. Teacher Librarian. Available full text on the web in Academic Search Premier. Make additional selections from Pathfinder
3	Jan. 23 Chats: Tu & Th @ 7:30		Topic: Inquiry Learning Why do teachers/librarians use inquiry learning? Should inquiry learning incorporate the use of an information process model?	Pappas & Tepe. Pathways to Knowledge® and Inquiry Learning. Chapter 2. Available in Library e-Reserves Make additional selections from Pathfinder
4	Jan. 30 Chats: Tu & Th @ 7:30	Feb. 1 Assignment Due: Process Models Essay	Topic: I-Search: Personal web Questions: What is I-Search? How is the I-Search process different from your previous researching	Tallman and Joyce. (2nd ed.). Making the writing and research connection with the I-search process. Bowen, C. A Process Approach: The I-Search with Grade 5. Tallman, J. Connecting Writing and Research Through the I-Search Paper.

			experiences? Why is metacognitive thinking an important part of I-Search?	Both articles are full Text in Academic Search Premier. For full bibliographic information check the Pathfinder under Information Process Models.
5	Feb. 6 Chats: Tu & Th @ 7:30	Assignment Due: Journal #1; Personal web using Inspiration or Kidspiration	Topic: I-Search: Brainstorming; Topic web(s) Question: Why are brainstorming webs an important part of the research process?	
6	Feb 13 Chats: Tu & Th @ 7:30	Assignment Due: Journal #2; Topic web(s)	Topic: I-Search: Pre-Notetaking; Essential Research questions	
7	Feb. 20 Chats: Tu & Th @ 7:30	Assignment Due: Journal #3; Pre-notetaking sheet with essential questions	Topic: I-Search: General reading; Read without notetaking. Create New notetaking sheet; comparison of 1st and 2nd notetaking experience	
8	Feb. 27 Chats: Tu & Th @ 7:30	Assignment Due: Journal #4; notes from general reading	Topic: I-Search: Specific research on essential question(s); Complete double-entry draft for each resource; include bibliographic information	
9	Mar. 7 Chats: Tu & Th @ 7:30	Assignment Due: Journal #5; double-draft entries from resources	Topic: I-Search: Develop presentation format and short side paper Question: Why is choice of presentation format important for students when they do research?	
	Mar. 14		Spring Break week	
10	Mar. 21 Chats: Tu & Th @ 7:30	Assignment Due: Final I-Search product: Short side paper—Due on March 24th	I-Search: Complete final project Chat questions: Compare your understanding of the research process now with the process you were using	Readings: Harada & Yoshina. Inquiry Learning through Librarian-Teacher Partnerships. Chapters 3 & 4. Pappas & Tepe, Pathways to Knowledge® and Inquiry Learning. Pp 41-53; 124-130; 134-140 Available in Library e-Reserves

			before you experienced the I-Search. How will you use this new knowledge to teach information skills to your students?	Make additional selections from Pathfinder
11	Mar. 28 Chats: Tu & Th @ 7:30		Topic: Collaboration and Inquiry learning Questions: How are information literacy and inquiry learning different? Why collaborate?	Koechlin & Zwaan, Info Tasks for Successful Learning, pp 5-15; 19; 29; 37; 46 & 47; 63; 106 Koechlin, & Zwaan. Build Your Own Information Literate School. pp vii – xiv; 90-91, 93; 120-123; 130-135; 146-154 Rankin, Virginia. The Thoughtful Researcher. Chapter 7 Available in Library e-Reserves Make additional selections from Pathfinder
12	April 4 Chats: Tu & Th @ 7:30		Topic: Instructional Strategies for Information Literacy Questions: What are strategies for teaching students to gather and use information? How do information process models and the I-Search fit together?	Readings: Harada & Yoshina. Assessing Learning, Chapters 1 & 2 Make additional selections from Pathfinder
13	April 11 Chats: Tu & Th @ 7:30		Topic: Assessment Strategies and Tools Questions: How do teachers and LMS assess information literacy?	
14	April 18 Chats: Tu & Th @ 7:30		Final chat questions: What does it mean to be information literate? How will you implement an information process as part of your information literacy curriculum as a library media specialist?	
15	April 25	April 27 Curriculum Units Project Journals Due including all parts of the two collaboration units and the planning process.		

16	May 2		May 3-5 Final Exam Week	

Note: Readings are always listed a week in advance.

APPENDIX F: I-SEARCH ASSIGNMENT DESCRIPTION

EDIT 6360 Assignment Descriptions
Spring, 2006

I-Search Research Project
Points: 60
Due Date: March 24 (Final Project)
You will complete an I-Search research project of your choosing as explained within the topic choice section of the of the Joyce/Tallman I-Search text. You will use and reflect on the information literacy skills and strategies suggested by the I-Search text for your own search, keep a reflective journal of the research process, carry out an I-Search as described in the Joyce /Tallman text, choose a format for presentation, and submit the final I-Search product to your classmates and me as an attachment to a WebCT email message.

