The Metacognitive Knowledge of Adolescent Students
During the Information Search Process

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Abstract

Metacognitive knowledge is a critical piece of the information literacy puzzle. In a world of exploding information and communications possibilities, the difficulty for users of information systems and services may not lie in finding information but in filtering and integrating it into a cohesive whole. To do this, they must be able to make sense of it, an act that assumes knowledge about one's own information needs, goals and abilities. This type of self-knowledge - called *metacognitive knowledge* – has three basic components: knowledge of one's self, knowledge of the nature of a cognitive task in relation to one's own cognitive abilities, and knowledge of how and when to effectively use cognitive strategies to complete a cognitive task. Such knowledge, when used in information seeking, may help users to solve complex information problems. There is perhaps no other user group who could benefit more from the development of metacognitive knowledge than adolescents, aged 16 to 18. On the cusp of adulthood, they face many of the complex information problems of adults, but as "novice adults" their depth of knowledge on most topics may be shallow simply because they have only experienced life for a handful of years.

This study used naturalistic research methods to investigate the metacognitive knowledge of adolescents as they searched for, selected and used information for a school-based, inquiry project, within the framework of Kuhlthau's Information Search Process (ISP). It was conducted over a four-month period in a Montreal-area CEGEP (post-secondary educational institutions in Quebec). The participants were students in their first year of CEGEP (equivalent to grade 12). Ten participants, ranging in age from 16 to 18, each kept a written or audio journal in which they recorded their thoughts, feelings, actions, and self-prompting questions, participated in four interviews, three conducted by telephone and one face-to-face, and completed a visualizing exercise (a timeline of their thoughts, feelings, actions and self-prompting questions).

The study identified 13 categories of ISP metacognitive knowledge used by 10 adolescents to complete an inquiry-based school assignment - *knowing your strengths*

and weaknesses, knowing what you don't know, scaffolding, building a base, parallel thinking, understanding curiosity, communicating, changing course, understanding time and effort, balancing, understanding memory, pulling back and reflecting and, connecting. The 13 categories of ISP metacognitive knowledge were not used uniformly by all the students, all the time; instead the patterns of use were unique to each participant. These categories, as well as the sub-categories that emerged from coding, together form the bones for an emerging a taxonomy of adolescent metacognitive knowledge during the information search process. With further research and development, the taxonomy may provide the framework for a rubric to be used in the teaching and assessment of metacognitive knowledge during the information search process.

Résumé

La connaissance métacognitive est essentielle à la maîtrise de l'information. Dans un monde où les possibilités en matière d'information et de communication ont explosées, la principale difficulté pour les utilisateurs des systèmes et des services d'information ne consiste pas tant à trouver l'information qu'à la filtrer et à l'intégrer à un tout cohérent. Pour y arriver, ils doivent être en mesure de la comprendre, ce qui présuppose la connaissance de ses propres besoins, objectifs et habiletés en matière d'information. Ce type de connaissance de soi – appelé *connaissance métacognitive* – est constitué de trois composantes de base : la connaissance de soi, la connaissance de la nature d'une tâche cognitive en relation avec ses propres habilités cognitives et la connaissance du comment et du quand utiliser efficacement les approches cognitives pour effectuer une tâche cognitive. De telles connaissances utilisées pour rechercher de l'information peuvent aider l'utilisateur à résoudre des problèmes d'information complexes. Le groupe d'utilisateurs à qui le développement de la connaissance métacognitive peut profiter le plus est probablement celui des adolescents de 16 à 18 ans. Sur le point de devenir des adultes, ils sont confrontés à nombre des problèmes d'information complexes des adultes, mais en tant que jeunes adultes, la profondeur de leur connaissance dans la plupart des domaines peut être limitée, leur expérience de la vie ne reposant que sur quelques années.

La présente étude a employé les méthodes qualitatives de recherche en milieu naturel pour analyser la connaissance métacognitive des adolescents pendant qu'ils recherchaient, triaient et utilisaient l'information pour un projet de recherche scolaire dans le cadre du processus de recherche d'information (*Information Search Process* (ISP)) de Kuhlthau. L'étude s'est poursuivie sur une période de quatre mois dans un des cégeps (institutions d'enseignement postsecondaire au Québec) de la région de Montréal. Les participants en étaient à leur première année d'études collégiales (équivalant à une 12^{e} année). Les dix participants, âgés de 16 à 18 ans, ont consigné par écrit ou sur support audio leurs pensées, leurs émotions, leurs actions et leurs questions auto-incitatives, ils ont accordé quatre entrevues, trois par téléphone et une en personne, et ils ont effectué un

exercice de visualisation (un tableau chronologique de leurs pensées, de leurs émotions, de leurs actions et de leurs questions auto-incitatives).

L'étude a identifié treize catégories différentes de la connaissance métacognitive ISP utilisées par dix adolescents pour réaliser un travail scolaire de recherche d'information : *connaître vos forces et vos faiblesses, connaître ce que vous ne connaissez pas, échafauder, construire une base, la pensée parallèle, comprendre la curiosité, communiquer, changer d'idée, comprendre le temps et l'effort, pondérer, comprendre la mémoire, reculer et réfléchir, et établir des liens*. Les étudiants n'ont pas toujours tous utilisé ces 13 catégories de la connaissance métacognitive ISP de la même manière. Chacun a plutôt utilisé un modèle qui lui était propre. Ces catégories, comme les sous-catégories découlant de la codification, forment l'ossature d'une nouvelle taxonomie de la connaissance métacognitive des adolescents dans le processus de recherche d'information. Grâce aux recherches et développements futurs, la taxonomie offrira peut-être le cadre d'une rubrique qui servirait dans l'enseignement et l'évaluation de la connaissance métacognitive lors du processus de recherche d'information.

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Chapter 1: Statement of the Problem

1.1 Introduction

Adolescents, on the cusp of adulthood, face many complex information problems in both their academic and personal lives, and decisions taken to solve these information problems may impact their studies and life choices. To solve complex information problems effectively, background knowledge in the domain is usually helpful (Allen, 1991; Hollands & Merikle, 1987; Hsieh-Yee, 1993; Marchionini et al, 1990, 1991, 1993; Hirsh, 2004). However, as "novice adults", adolescents' depth of knowledge on most topics may be shallow simply by virtue of the fact that they have only experienced life for a handful of years. Complex problem solving also requires cognitive abilities that for the adolescent may be new and unpracticed or even, according to recent brain research, in development (Giedd et al, 1999).

To add to the problem, adolescents' information problems are more likely, at least in Canada, to be negotiated via the Web, a complex environment where information can be from a variety of inconsistent and often incompatible sources (Environics Research Group, 2001). For Canadian youth, searching for information is as popular as playing games online (Environics Research Group, 2004, p. 11). Canadian adolescents enjoy using the Web to find information and willingly choose it over other information sources. Ironically, although they prefer to use the Web to find information, young people recognize that it is not always the best or easiest way to find information (Environics Research Group, 2004). Perhaps this is because in the open-ended information environment of the Web, the difficulty may not be in finding the information, but in filtering and integrating it into a cohesive whole. These acts assume a level of understanding about one's own information needs, goals and abilities – a kind of self-knowledge that many adolescents may not have or at least, do not know how to reveal.

It has been argued that reaching a level of self-knowledge requires a different kind of thinking, a second stream of thought that is focused, controlled and reflective (Dewey, 1933; Flavell, 1979). Called *metacognition*, this under-current of thinking about one's

thinking is essential to information literacy, the package of competencies needed to negotiate complex, open-ended information systems. In the context of this study, metacognitive knowledge refers to knowledge about cognition in general as well as awareness of and knowledge about one's own cognition (Anderson & Krathwohl, 2001). Metacognition, "thinking responsibly" about our thinking, is seen by educators as a critically important life skill required for "successful academic studies, in demand in the workplace, needed for good citizenship, and valued in the development of the whole person" (Foster, Sawicki, Schaeffer & Zelinski, 2002, p. 24).

Metacognition offers rewards when the task is challenging, but an automatic or intuitive response is not sufficient to provide a solution (Foster, Sawicki, Schaeffer & Zelinski, 2002). Under some circumstances, it has been suggested, metacognitive knowledge may compensate for weak knowledge in other areas (Land & Green, 2000). It has also been suggested that there are links between awareness of one's own thinking (metacognitive knowledge) and feelings experienced during the information-seeking process (Kuhlthau, 1991, 2004). Patterns of metacognitive knowledge, within the context of both affect and information seeking, have been largely unexplored in any age group. The scarcity of information is regrettable as we still have an incomplete picture of the process.

The need for such studies becomes more acute when we consider the problems of adolescent information-seeking behavior. Studies have indicated that, although technologically adept, adolescents still find information seeking to be a difficult task (Fidel et al, 1999; Agosto, 2002). Adolescents, as novices in life, are a vulnerable group. They may have left their childhood behind but they are in some ways only "beginner adults", the ability to reflect upon their own thinking a new skill lately learned. Interestingly, the latest brain research goes so far as to suggest that adolescent thinking is entirely unique and not simply a "junior version" of adult thinking, due to the real physical boundaries of brain development. In the first long-term study of the adolescent brain, magnetic resonance imaging revealed that adolescent brains are still in transition and that some young adults do not think logically and rationally until well into their early twenties (Giedd, 1999).

Adolescents as information seekers would seem, then, to be at a disadvantage in terms of the ability to filter the onslaught of information from open-ended information systems such as the Web. Rather than see this as a drawback, Giedd suggests that adolescence is the ideal time to develop life-long thinking and problem-solving skills. Following a "use it or lose it" approach, Giedd argues that if the "teenage brain is still changing so much, we have to think about what kinds of experiences we want the growing brain to have." (Giedd, in Strauch, 2003, p. 21). As they begin to face complex information problems in both their academic and personal lives, adolescents need to be taught the intellectual skills to navigate a complex world. But where to begin?

In the context of information seeking, we must first paint a picture of the process before offering solutions for support and training. Little research has been done in relation to teenagers and information-seeking behavior. Large (2004, 357), in his synthesis of the research on children, teenagers, and the Web, found that older teenagers in the "upper grades of high school, like those in the lower grades of elementary school, have not yet received much attention from researchers", an observation that suggests the need for further investigation.

More scarce are studies that have looked at the metacognitive knowledge of adolescents, and specifically in relation to information seeking (a situation that is certainly ironic given the current educational focus on information literacy). One such study, however, was undertaken by McGregor (1994a; 1994b) but although it looked at the "higher order thinking skills" of adolescents during the research process, it did not focus on the specific nature of adolescent metacognitive knowledge. We are left, then, with many questions about adolescents and metacognitive knowledge during the information-search process. Do adolescents possess metacognitive knowledge and if so, how do they employ it during information seeking? Does their use of metacognitive knowledge follow an identifiable pattern throughout the search process, a process that has affective and cognitive aspects to it? Is there a pattern between the kinds of feelings they experience during the information search process and the nature of their metacognitive knowledge? What are

the strengths of their metacognitive knowledge? Where are the gaps? These are a few of the questions that need to be asked.

1.2 Purpose of the Study

The purpose of this study is to uncover patterns of adolescent metacognitive knowledge during the information search process, and how they relate to cognitive certainty/uncertainty, positive or negative feelings (affect) and actions taken during the information-search process in order to further describe and model the information behavior of adolescents. The study is driven by an inductive theoretical thrust, which is to say that the purpose of this study is to discover themes and patterns in adolescent information behavior rather than to confirm a hypothesis. It was assumed that metacognitive knowledge would manifest itself through various attributes and the study was designed to draw out these attributes. What this study is *not* is an evaluation study. In other words, it is not testing the effects of metacognitive knowledge on academic achievement. Nor is it testing the validity of the construct of metacognitive knowledge.

This study fits into the research area of Information Behavior, a holistic approach to the study of how humans interact with information. The unit of analysis is the search process of 10 adolescent students, aged 16 to 18, as they search for, evaluate and use information to complete an inquiry-based school assignment, using any variety of information sources.

1.3 Research Questions

The primary question guiding this research is: *What is the role of metacognitive knowledge during the information search process of adolescents?* Two secondary questions frame the study and provide conceptual categories for data analysis:

1. Within the context of the search process, what are the qualities of adolescent metacognitive knowledge?

2. How does the metacognitive knowledge of adolescents map on to the cognitive, affective and behavioral dimensions of the search process?

The study attempts to answer these questions by investigating metacognitive knowledge through the lens of one widely cited model, Kuhlthau's (1991) Information Search Process (ISP), a multi-dimensional model of users' thoughts, feelings and actions during the information search process.

Chapter 2: Background to the Problem

2.1 Introduction

This chapter discusses the theoretical framework that shaped the study and explores the literature associated with it. The study explored the metacognitive landscape that lies at the intersection of three constructs – *affect*, *cognitive certainty/uncertainty* and, *action*s – through the lens of Kuhlthau's (1991) Information Search Process Model, in an attempt to further describe and model the information behavior of adolescents.

Four propositions guided this research. They are: 1) information seeking is a problem-solving process; 2) knowledge is constructed by information seekers during the problem-solving process; 3) information seeking, as a problem-solving activity, is facilitated by metacognitive knowledge and its accompanying strategies and 4) information seeking is an interplay between three phenomenological domains – cognition, affect and behavior – and the role of each should be understood. By drawing these four propositions together into one study, the information seeking behavior of adolescents investigated metacognitive knowledge from a unique perspective.

2.2 The Information-seeking Behavior of Adolescent Students

Information seeking can be a messy, ill-structured process but labels such as the "net generation" (Tapscott, 1998, p. 3), the "wired generation" and "gentech" (McNamara, 2007), or "digital natives" (Prensky, 2001), suggest that young people are technologically savvy, experts in the area of information seeking, and therefore not in need of closer attention. While this study is not specifically about the use of information technologies, the statistics, at least for Canada, do tell us that information technologies do play a large role in the information-seeking behavior of young people: 94% of young people in grades four to 11 (ages 9 to 17 years) report going online from home. Sixty-one percent of Canadian online youth have high-speed access and 23 % have their own cell phone, 44 % of which have Internet capability. For Canadian youth, searching the Internet for

information is as popular as playing games online and they willingly choose the Internet over other information sources (Environics Research Group, 2004).

Much of the recent research into school-related information-seeking behavior has, not surprisingly, looked at it through the lens of Web-based searching. Research indicates that adolescents, although technologically adept, still find information seeking to be a difficult task (Watson, 1998; Fidel et al, 1999; Agosto, 2002; Branch, J., 2003, Todd, R., 2003; Neilsen, J., 2005; Dresang, 2005; Chung & Neuman, 2007). More recently, a study designed to forecast the behavior of future researchers explored the published literature related to young people's information behavior over the past 25 years and conducted a deep log analysis comparing different age groups' use of the same platform (CIBER, 2008). Findings from this study suggest that young people's information search skills have not improved over time. The idea that young people are expert searchers, the authors suggest, is "a dangerous myth" (2008, 20).

Despite the whole-hearted adoption of information technology into the lives of adolescents, teaching and support in the area of information seeking remain critical. For information professionals, this is an opportunity to develop the habits of mind that will help young people access, interpret and use information in meaningful and effective ways.

2.3 Propositions Guiding the Study

2.3.1 Information Seeking as a Problem-solving Process

The first proposition represents information seeking as a problem-solving process, a set of developmental stages that culminate in a solution. Kuhlthau has suggested that an understanding of the processes involved in information seeking is as important as the outcome (1985). This is an important concept for this study as it sets the stage for the longitudinal approach that will be taken in data collection. The notion of "process" implies sequence; it is a "moving picture" that takes place over a period of time, rather

than a "still photograph" of one search incident (Dervin & Nilan, 1986, p 14). To capture the true image of the phenomenon we call information seeking, a holistic and long term approach is essential.

Various models of the problem-solving processes in information seeking exist, heretofore referred to as *process models*. This study is framed by one process model in particular; Kuhlthau's Information Search Model (ISP). Since there are many *process models* in the field of LIS, a clear explanation of what they are and where Kuhlthau's model stands in relation to the others will be helpful. A distinction should be made at this point between those models of information behavior which outline a set of stages – *process models* – and other models which describe the *characteristics* needed to solve information problems (Ellis' information-seeking behavior model of social scientists is a good example of the latter; Ellis (1989) describes specific features of information seeking such as chaining and browsing but makes no claim as to the order or importance of each task in the overall process). This section will focus on *process models*.

To add to the confusion over models, the field of LIS has seen two distinct sets of process models emerge – the *prescriptive* (instructional) and the *descriptive* (theoretical). There are two important contrasts between the prescriptive and descriptive model; one is their purpose and the other is their scope. The prescriptive models have learning and instruction as their purpose while the descriptive models serve to explain interactions between people and information. In terms of scope, the prescriptive models are more comprehensive, viewing information seeking as but one part of a larger process leading toward knowledge construction whereas the descriptive models tend not to look at information use and transfer, typically ending at the point where information seekers begin to organize information into representations of their knowledge (Wilson's (1999) model being the exception here). The focus of the descriptive models (thus far) is narrower and, for the purposes of this study, more manageable.

This study is situated within the parameters of the descriptive models for two reasons. First of all, this study seeks to *describe* a process rather than *apply* a prescribed process.

It will not be testing or evaluating an instructional strategy (or search process as the case may be) to see if it works. Secondly, its focus is on the events that occur during the search rather than on the learning outcomes of the search. Since confusion can arise if the two typologies of process models are not clearly defined, an explanation follows.

a. Prescriptive Process Models

The first set of models – the *prescriptive* - is related to information literacy instruction and has a learning-focused view of the process. (Eisenberg, M.B. & Berkowitz, R.E., 1990; Harada, V. & Tepe, A., 1998; Irving, 1985; Stripling & Pitts, 1988; Todd, R., 1998; Yucht, A. H. 1997, 2002). These are instructional models designed for the library setting. Prescriptive process models designed for Canadian schools can be found in The Atlantic Model (Prince Edward Island Department of Education, (n.d.)); the Inquiry Model (Alberta Learning, 2004) and the Information Studies model from the Ontario School Library Association (Gauntley, Kerr & Dotten, 1998). We can add to this list of prescriptive process models Kuhlthau's ISP model, which made the transition from theory to practice in the book, *Teaching the library research process,* a handbook designed for teacher-librarians (Kuhlthau, 1994b).

The prescriptive models are instructional in nature, their purpose being to suggest "best practices" for students engaged in information seeking and problem solving. These models focus on specific learning outcomes and describe the stages that information seekers *should* go through in order to gain meaning from information and effectively use it. As such these instructional models can act as a metacognitive support during the search process (Wolf, Brush & Saye, 2003). The stages are developmental (one must go through the first stage in order to get to the second); however, they are also iterative: information seekers can return to an earlier stage if dissatisfied with their search.

Many of the prescriptive models go beyond the information search and include steps for communicating ideas via products such as a research paper. For example, Eisenberg and Berkowitzs' Big6 model (1990) prescribes six stages in the framework for solving

information-based problems: 1) Task definition; 2) Information-seeking strategies (selecting sources); 3) Location and access (finding sources and the information in sources); 4) Use of information (extracting relevant information); 5) Synthesis (organize and present information) and; 6) Evaluation (judging the product and process).

Interestingly, the prescriptive models have a metacognitive component to them. That is, their successful completion depends upon the use of metacognitive skills. For example, Stripling and Pitts' 10 step model for research projects (1988) provides a series of questions students should ask themselves in order to prompt self-reflection, each question matched to a particular phase in the research project. At Level 3 in the model, when the task at hand is to narrow the topic, students must ask themselves "Is my topic a good one?" It is not known, however, whether students are actually able to trigger such self-questioning and whether they have the self-knowledge needed to arrive at an answer.

b. Descriptive Process Models

The second set of process models is *descriptive* in that the models describe what is believed to occur during human interaction with information. (Kuhlthau, 1991; Hill, 1999; Wilson, 1999; Lin & Belkin, 2000, 2005; Spink, Greisdorf, & Bateman, 1998; Vakkari, 2001, Cole, 1999; Ford, 2004). Rather than tell us what *should* happen, they suggest what *does* happen, proposing relationships that might be explored or tested later on (Wilson, 1999, p. 250). In this sense, these models are also *predictive*.

Within the category of descriptive models there are yet more defining characteristics. Using Wilson's nested model of information behavior (1999), we can categorize these models into three levels, each level increasingly specific and focused. The three levels are: 1) *information behavior*; 2) *information seeking* and; 3) *information searching* (perhaps more accurately called information retrieval). Figure 1 shows an illustration of Wilson's nested model of information behavior).

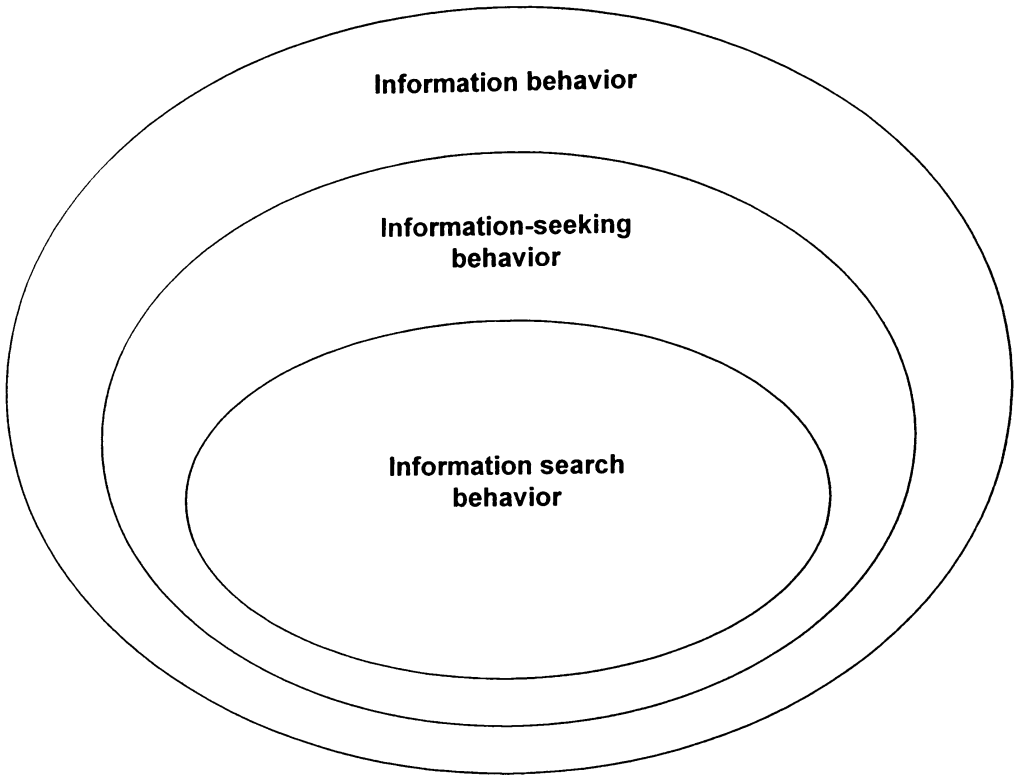


Figure 1: Wilson's nested model of information behavior
(Source: Wilson, 1999, p. 263)

Process models that describe *information behavior* are located at the macro level and explore a broad spectrum of behaviors related to the investigation of an information problem. While information seeking is part of this spectrum, models of information behavior also consider factors such as problem identification (information need) and information use (Wilson, 1981; 1999). *Information-seeking* models look at the various methods people use to discover and gain access to information resources. They delineate broad stages of behavior rather than the particular events or actions people take to get there. Furthermore they are not restricted to a particular information environment, such as, for example, an IR system (Wilson, 1981; 1996; Kuhlthau, 1991; Hill, 1999). Models that describe the *information search* focus on the specific interactions between people and information systems in the course of information seeking. They take a micro level approach, focusing on the search tactics and terms that people use when interacting with

an IR system (Spink, Greisdorf & Bateman, 1998; Cole, 1999; Vakkari, 2001; Ford, 2004; Lin & Belkin, 2005). This study is located at the *information-seeking* level, the middle ground between the broader information behavior models and the narrower information searching models.

One characteristic that the descriptive models of information seeking at *all levels* seem to share is their focus on cognitive processes. Alone among these models stands Kuhlthau's Information Search Process model (ISP), which modeled three parallel domains of processes - the cognitive, affective and behavioral - leading Wilson to say that Kuhlthau's model represents a "phenomenological, rather than cognitive" perspective on information seeking (1999, p. 255).

c. The Information Search Process Model

Kuhlthau's ISP model, is not simply the only model that provides a multi-dimensional perspective of the information-seeking process, but it is also one of the few grounded in a significant body of empirical study. Initially based on an investigation of gifted high school students, the ISP model was validated in a series of five studies over a span of six years, using both small and large scale sample sizes, in a diverse range of settings, within a variety of populations (Kuhlthau, 1985, 1988, 1989, 1990).

The ISP model identifies six stages, each representing specific tasks of the information seeker: task initiation, topic selection, prefocus exploration, focus formulation, information collection and search closure (presentation) (1991). In the ISP model, cognition, affect and behavior are intertwined. Kuhlthau found a pattern of feelings that paralleled the specific stages of knowledge integration during the search process. As information seekers move through the process, their feelings reflect their understanding of their research topic. High anxiety was associated with cognitive uncertainty and was related to difficulty integrating information from various sources into a meaningful whole. A turning point in the process came when information seekers were able to find a focus for their information-seeking mission. Cognitive certainty was soon thereafter

accompanied by feelings of confidence, helping to launch them forward in their information search. The central lesson for both information seekers and information providers is that formulating a focus is a prerequisite for moving forward in the search process.

Each stage in the ISP is associated with cognition (thoughts), affect (feelings), and behavior (actions). The stages in the Information Search Process model are as follows:

Stage one: At *Task Initiation*, people become aware of an information need. Thoughts are unfocused as the information seeker tries to relate the task at hand to previous knowledge. Feelings are uncertain and anxious as the person becomes aware of gaps in his/her own knowledge and understanding of the problem.

Stage two: The task of *Topic Selection* requires making a choice between topics at the broadest level. Predicting the outcomes of possible choices (thought) leads to confusion and sometimes anxiety (feeling). Selecting a general topic leads to a brief reduction in uncertainty.

Stage three: During *Prefocus Exploration* the information seeker tries to become informed about the general topic area in order to narrow the focus. Several possible focuses can present themselves, leading to confusion, doubt and uncertainty.

Stage four: The *Focus Formulation* has been identified as the most critical stage. This is where a personal perspective on the research question is established through the intellectual tasks of prediction, evaluation and synthesis. Having developed a conceptual structure of the information problem space, the information seeker now moves from a state of confusion and anxiety to one of clarity, optimism and confidence.

Stage five: During *Information Collection* the information seeker systematically gathers the information related to the selected focus. Feelings are optimistic as the information seeker refines and extends the focus through gathering and organizing information. As

the outline of the problem becomes clear, the information seeker feels an increased interest in the task at hand.

Stage six: At *Presentation (Search Closure)*, a pattern of information redundancy begins to appear, indicating that the resources have been exhausted. This could signal success or failure to the information seeker, depending upon whether a focus with potential was established earlier in the process. The final pieces of information are gathered and the preparation for presentation begins. The information seeker feels either satisfaction or disappointment. Disappointment indicates a weak focus.

Self-assessment stage: Through *Reflection and self-assessment* the information seeker reviews the experience in order to diagnose the source problems and think of ways to improve the process and final presentation. This stage was added to the process model in Kuhlthau's book, *Teaching the library research process: A step-by-step program for secondary school students* (1985). Most writing and research on the ISP model does not acknowledge this stage. Figure 2 illustrates the six stages of the ISP model.

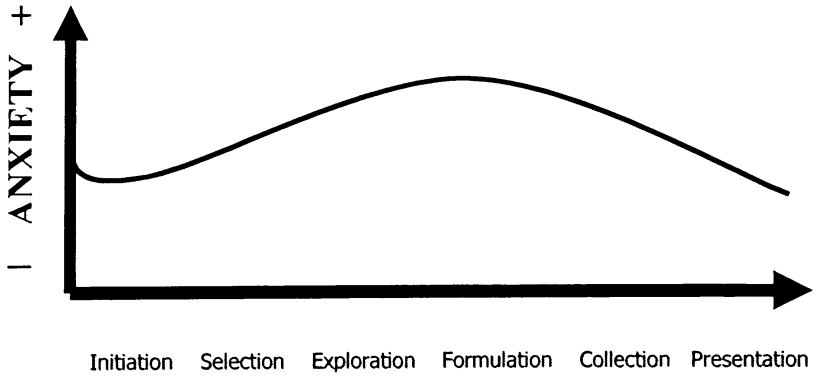


Figure 2: The Information Search Process (ISP) Model

d. Adaptations and Additions to the Information Search Process Model

Through research, a picture of where Kuhlthau's ISP model holds true, and where it does not, is emerging. Modifications to the ISP model have led to the elaboration of, extensions to, and elimination of stages in the process. In his study of enabling devices for conceptualizing topics, Cole (2001) observed an interim stage, somewhere between stages two and three. In later writings this was articulated as two levels within stage three (exploration). At the lower level, students would explore the topic structure, then move on to stage 3.5, where they would try to map the topic to their own mental model (Cole & Leide, 2003). Swain suggested the addition of a communication dimension that she observed had an impact on topic and focus formulation, expanding the model beyond the thoughts, feelings, actions, strategies, and moods described by Kuhlthau (1996). McGregor studied high school students' research processes within the context of Kuhlthau's ISP model and extended the process into stages of writing (planning and organization, first draft, and final draft) (1994a; 1994b).

In a study into the effects of awareness training on uncertainty, new categories of thoughts and feelings were used to analyze the process. These new variables, if studied further, could potentially reshape the ISP model (Kracker, 2002; Kracker & Wang, 2002). In this research, awareness was measured by eight sub-variables, the first six being the six stages of the ISP model. In the cognitive dimension, Kracker added a seventh variable, called "overall", a stage of self-evaluation similar to Kuhlthau's assessment stage. An eighth variable, called "iterative" addressed the spiral nature of the process. Elaborating on Kuhlthau's affective states of anxiety, uncertainty, confidence and relief, new variables of feelings were added to the affective classification scheme; difficult, easy, stress, dislike, calm, overwhelming, frustration, exhausting and stupid. Limburg (1999), in her study of 25 high school students in Sweden, looked at the interaction between information seeking and use through the lens of Kuhlthau's ISP model. She found that working in groups influenced the students' ways of thinking and acting during the search process, suggesting yet another layer to the ISP model – a "group" layer.

While most researchers have observed that students skip stages in the process, only Shamo's study of information searching in the Web environment has suggested the elimination of stages that students did not report experiencing (2001). Shamo suggests that a new model, unique to the Web environment, is needed, one that reflects the latter stages only (three to six), the implication being that stages one and two happen off-line.

There has also been a process of reduction, with some researchers speaking of three broad stages rather than the original six. This bunching into fewer stages was first proposed by Kennedy, Cole and Carter (1997). Using the concept of a "focus continuum" three broad categories were outlined; Pre-focus, Semi-focus, and Post-focus. In later writings, Kennedy and Cole (1999, 268) renamed the mid-stage as "Focus". Others have followed suit. Vakkari (Vakkari, 2001; Pennanen & Vakkari, 2003) condensed the six original stages in the ISP into three broad phases, using the same terms as Kennedy and Cole; pre-focus, focus, and post-focus. This was done more for methodological than theoretical reasons as it seemed unlikely that the specific stages of Kuhlthau's model could be differentiated within the limited timeframe of the study. Kracker (2002) speaks of phases rather than stages, delineating the stages as Phase 1, Phase 2, and Phase 3. The completion of each phase signals a major decision. The suggestion is that it will be easier for students to retain the model if it is simplified. Kracker suggests further investigation into whether the addition of an overarching layer (self-assessment and iteration) is justified.

e. Summary

Kuhlthau's model stands as one of the few process models based on empirical evidence. It was validated by Kuhlthau in a series of five studies (Kuhlthau, 1985, 1988, 1989. 1990). Subsequent research by others supports the behavior predicted by Kuhlthau's model, although some modifications have been made to it (Friel, 1995; Swain, 1996; Byron & Young, 2001; Shamo, 2001; Kracker, 2002; Kracker & Wang, 2002). Kuhlthau herself has suggested that the ISP model needs to be further explored as a means to

provide effective models for the design of library and information systems that will guide and assist people during the search process (2004).

Kuhlthau (2004) identified three dimensions in the information search process - the behavioral, the cognitive and the affective in an attempt to paint a fuller picture of what happens during the information search process. Could metacognitive knowledge be the missing piece to the puzzle, a fourth dimension of the information search process? Perhaps in answering this we may answer a broader question posed by Kuhlthau, which asked, "when is intervention needed and what intervention is helpful to an individual in his or her information seeking and use?" (p. 128).

2.3.2 Knowledge Construction

An important principle guiding this study is that knowledge gained through the information search is constructed by, not transmitted to, information seekers. Understanding this helps to put the topic of this study – metacognitive knowledge – into focus. Information seekers approaching information problems are often faced with an ill-defined problem space and their task is to define this space through their own understanding of it. Some theoretical models in Information Science argue this same perspective. The ASK (Anomalous States of Knowledge) model, from Belkin (1980), is built upon the notion of varying states of knowing (1980). Information seekers in the ASK are conscious of an information need but experience a lack of coherence, an uncertainty, as to the specific shape of the information problem. As they gain an understanding of the problem space their knowledge-state moves from one of not-knowing to knowing.

In her Sense-Making framework, Dervin (1986, 1999) described a similar constructive process, speaking of a gap between order and chaos that must be bridged by the information seeker. Kuhlthau (1991) expresses the importance of knowledge construction through the concept of Focus Formulation, defined as the stage where the information seeker gains a personal perspective on the research question. All these perspectives fall

within the framework of user-centered approaches to the study of information seeking and system design, and are of increasing interest to the discipline of Information Science (Belkin, 1980; Dervin & Nilan, 1986; Ellis, 1989; Nahl, 1995; Watson, 1998; Watters & Shepherd, 1994). A question resulting from this perspective, and one that is relevant to this particular study, is how can we help information seekers find meaning in information? To answer this, a fuller knowledge of what information seekers actually think, feel and do during the process as well as where their strengths and weaknesses may lie, is necessary.

2.3.3 Metacognitive Knowledge as a Scaffold to Knowledge Construction

The third proposition is that knowledge construction is facilitated by metacognitive knowledge and its accompanying strategies. Information seeking often occurs in response to open-ended questions, in open-learning environments or large information spaces, where information is from a variety of inconsistent and often incompatible sources. In such ill-defined problem spaces, global strategies that can be applied to a wide range of information problems may provide the kind of scaffolding needed to move information seekers through the process successfully. Land (2000), in her study of project-based learning with the Web, found that metacognitive knowledge compensated for a lack of system and domain knowledge, suggesting that metacognitive knowledge can act as a scaffold in knowledge integration from Web sources.

The strategies that information seekers use can be both cognitive and metacognitive in nature. Cognitive strategies are "invoked to make cognitive progress", but when they are invoked in order to provide self-assessment, they become metacognitive (Flavell, 1979, p. 909). The ability to know when, why and how to invoke these strategies is a part of metacognitive knowledge and can provide individuals with the intellectual weaponry needed to negotiate complex problems. As "novice adults" with limited life experiences upon which to base their decisions, adolescents may need such weaponry to compensate for gaps in other types of knowledge.

a. What Exactly is Metacognitive Knowledge?

Metacognitive knowledge, as its name suggests, is a form of knowledge. Anderson and Krathwohl (2001) view metacognitive knowledge as but one of four types of knowledge, the others being factual, procedural, and conceptual. Of these four types of knowledge, metacognitive knowledge is the most abstract, and therefore the most difficult to teach and assess. It is likely, then, to be the type of knowledge least addressed. This has implications for information literacy instruction because planning learning outcomes that neglect metacognitive knowledge will result in gaps in information competencies.

In order to define metacognitive knowledge we must look at it within the framework of a larger concept – metacognition. Often described as "thinking about thinking", metacognition is deliberate, planful, intentional, goal-directed, future-oriented mental behavior that can be used to accomplish cognitive tasks (Flavell, 1979). The premise underlying metacognition is that human beings are the agents of their own thinking.

Hacker (1998), in his synthesis of the literature on metacognition, suggested that any definition should at a minimum contain the following notions: "Knowledge of one's knowledge, processes, and cognitive and affective states; and the ability to consciously and deliberately monitor and regulate one's knowledge, processes, and cognitive and affective states" (p. 11). Much of the foundational research on metacognition has been in the area of children and education, specifically in reading, writing, studying, math and science (see, for example, Baker & Brown, 1984; Forrest-Pressley & Waller, 1984; Garner, 1987; Paris, Wasik, & Turner, 1991; Van Hanaghan & Baker, 1989; Scardamalia & Bereiter, 1985; Baker, 1991, as cited in Baker & Cerro, 1996, p. 99).

The literature on metacognition reflects a general agreement that there are two distinct, albeit interrelated, aspects to metacognition: *metacognitive knowledge* and *control processes*. (Flavell, 1979; Garner, 1987; Moore, 1991, 1995; Baker & Cerro, 1996; Anderson & Krathwohl, 2001). The first half of the equation, *metacognitive knowledge*, is concerned with the contents of knowledge – the "knowing that" certain strategies work better than others or "knowing that" certain tasks might be easier to perform. The latter

half, *control processes*, has also been referred to as executive control, self-monitoring and self-regulation, and reflects the application of strategies to control and coordinate aspects of metacognitive knowledge – the actual "doing" (Kluwe, 1982, p. 204; Brown, 1987; Moore, 1995, p. 4; Hacker, Dunlosky & Graesser, 1998).

Metacognitive knowledge – the first aspect of metacognition - can be further refined. Typically, it is seen to consist of three interrelated components: *self-knowledge* (awareness of one's own cognition, including knowledge of one's strengths and weaknesses and the awareness of one's motivational beliefs); *task knowledge* (knowledge about the cognitive demands of the task); and *strategic knowledge* (procedural knowledge of strategies to employ when unsuccessful) (Flavell, 1979; Garner & Alexander, 1989; Pintrich, Wolters & Baxter, 1996; Anderson & Krathwohl, 2000).

This study focuses on the *knowledge* half of metacognition, aiming to explore the nature of adolescents' awareness of their own thoughts and feelings, as well as their awareness of cognitive strategies and the nature of the tasks to be tackled within the specific phenomenon of the search process. Figure 4 illustrates the general model of metacognition.

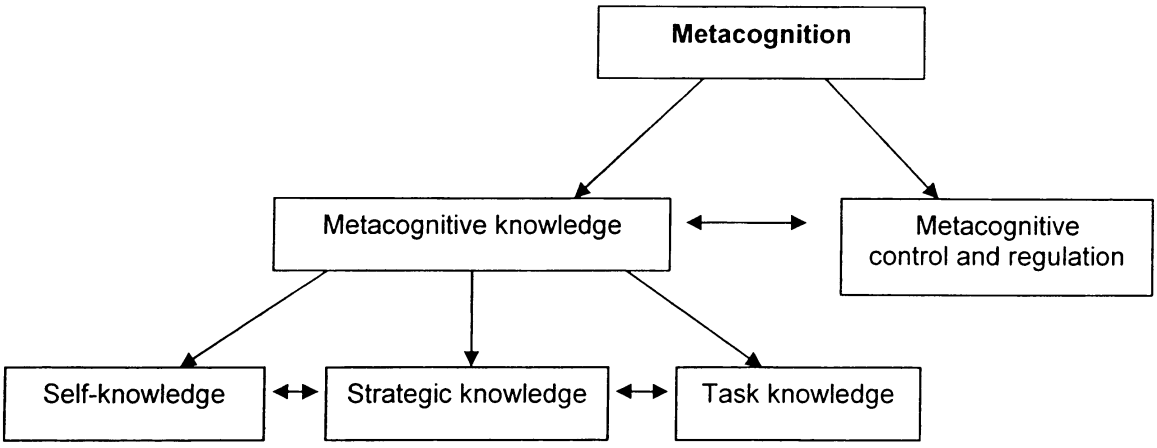


Figure 3: A general model of metacognition

If metacognitive knowledge is a critical component in learning and problem solving, then its role in the specific phenomenon of information seeking, a problem-solving process, should be investigated. Even though metacognitive knowledge and control are necessarily bundled together, this study will focus its analysis on the *knowledge* half of metacognition, aiming to explore the nature of students' awareness of their own thoughts and feelings, as well as their awareness of cognitive strategies and the nature of the tasks to be tackled within the specific phenomenon of the search process.

b. Metacognitive Knowledge During the Information Search Process

Many studies in Education have investigated metacognitive knowledge and its relationship to learning. As this study falls within the domain of Library and Information Science (LIS) and is concerned with information behavior rather than learning outcomes, it is useful to focus on the studies that have emerged from our own field, looking for relevance to the particular problem at hand. Only a small number of LIS studies have investigated metacognitive knowledge during the research process, generally under the rubric of *information literacy*. Fewer still have looked at how metacognitive knowledge and affect simultaneously play out during this process.

Bertland (1986) introduced the concept of Metacognition to the school library audience in her review of research that *could* have implications for information skills instruction. At that point in time, research in this area was new and principally connected to text comprehension, attention and memory rather than information seeking as such. Interestingly, Bertland noted that very little was known about the metacognitive processes of adolescents, most of the research having focused on children under the age of 12 or on college-level students. It would be safe to say that, at least within the realm of LIS, the situation has not changed much today.

Moore (1991, 1995) studied metacognitive issues within the scope of information problem solving in her study of grade-six children in a New Zealand school. Using an interviewing technique, she looked specifically at the children's thinking processes and

awareness of the information retrieval process itself during the course of a school-based research task (a research project on birds). Moore's study pre-dates the Internet; it focused on behavior related to searching the library catalog and physically locating books organized by the Dewey Decimal System. She found that although all the students were guided by metacognitive knowledge during the research process, the nature of this knowledge was incomplete and flawed. For example, although the students could predict the steps they would need to take, when they encountered problems they did not know what to do next. When asked how they would continue their search, most students would simply choose to repeat their strategy rather than re-evaluate their thinking and methods. Although Moore's study gives us a window into the metacognitive knowledge of "youth", it may not be indicative of the specific metacognitive knowledge of adolescents.

Roche (1996) in her Master's thesis looked at metacognition in the library research process amongst a grade-five population. Focusing on the use of metacognitive strategies (earlier defined as *control processes*) and pedagogical outcomes, Roche looked at specific tactics such as planning, goal setting, self-reflection, monitoring progress, and self-evaluation, tactics she had earlier identified through an analysis of the literature surrounding metacognition. These strategies were formally defined in a research framework which she set up *before* data collection. Roche's study supported a complex pattern of metacognitive processes and found strong positive outcomes for those students who monitored their own mental processes. Because Roche's study was structured around an elaborate research framework created a priori, it served more a confirmatory than exploratory role in the study of metacognition in information seeking.

In her doctoral research Wolf (2000), as in the case of Roche, studied specific metacognitive strategies rather than the nature of metacognitive knowledge. The participants were 35 grade-eight students. Using a teaching model called the Big Six Information Skills, Wolf tested the effectiveness of the model in providing metacognitive scaffolding in solving information-based problems. The purpose of her study was to advance knowledge in "best practices" related to information skills instruction rather than to describe information behavior. The study, then, was a treatment study, not exploratory,

and served a confirmatory role. The Big Six Information Skills approach to information problem-solving follows six stages of instruction – task definition, information seeking strategies, location and access, use of information, synthesis and, evaluation. Wolf found that the Big Six Information Skills model provided effective metacognitive scaffolding for students solving an information problem, the students who had followed the Big Six methodology receiving higher scores in their classroom assignments.

McGregor (1994a; 1994b) produced one of the few studies with anything to say about adolescents and metacognition. Using Kuhlthau's model of the ISP as a starting point, McGregor explored what she termed the "higher order thinking skills" of grade-11 students in a gifted program in a Canadian high school. The students' task was to find and use information to produce a research paper. She found that the students' thinking was carried out at an intuitive level, without awareness of their own thinking or ways they could modify their thinking to advance their learning. To the students, the process of thinking was "a mystical, unexplainable phenomenon, one that had almost magical qualities" (1994a, p. 129). The students, she found, did not "instinctively operate in a metacognitive manner" (p. 131). This contrasts with Moore's (1995) finding that children as young as 11 can exhibit and use metacognitive knowledge during the information search process.

Young adults as "intelligent novices" in information seeking and more generally, life, need the intellectual skills to navigate a complex world (Brown & Palincsar, 1985). And yet they are unpracticed in terms of their ability to filter the onslaught of information from open-ended information systems such as the Web. The nature of metacognitive knowledge as it relates to adolescents and the search process has been largely unexplored. What it looks like, how students use it, how it relates to cognition and affect – these are questions that remain. The scarcity of information on how adolescents might employ their metacognitive knowledge during the research process and the patterns resulting from either the use of or lack of such knowledge, suggests an area in need of examination.

2.3.4 Affective Aspects of Information Seeking

The final proposition grounding this study is that information seeking is a multi-dimensional process involving an interplay between cognition, affect and actions. Calls for a broader perspective in LIS have shifted the focus from a narrow, cognitive perspective to a wider view of human behavior that includes the affective experiences related to library-use and information seeking (Nahl, 1995; Wilson, 1997).

a. Attitudes Toward Searching the Web

Recent studies that have investigated the role of affect on youth in information seeking have focused on the medium of the Internet. Typically they have looked at broad attitudinal aspects related to the novelty or interestingness of the Web, rather than, as in the ISP model, anxiety specifically related to a particular stage in the information-seeking process or the information seeker's understanding of the topic. In one of the earliest studies in the area of children's use of the Web, Watson (1998) used qualitative methods to reveal eighth-grade student experiences and reflections on using technology as a tool. The students had access to a variety of information technology, including CD-ROM drives, laser-disc players and Internet connectivity. Watson found that, despite difficulties, children exhibited positive attitudes and self-confidence in relation to their use of information technology, and in particular, the Internet, although positive feelings did not necessarily indicate the successful completion of a search task.

Bilal's three-part series of studies (Bilal, 2000; Bilal, 2002; Bilal and Kirby, 2002) of seventh-grade students searching the Web using the Yahooligans! search engine/directory confirmed Watson's findings. Bilal recorded the specific Web moves used to locate information rather than the broader stages in the process. An interview followed the search sessions in order to gauge attitudes and perceptions. The students were asked to complete three different types of search tasks: an assigned fact-finding task on a science topic, and two complex tasks that required the interpretation of meaning – one an assigned research-oriented task and the other a self-generated task (2002, p. 108). A high

percentage (87%) of the students had positive feelings toward searching the Web, saying that they enjoyed using it over other types of information sources because of; "(a) ease of use over other types of sources, especially print; (b) ability to employ keyword searching; (c) visiting different web sites to find the information; (d) availability of graphics, and (e) fun. (2000, p. 659).

The students in Bilal's study reported few negative feelings, but those who did related it to the "difficulty in finding the answer" and a "lack of matches" (2000, p. 659). Most students expressed motivation, Yahooligans! apparently being able to provide incentives such as a growth in self-confidence, interesting content, intellectual challenge and convenient access from home. The students were persistent and patient information seekers when answering a fact-based question. The reasons for their resilience were that the Web allowed for "efficiency, exploration, challenge, and convenience." (2000, p. 659). Interestingly, most students (47%) reportedly preferred the self-generated task, with a full 73% succeeding in this task, a finding that supports educational theory about the positive role of individual interests in processing information (Blumenfeld et al, 1991; Hidi, 1990). Bilal warns, however, that the students often chose topics that were very broad in nature and that mediation was needed to help the students narrow the focus of their information need.

In the belief that attitude, an affective attribute, can affect motivation and performance, Tsai, Lin & Tsai (2001) created an Internet Attitude Scale for Taiwan high school students to measure their levels of anxiety and confidence as well as their perception of the Internet's usefulness. The Internet Attitude Scale ranked perceived usefulness, affection, perceived control, and behavior. The study also explored gender differences and prior experiences using the Internet. The study reports that, irrespective of gender or experience, students in general appreciated the usefulness of the Internet and showed positive feelings toward it. Gender differences did emerge when factors such as anxiety and confidence were analyzed; the males expressing lower anxiety and higher confidence levels than the female students did. (2001, p. 47). Attitudes were not related to the students' ability to successfully complete a search task.

Large, Beheshti and Rahman's (2002) study of grade-six boys and girls searching the Web over several weeks to complete a school assignment also showed gender differences in affective responses to the Web. As with Bilal, interaction with the Web was analyzed within the framework of specific moves on the screen, such as, for example, keyword/browsing search strategies or time spent viewing web pages. While both genders assessed information on the Web using affective criteria (novelty and interesting information) rather than meaningfulness, the boys seemed to be less engaged with the content, spending less time viewing and more time clicking hyperlinks.

Although most of the research on youth, affect and the Web seems thus far to indicate strong positive attitudes, it should be noted that, first of all, there has been little linkage between general impressions/perceptions and final outcomes (ability to solve the information problem) and secondly, much of this research was conducted nearly five years ago, when the Web was still a novelty to many. And thirdly, many studies were snapshots rather than long-term studies of information-seeking behavior.

b. Library Anxiety

Another LIS area of study related to affect is the phenomenon that has come to be known as *library anxiety*. In a qualitative study involving over 6000 undergraduate students, Mellon (1986) identified a phenomenon experienced by 75% to 85% of undergraduate students during the research process - the feeling of apprehension about using an academic library. She labeled it *library anxiety* and suggested that the negative feelings associated with it were such as to interfere with the students' abilities to attain their academic goals. The Library Anxiety Scale (LAS) (Onwuegbuzie, A. J., Jiao, Q. G. & Bostick, S. L., 2004), was developed as a quantitative tool for measuring the phenomenon of library anxiety amongst all levels of students in higher education. As interesting as the idea of library anxiety is, in actuality it is not specifically relevant to this particular study because its focus is on the library as a *place* rather than research as a *process*. Of greater interest is the spotlight that this area of study has shone on affective issues in general.

c. *Uncertainty During the Information Search Process*

Kuhlthau (1993, 1998) looked at uncertainty during the information search process. In her five studies of high school students completing a research project, she found a correlation between the extent of understanding that students had of the topic space, their level of anxiety, and their ability to complete the information task successfully (1993, 1998). The greater the uncertainty over the meaning of information, the higher the sense of anxiety felt by students about the search process, and the higher the sense of anxiety, the less likely they were to complete the task. Thus, information seekers' feelings have a positive or negative effect on the outcome of their information searches. It seems, then, that alleviating the cognitive state of uncertainty might create affective conditions of confidence that will help information seekers move forward in the process. The problem, however, is that information seeking often occurs within a multiple-source, ill-defined information space, making it difficult to diagnose the timing, content, and degree of specific design-based interventions that might target uncertainty.

Kracker and Wang (2002) united the concepts of anxiety and awareness of task (a metacognitive attribute) into one study of the research process. They looked at the effects of awareness training on the research anxiety experienced by undergraduates. Although Kracker and Wang do not claim to have studied "metacognition" per se, their study relates to this topic because awareness of one's own thinking and feelings as well as the cognitive demands of tasks is considered a characteristic of metacognition. Speculating that students who had greater awareness of the research process would be better able to cope with feelings of uncertainty, Kracker and Wang used a quasi-experimental design to test their hypothesis. During a 30-minute presentation students were shown Kuhlthau's ISP model, a model which views uncertainty as a natural and expected part of the information search process rather than a sign of failure. They found that a general knowledge of the ISP model was sufficient to reduce anxiety. The study focused on variables related to emotion and cognition, and related these variables to the concept of "awareness". Awareness, a concept that could be viewed as related to metacognitive knowledge, was the dependant variable and therefore left unexplored.

From this preliminary research into the connection between affect and the search process, it seems that information seekers' awareness of the task, and the thoughts and feelings associated with it, can have a positive or negative effect on the outcome of their information searches. Despite this recognition of the link between affective states and the outcome of the information search, little research has explored this aspect of information seeking. Global (metacognitive) strategies that can be applied to a wide range of information problems might provide the kind of scaffolding needed to alleviate anxiety, helping to move information seekers through the information search process successfully.

Chapter 3: Methodology

3.1 Introduction

This chapter describes the methodological approach that was used to investigate the research problem. It begins by describing the purpose of the study and the theoretical lens that shaped its design. It then discusses some of the contextual factors influencing the design of the study such as, for example, the difficulties associated with working with an adolescent population in a school setting. The chapter then looks more specifically at the setting, the participants, the information-seeking task and, finally, a detailed description of the procedures that were followed to gain access and collect data. Methods undertaken to analyze the data are presented. The chapter concludes with a look at the role of the researcher, ethical considerations and the limitations of the study.

3.2 Overall Structure of the Study

The approach to research design used throughout this study falls within the family of qualitative research. This type of research design is used when the primary purpose is discovery rather than testing. A principle feature of qualitative research is its naturalistic nature. That is, the research is conducted in the field and in the context of a real life situation, rather than under controlled laboratory conditions. The people who participate in a qualitative study are participants, not subjects, and the qualitative researcher tries to capture data that reflects the participants' perspective. The researcher is the principle "measurement device" in the study, and, although some of the instrumentation can be prepared in advance of data collection, it is assumed that data collection protocols must be readily adaptable to situations or questions as they arise. Because the data emerges from "inside" the participants, most analysis is done with words rather than numbers (Miles & Huberman, 1994, p. 6-7). In this study, the nature of adolescent metacognitive knowledge (as well as the thoughts, feelings and actions that accompany it), were discovered inductively through the participants' discourse with self. This discourse was

elicited in tape-recorded verbal protocols, three telephone interviews, a final in-person interview and a visualization exercise.

Several factors shaped the design of the study. To begin with, looking at metacognitive knowledge through the lens of Kuhlthau's ISP model (in other words, as a series of successive search tasks which together help to construct knowledge, rather than as one discrete stage of information retrieval)[1] meant that the study was necessarily longitudinal and therefore methods had to be devised that would capture change over time. Since it was not known *when* the students would choose to conduct their information search (for example, as soon as the assignment is given by the teacher or the night before it is due) nor *where* they would choose to search (for example, in the school library or at home), direct observation was not possible. The data, therefore, was collected in a naturalistic setting rather than in a controlled laboratory environment, in order to capture the breadth and scope of variables associated with metacognitive knowledge during the information search process.

Secondly the multi-dimensional nature of the ISP model implied that metacognitive knowledge should also be explored alongside three other key concepts - *cognitive certainty/uncertainty*, *affect*, and *actions*. The four key concepts guiding this study are defined as the following:

- *Metacognitive knowledge:* "Knowledge of one's knowledge, processes, and cognitive and affective states; and the ability to consciously and deliberately monitor and regulate one's knowledge, processes, and cognitive and affective states" (Hacker, 1998, 11).
- *Cognitive certainty/uncertainty*: Cognitive uncertainty is "a lack of understanding, a gap in meaning, or a limited construction" (Kuhlthau, 2004, p. 92); Cognitive certainty is the antithesis of "clearly focused thoughts" (Kuhlthau, 2004, p. 92).

[1] The tasks in the ISP model are *Task initiation, Prefocus exploration, Focus formulation, Information collection* and *Presentation.*

Cognitive uncertainty implies a lack of focus on the research topic. It is the state of "knowing" or "not knowing" what the focus of the information search is to be.

- *Affect*: The emotional states (feelings) and attitudes (perceptions) associated with information seeking. Emotion can affect the process of information seeking "by the stance or mood that the user assumes. A mood may be thought of as an attitude that determines one's approach to the task at hand" (Kuhlthau, 2004, p. 98).
- *Actions*: Behavior. The tasks undertaken during the information search process (Kuhlthau, 2004) in order to solve an information problem. The tasks are: Task initiation, topic selection, prefocus exploration, focus formulation, information collection, and presentation.

Thirdly, the triad of phenomenological domains in the ISP model - cognition, affect, and behavior - are mirrored in the conceptual categories that shape this study – thoughts, affect, and actions. *Metacognitive knowledge* and *cognitive certainty/uncertainty* have been grouped together under the conceptual category of "Thoughts", and represent the cognitive domain. "Affect" as its name suggests, represents the affective domain while "Actions" represents the behavioral domain.

Other factors shaping the design of the study relate to the characteristics of the user group under study, all of them active and busy young people, many with conflicting demands on their time. Canadian teens in particular carry high workloads. A Statistics Canada study into the busy lives of Canadian teens compared time-use studies from nine OECD countries. Among these countries, Canadian teens ranked first in terms of average hours spent on unpaid and paid labour during the school week. Canadian teens in fact spend an average of 50 hours a week on school work, home work, paid work and housework, the same as adults aged 20 to 64 spend on similar activities (Marshall, 2007). The problem of how to encourage the long-term engagement of adolescent participants over the duration of this data collection (almost four months) was therefore a very serious consideration. Given these constraining factors, it was critical to devise a methodology that was portable, user-friendly, interesting, and non-invasive.

Layered over these issues are questions related to the study of thinking processes. Trying to look at metacognitive knowledge is akin to using shadows in order to determine the sun's position in the sky – rather than look directly at the sun, one must use inference and interpretation to draw conclusions. One cannot simply ask "what do you know about your own thinking?" and assume that the answers represent reality. Verbal reports are, after all, just data – "nothing more, nothing less" – and should not always be taken at face value (Genest & Turk, 1981, p. 244). Why is this? First of all, participants may not be practiced in externalizing their thoughts and may simply lack the skills needed to make their knowledge about their own thinking explicit to others. Secondly, there is no guarantee that the answer is authentic – is it what the participant really thinks or is it what he or she wants the researcher to know? Thirdly, the participant's memory of the event may be hazy, especially if the report is not in close proximity to the event.

A common practice in studies that rely on verbal reports is triangulation, or crosschecking of information, to corroborate the evidence. In this study triangulation during data collection occurred on three levels. First, four types of data collection protocols were designed and used. Secondly, the protocols were used at different times throughout the study in order to contrast "think-aloud" data (information that is reported at the time of the event) and "think-after" data (information that is reported at a later point in time) (Branch, 2000). Thirdly, the data collection questions were crafted in such a way as to ensure that the participants' thoughts were juxtaposed to their actions. This was done to highlight patterns or reveal inconsistencies among findings about the same phenomenon and to provide evidence of competency. Irrespective of how well data is triangulated, the question remains - does it open a window on thinking? This problem was tackled specifically through open-ended data collection questions that asked the participants *why* they did what they did (in other words, what was their rationale) and what types of *self-prompts* guided their thinking.

Devising a research method that would, on the one hand, track information behavior in the context of the participants' everyday lives in a non-intrusive way but would, on the other hand, provide credible evidence of their thoughts, feelings and actions, was critical

to the success of this study. In short, a balance had to be found between methods that were do-able and methods that were actually useful – a difficult task indeed.

3.3 The Study

The study was conducted in two phases: 1) A pilot study conducted during Spring 2006 and; 2) the principal study conducted six months later in Fall 2006. This section discusses findings from the pilot study and follows with a description of the setting, participants and the information-seeking task in the principle study. Table 1 provides the timeline of the study

Table 1: Timeline of the Study	
Phase	**Date**
Pilot Study	March 2006 (Winter term)
Principal Study	August to December 2006 (Fall term)

3.3.1 Pilot Study

The pilot study provided an authentic platform for testing the protocols and practicing their implementation with an adolescent student. It also helped to highlight some issues related to navigating throughout the school system. Although seven students initially expressed interest in participating in the pilot study, only one student, aged 17, stayed with the pilot study from beginning to end, suggesting a potential retention problem.

The pilot study was not held in the same location as the principal study so as not to taint the data. Ethical approval to run the pilot study was received from the school and written consent was received from both the student and her parents. Access to the student was gained through a personal connection with a teacher, and while the teacher was able to point to interested students, the actual assignment in her class did not have a research component. The student who participated in the study had to identify another course which included a research component. The research project was small, extending over

less than a month, with the outcome being a class presentation – nothing comparable to the research project followed by the students in the main study (see below). As a result the data derived from the pilot study has not been included in the analysis. Nevertheless, the pilot project did teach the researcher some important lessons.

There were three principal outcomes from the pilot. First, problems with the question prompts for the written or audio journal came to light. They did not shine a big enough spotlight on thinking processes and seemed to lead the participant to focus on procedural matters. Furthermore, a prompt asking the participant to identify the date was not included, making it difficult to corroborate the timeline. As a result, the wording for the question prompts was refined and the final number of question prompts increased from four to seven.

Secondly, the researcher was alerted to potential problems accessing and retaining participants in the study, suggesting that a generous approach should be adopted when recruiting participants and that every effort should be made to accommodate their lifestyles. A final outcome of the pilot was that the researcher was alerted to potential logistical problems (such as meeting rooms being locked or student schedules changing) and as a result, approached the principal study armed with possible solutions to problems related to scheduling and location.

3.3.2 The Principal Study

a. Unit of Analysis

The unit of analysis in this study is the information search process, within which there are multiple examples, events and conditions. The unit of analysis is bounded by the series of tasks undertaken by 10 students to complete a research essay for a college-level course in the history of western civilization (more details about the school assignment are provided below).

b. Setting

The principal study was conducted within a Montreal-area, English-language, junior college, commonly called CEGEP, herewith referred to as College A. The acronym CEGEP stands for "Collège d'enseignement général et professionnel" or, "College of General and Professional Education." There are two program streams in the CEGEP system - a two-year pre-university program and a three-year professional program. In either case, the first year is roughly equivalent to grade 12 elsewhere in Canada because high school in Quebec ends at Grade 11. Like Grade 12 students everywhere else, students in CEGEP are at a critical time in their life vis à vis academic performance and personal decisions – the outcome of their educational experience has an impact on their future. While CEGEP students negotiate the same complex world of information as adolescents in the rest of North America, they do so in a new learning environment, many having just graduated from high school the year before. This puts an interesting twist on their search behavior because the CEGEP library and information systems available through the library are completely new to them. As well, the position of teacher-librarian does not exist in Quebec public high schools and most private high schools, and therefore information skills instruction at the high school level is limited. New CEGEP students are, in a sense, a *tabula rasa* – a clean slate as it were – and, at least in terms of library experience, they may have little else to guide them but their metacognitive knowledge.

Most students in CEGEP are between the ages of 17 to 19, although the larger CEGEPs do attract older students to the three-year professional programs. Most CEGEPs are public institutions, but the CEGEP where this study was conducted is a small, private educational institution with no more that 1500 students and offers only a two-year pre-university program. Admission to it is highly competitive and the majority of students continue on to university. While the college is considered to be private, tuition is low because it is partially subsidized by the provincial government. As well, financial aid is available to students who require it.

Initially, an alternative site in a larger, comprehensive, public CEGEP had been investigated for the study, but was dropped when difficulties recruiting participants arose. Only one participant volunteered for the study from this second CEGEP, and while the researcher did collect data from this participant the data has not been included here. It should be noted, however, that a multi-case approach initially was chosen for practical reasons, and not for reasons related to confirmability and reliability. In fact, the researcher had always intended to have a sample size of eight to 10 participants from the same class (the reasons are discussed below). However, given the potential difficulties likely to be encountered in gaining access to students, two CEGEPs were initially targeted simultaneously – either one being acceptable - the rationale being that should one site fall through there would be a back-up available. This is exactly what happened.

c. Participants

Ten adolescents, aged 16 to 18, participated in the study. All were in their first term at CEGEP, having graduated from high school the previous year. All were also in the same required humanities class.

Because CEGEP students are not confined by the boundaries of a local school board and can attend the CEGEP of their choice, the 10 participants did not share a uniform high school experience and in fact had attended nine different high schools from across the Montreal region. Nine of the 10 participants identified the language of their high school instruction: Four had gone to English high schools, three to French high schools, and one to a bilingual (English/French) school. Irrespective of the language of instruction in their high schools, all participants were fluent in English (Table 2 outlines the gender and age distribution among the 10 participants).

Table 2: Participants N = 10						
Date	**Number of participants**	**Gender**		**Age**		
		Female	**Male**	**16**	**17**	**18**
August to December 2006	10	8	2	1	6	3

The sample size of 10 allowed for an ample and rich set of data to be gathered while avoiding the problems of data overload. It also provided a small cushion of security should participants elect to withdraw from the study (which in fact none did). As this study is inductive in nature, its purpose is not to assess a few variables, determined a priori across a large number of instances. Rather, its purpose is to expose the variables present in a single unit – the single unit in this study being the group as a whole. Since these variables were unknown at the start, it was preferable that the sample size be small in order to allow for in-depth exploration.

Related research in this area used a similar range of sampling sizes. For example, Kuhlthau (1991) used the case studies of six students to verify and explain the data collected in an initial survey of 26. McNally's (2005) study into 13 high school students' mental models of the Internet was structured around Kuhlthau's ISP model. Vakkari's (2001) longitudinal study of problem stages in information seeking, a study framed by the ISP model, followed the activities of 11 participants. Swain's (1996) study investigating the ISP model in a college environment initially included 28 students, but only five were interviewed.

Purposeful sampling was used to select a specific class in College A. The purpose of selecting samples is to be able to gather the most relevant data about the phenomenon – in this case, metacognitive knowledge during the information search process – in order to develop a deeper understanding rather than to achieve population validity. Sampling was therefore conducted on the basis of the likelihood that the participants would be

"information-rich" and thus ensure confidence in the categories that emerged from the data.

Different strategies can be used to select cases that are likely to be information-rich for a qualitative study. This study used *criterion sampling*, the criteria that satisfied the needs of the study being the following: participants must be older adolescents between the ages of 16 and 19, must be in the same first-year class at an English-language CEGEP (it was assumed that most students in first year would be adolescent) and critically, the class must have a significant information-seeking task to perform. In the case of this study, the task was a term paper requiring an investigation of information sources over the course of a four-month period. While CEGEP is considered college level, it is not common for CEGEP students to conduct in-depth, research-based projects and therefore the identification of particular classes where such projects were assigned was critical to the success of the study. In the case of this study, the researcher was aware of one teacher who assigned such a project (the researcher had not met the teacher prior to this study) and contacted her directly, rather than ask the CEGEP to identify an appropriate class.

While the specific class was selected purposefully, few constraints were set on the individual characteristics of participants drawn from these classes. In other words, the study was open to any student in the class wishing to participate. All volunteers were accepted, irrespective of gender, language or ethnicity, or of the number of volunteers. One reason driving this decision was the high drop-out rate in the pilot study (seven students were offered the opportunity to participate and only one stayed with the pilot study until the end) which suggested that a generous approach should be adopted to sampling, especially since the study was additional to the participants' regular school assignments and responsibilities.

The primary reason for opening the study to all students in the participating class was, however, to assure the teacher that the students would have equal opportunities to benefit from the study (a concern expressed by a teacher and which might have led to the withdrawal of that class from the study). To walk into a class and say that only some of the students in this class are eligible to participate might be seen as offering a benefit to

some students and not to others. It was decided that, in the interest of fairness to all students in each class, anyone wishing to participate would be able to.

An alternative approach to recruiting volunteers for the study - to advertise throughout the institution with posters and flyers that specify a specific age - was considered and discarded. This random approach might have circumvented the issue of "equal opportunity" within a class but may have resulted in a sample that is "reduced to uninterpretable sawdust". In studies with a small sample size, "random sampling can deal you a decidedly biased hand" (Miles & Huberman, 1994, p. 27) in the sense that there might be *too* much diversity amongst a very small sample size – making it difficult to see patterns and ultimately threatening the reliability of the study's findings.

The decision *not* to find participants through campus-wide advertising was, however, based principally on the fact that the researcher did not work at the CEGEP where the study took place, did not know the students and they, of course, did not know her. It was felt that this might lead to a lack of trust and credibility, two critical ingredients in a qualitative study of this nature. Working with a teacher was a more purposeful method that helped to lend credibility to the study (at least in the students' eyes) and thus helped to ensure there would be reliable and interested participants in the study.

d. The Information-seeking Task

The research design was bounded by an information-seeking task that was created and assigned by the teacher. Adolescents, aged 16 -19, searched for, evaluated and used information to complete a semi-imposed, inquiry-based research paper, using any variety of information sources. The notion of a "semi-imposed" research assignment is derived from the model of the *imposed query* (Gross, 1995, 1998) which states that information seekers ask two types of questions: self-generated and imposed. Self-generated questions evolve from a personal context and are answered directly by the questioner. Imposed questions, according to Gross (1995, 1998), are constructed by one person but answered by another, and pose a challenge to information seekers because the further one is from question generation, the more difficult it is to answer the question. Meaningfulness and interpretation come into play and create a barrier to effective information seeking.

Imposed questions are common within the school context, with the teacher providing the question and the student asked to answer it. In this respect, the teacher is the "imposer" and the student acts as the "imposer's agent". In the case of this study, the question (or assignment) was imposed by the teacher, in the sense that the participants probably would not have gone through a similar information-search process had the teacher not requested it. The participants were, however, free to choose the specific topic as long as it remained within the relevant domain of knowledge. For this reason, the task has been labeled as "semi-imposed" rather than "imposed".

The 10 participants in College A were asked by their teacher to write a seven to eight-page argumentative essay exploring continuity and change in western civilization. The search process was a critical element to the success of the assignment because the students were to use information sources to defend their position. The class had an assigned text book but it was not to be included in the list of sources for the research paper. The students were first asked to identify a topic and to locate it within a specific geographic location and time frame. No specific guidelines or boundaries as regards the topic were provided, as long as it was related to the history of western civilization. As a result, the 10 participants investigated a wide array of topics – from Greek architecture to classical music (see Table 3).

Table 3 : Research Topics for School Assignment

- Baroque and Classical Music
- Greek architecture: Doric and Corinthian
- Greek philosophy: Hellenic and Classical Greek views of nature, as embodied in the visual arts
- The influence of the scientific discoveries of ancient India on western civilization
- The study of stars in medieval Islam and renaissance Europe
- Greek philosophy and early Christianity: the infinite God, human love and sexual understanding
- Women with influence during the Egyptian New Kingdom
- The French Revolution
- What happened to Christians during the transition to the Ottoman empire
- Clay tablets versus papyrus : The evolution of Egyptian libraries

The students were told about the assignment during the first class (last week of August) and the assignment then unfolded in four stages over the course of four months. By the second week of school they were to identify the topic. Two weeks later they were to present a short annotated bibliography of five sources. They were then asked to critically evaluate one website that would be helpful in their research and finally, they were asked to write a seven to eight page research paper, due just before the exam period at the end of the term. The bibliography for the final paper had to have at least eight information sources, only three of which could be websites (see Appendix C for the actual assignment).

3.4 Procedures for Data Collection

What follows is a description of the procedures used during data collection, including the steps taken to gain access to the site, a discussion of the considerations at play in the

development of the data collection protocols, and finally, a description of each protocol and how it was used.

3.4.1 Gaining Access

The process for gaining access to the institution and to participants at College A took place both at the departmental and teacher level. Ethics approval from McGill University was deemed by the college to be adequate evidence that participants' interests would be protected. The researcher was told to contact a teacher directly and that the decision to participate would be his or hers to make.

Approval from College A took time and only finalized a few days before actually entering the classroom. A teacher who taught a humanities course in the history of western civilization, a course in which the students would have to complete a significant research paper, was contacted in Spring 2006 – a full six months before the formal study was to begin. The teacher said she wanted to read the research proposal carefully over the summer, understandable given that the college does not have a formal ethics approval process in place. She was contacted again in mid-August, as requested, and she agreed in principle to allow her students to participate but still wanted to discuss it with her department head. At this point the timing became critical because the fall term would soon begin (a critical piece of the research methodology was that participants should be recruited *before* they had begun to work on, or even think about, their research projects so as to capture the information-seeking process in its entirety). In the event, the teacher agreed to allow the study to be conducted in her class; her approval was indicated by an email, followed up by a letter. A meeting with the teacher was quickly arranged to discuss in detail the process for introducing the research to her students.

The teacher introduced the researcher during the first class, and the latter gave a short, five-minute PowerPoint presentation to the class, explaining the purpose of the study, the procedures, and the risks and benefits to the participants. Anonymity and voluntary participation were emphasized. The presentation was not considered to be part of the

informed consent process. Indeed, during the class presentation it was emphasized that although much of the data could be collected over the telephone, participants would have an initial meeting with the researcher on campus for about 30 minutes to ensure a full understanding of the procedures involved. It was also explained that consent from parents would be required for those under 18. Blank forms for names and a contact (telephone or email) were then handed out in class. Of 31 students in the class, 11 initially expressed interest in participating in the study (10 finally consented to participate; it is not known why the rest of the students in the class did not participate). The researcher met with each consenting student on campus in order to explain the procedures. Written consent was received from all 10 participants, as well as the parents of participants under the age of 18.

3.4.2 Data Collection Protocols

This section discusses the design and application of the data collection protocols. It looks at issues related to data collection protocols that monitor internal processes over time. The relationship between the research questions and the questions used in the data collection protocols is explored and then each protocol is looked at more closely. The rationale underlying the design of each protocol is explained as well as its connection to the conceptual categories guiding this study. Five types of data collection protocols were used with the students in this study: 1) a series of three telephone interviews; 2) written and/or audio journals; 3) an in-person interview immediately following the submission of the essay 4) a visualizing exercise (a timeline) and; 5) a follow-up interview conducted several months later (see Table 4 for a list of data sources).

Table 4: Data Sources								
Participant	Telephone interview #1	Telephone interview #2	Telephone interview #3	Interview (in-person)	Visualizing exercise (Timeline)	Journal		Follow-up interview with students
						Audio	Written	
H01	√	√	√	√	√		√	√
H02	√	√	√	√	√		√	
H03	√	√	√	√	√		√	
H04	√	√	√	√	√		√	
H05	√	√	√	√	√		√	
H06	√	√	√	√	√		√	
H07	√	√	√	√	√	√	√	√
H08	√	√	√	√	√	√		√
H09	√	√	√	√	√	√	√	
H10	√	√	√	√	√		√	√
Number of data sources	**10**	**10**	**10**	**10**	**10**	**3**	**9**	**4**

In the design of the data collection protocols, consideration was given to the study's longitudinal nature. As it looks at process, data collection methods that capture *change over time* were used in order to see emerging trends. To this end, a telephone interview was administered three times during the school term: at the beginning of the time frame allocated to complete the school assignment, and at two points in the middle. An in-person interview was conducted at the end of the search process, immediately after the research paper had been submitted. It is important to note that it was not known at what point the students would actually conduct their information search; some students began

their search as soon as the assignment was given by the teacher, others waited until the last minute!

Capturing the students' record of thoughts, feelings and actions throughout the process via a small hand-held tape recorder was another method to monitor change over time, although it can not be known exactly when the recordings were made – at the time of the event or several weeks later. The timeline exercise demonstrated process and change visually, while the final in-person interview focused on themes related to the six stages (or processes) of Kuhlthau's ISP model, thus opening a window into the evolution of the information search process as experienced by each participant.

3.4.3 Verbal Reports: Think Alouds and Think Afters

The study used a combination of *Think Aloud* and *Think After* verbal protocols in order to provide as many venues as possible for the expression of thoughts, feelings and actions. In this way, the data could be triangulated. Both methods can provide data about behavioral, cognitive and affective process, and each has its strengths and weaknesses.

Think Alouds are a way to look at a phenomenon as it happens. Also referred to as talk aloud, think aloud, or thought-listing (Branch, 2000, p. 373), they are collected in the midst of a process or action, typically by asking participants to explain their thinking out loud as they complete a task, or by interrupting their actions with questions, also called "concurrent verbalization" by Anders Ericsson & Simon (1980, p. 218). As Branch (2000) reports, *Think Alouds* can provide rich data but some participants find it hard to talk at the same time as they carry out a task, particularly if the task is cognitively demanding. In the context of this study, the hand-held tape recorder or written journal provided the participants with an opportunity to think aloud as they searched for information. The most authentic think aloud method used in this study was the telephone interview, which caught the participants "live", in the midst of their contemplation about the search process (recall that this study is not about information retrieval, but about the larger search process).

Think Afters, as the name suggests, are collected after a phenomenon has occurred and can include interviews, surveys, concept mapping and other visualizing methods. Also called "retrospective verbalizations", these techniques allow for some reflection on the part of participants, perhaps opening a wider window into their own thinking (Ericsson & Simon, 1980, p. 218). The great weakness of these post-task methods, however, is that participants can forget. In doing *Think Afters*, participants tend to describe the shortest route to completion of a task, forgetting to mention some of the dead ends they encountered along the way (Branch, 2000). In this study, *Think After* methods included a timeline exercise and an in-person interview at the end of the school project.

Given that both *Think Aloud* and *Think After* verbal protocol analyses have weaknesses, a total dependence on one method over the other is not recommended. This study used a mixture of both, an approach that is supported by Moore (1995