Purpose:
I believe that students understand a process better if they have done it themselves. Thus, if you are to teach the I-Search process or use some of its strategies in your curriculum units or in collaborative units with other teachers, you need to complete a personal I-Search to experience the strategies yourself. Most IT students who take this course have not thought about the research process or its information literacy strategies as ways to integrate technology tool uses and skills seamlessly into the curriculum. Thus, your second assignment will be to read the text chapters and complete your personal I-Search.

In this project you will complete the following I-Search tasks:

Here are the strategies I expect you to use and reflect on in your journal. Do not skip any step or attempt to go back and recreate the steps after you have researched through your old process, even though your old process is more comfortable for you. The purpose of you following each step is to aid your understanding of the way the strategies within the process are used to scaffold the following steps. If you skip, you lose, both for yourself and your future students. I will ask you to backtrack and change directions which will cost you time.

Strategies by the week:

1. Read the text chapters ASAP during the first week of February. Create a personal web using “Inspiration” or “Kidspiration” with you as the center bubble. Fill in connected outer bubbles with your interests, family, activities, teaching, health, hobbies; anything that might provide a clue for a good research topic. Email it to me along with journal #1 with your reflection on the process of webbing. All reflections need to be written in first person. Due on Feb. 6th.

2. Take the topic(s) that pique your interest as topics and brainstorm all the possible angles to that topic. Create another web with the topic in the center bubble and organize your brainstorming into connected outer bubbles on the web. If you decide to investigate more than one topic, create a web for each topic. Place the web(s) and journal entry #2 with your reflection on the effectiveness of the second webbing step into the drop box. Due on Feb. 13th

3. Use the pre-notetaking sheet (see example on WebCT class homepage) and make entries in the "What I know about my topic?", "What I don't know about my topic?", and "What I want to know about my topic?" You may not have many entries yet in your 2nd and 3rd columns. All entries in the third column must be in higher order question format that start with such probes as "how (explains process), why (creates understandings), and which (compares and contrasts)"? These become your essential research questions. Yes, you might only have one essential question. Or you may have more if you need. However, some of what you want to know may be considered as secondary questions that start with "what and when" that come under the essential questions. Email it to me along with journal entry #3 with your reflection on using the pre-notetaking sheet for creating your essential research question(s). Due Feb. 20th.

4. Read without notetaking to boost your general knowledge. Take notes only after you have completed your reading of a resource and with the resource closed. When you read, concentrate on your essential question and try to ignore the interesting, but non-essential information in your reading. Read at least two general resources that give you all around knowledge about your topic without getting into specifics. Your notes should be in first person, such as "I think this piece of information (. . .) fits my question because . . . ", or "This . . . information strengthens my thought that . . . is taking place," or "This . . . information makes me want to ask . . . ". Complete a new notetaking sheet using what you have learned from your general reading sources. Make your changes in all three columns and compare them to your first pre-notetaking sheet draft. Submit your notes from your general reading containing your reflection on the process of reading without immediate notetaking, only after you are done with the resource. Also submit the new pre-notetaking draft to me along with journal entry #4 containing your reflection on your changes and how you used the general reading to refine your essential and secondary questions. Due February 27th.

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5. Start your specific research on your essential question(s). Use the double-entry draft strategy (see example on WebCT class page) for each resource. Complete a separate double-entry draft page for each resource, including print materials, electronic resources, interviews, pamphlets, and multimedia. Complete at least two resources each day. IN the left-side column, note the word or phrase from the resource (including interviews) that relates to your essential question. In the right hand column, in your own words, explain how and why the word or phrase informs your question or provokes another question that you need to answer. Use your word processing software to create the columns. Include the complete bibliographic citations at the top of each double-entry draft. Include the page numbers for each entry, whether quoted or not. Save the document as a pdf file. Submit your two double entry-drafts and your journal entry reflections on the process of

obtaining the resources and their value to your research. With this last submission, include your journal reflection #6 about the process and your reactions. Due March 7.

6. Choose the best presentation format that fits your topic and essential question(s) and create your I-Search product. Remember that you are not researching for the class or to educate us on your topic (that's a side effect). Thus your format can be quite unique for your topic, such as a scrapbook, a paper, a PowerPoint, a letter to relatives, or an action plan for yourself. Here is a place for students to use presentation software quite effectively, but as a tool, not as a means to an end. All your writing and perspective on your topic is in the first person. Everyone must answer the following ***four*** categories in your final product, whether it is your main product or a short side paper (1-2 pages) to be included with your main product:
why your topic chose you
the story of your search
what you found
how you are going to apply your findings to answer your essential question(s)

Your journal should already contain the content for these four sections. Transferring that content (in first person) to the final product is the essence of the I-Search for preventing meaningless copy and paste re-search products. Submit your product to me or, if in a non-digital format such as a scrapbook, take digital images of each page of the scrapbook, and send me the images in readable and attachment friendly resolution and size gif files.

Include also a reflection on your thoughts and feelings about the I-Search process. How has your understanding of the information seeking process changed as a result of this experience? (minimum of one page)
Due March 24.

APPENDIX G: I-SEARCH PROJECT REQUIREMENT REVISION

Planning for the Next Several Weeks

As you are starting to work on the 5th task for I-Search this week, I want to clarify several items that are in the assignment description and highlight some important parts of this process.

Assignment Description #5 (revisions in italics)

Start your specific research on your *research question and essential subquestion(s).* Use the double-entry draft strategy (*see pages 71-73 in Tallman book*) for each resource. Complete a separate double-entry draft page for each resource, including print materials, electronic resources, interviews, pamphlets, and multimedia. *There are no set requirements for the number of resources you use and the double-draft entries but you need to gather sufficient information to answer your research question*. In the left-side column, note the word or phrase from the resource (including interviews) that relates to your research question. In the right hand column, in your own words, explain how and why the word or phrase informs your question or provokes another question that you need to answer. Use your word processing software to create the columns. Include the complete bibliographic citations at the top of each double-entry draft. Include the page numbers for each entry, whether quoted or not. *[Save the document as a pdf file – omit]. Keeping these in a Word file works for me*.
The following items are due on March 7:

- *All of your double entry-drafts from resources used this week*
- *Your learning log that covers the readings in the double entry-drafts (see page 77-81 in Tallman)*
- *Journal reflection #5 that is a reflection on this process and your reactions.*

IMPORTANT: Put your name and page numbers on your double entry-drafts in a header or footer. Number those pages in sequence from the beginning double entry-draft to the last one. On rare occasion I have dropped sections from a student's paper – with no pagination I am in real trouble if that happens. Also, put your name and pagination on the learning log and your reflection – in a header or footer.

Questions and Bloom's Taxonomy

Stephanie Jones found two wonderful web sites on an updated version of Bloom's taxonomy by Lorin Anderson.
Bloom's Taxonomy. http://www.odu.edu/educ/llschult/blooms_taxonomy.htm
Bloom's Revised Taxonomy.
http://eprentice.sdsu.edu/J03OJ/miles/Bloomtaxonomy(revised)1.htm

Note about the Final Product

I am changing the due date to March 26th. I will be traveling from March 22nd to the 24th and probably exhausted on the 25th so you might as well have the weekend to complete that task.

I plan to post the checklist for this final product in the next couple of days.

Chats

March 13-19 is the UGA spring break. There will be no chats during this week. There will be chats on March 21 and 23. Since I will be in Washington for the chat on the 23rd, Stephanie will moderate that chat. Those chats will be a wrap-up discussion on the I-Search process. You have a final reflection due with your final product. Please try to work on that reflection prior to the chat in which you are participating so you will have your thoughts about the I-Search experience together for the chat.

Chats on March 28 and 30 will focus on collaboration and inquiry learning. Please note the readings on your calendar listed the week before which means you have some reading to do that week along with finishing your I-Search.

APPENDIX H: I-SEARCH FINAL PRODUCT AND REFLECTION ASSESSMENT

I-Search Final Product and Reflection Assessment

Project Due Date: March 26th
Drop box will close at 11:55 pm on that date)

Final Project Points: 55
Total I-Search Points: 60
(5 additional points from weekly journals and other I-Search documents)

Content (Demonstrated through the Learning Log and Final Product) 9 points

Assessment Criteria	Excellent	Satisfactory	Needs Improvement
The content of the learning log and final product demonstrate the student's comprehension of the topic through reflective thinking			
The learning log and final product demonstrate the student's comprehension and understanding of the topic through reflective thinking			
The student presented differing perspectives related to the research question and synthesized these into the student's own perspective			

Process (Demonstrated through the Learning Log and Final Product) 36 points

The research question and subquestions reflect an understanding of higher level thinking and Bloom's taxonomy			
The student demonstrated an ability to limit the focus of the topic as represented by a reasonable number of questions related to the research question.			
The learning log notes and bibliographic references demonstrate an ability to discard irrelevant sources			
The learning log provides evidence of reflection related to the research question and subquestions			
The learning log shows evidence the student can apply information from a variety of sources for resolving the research question.			
The product demonstrates the student's ability to express thoughts in the first person			
The product presents content in a focused, clear, and logical manner			
The product incorporates examples that develop the main points.			

The product is edited and correct			

Reflection 10 points

Criteria	Excellent	Satisfactory	Needs Improvement
The reflection demonstrates the student's ability to self-assess their understanding of this I-Search experience			
The reflection demonstrates the student's ability to apply the higher levels of Bloom's taxonomy to their writing			
The reflection demonstrates the student's ability to relate their prior knowledge of the research process to their new understandings about an information seeking process			

Comments: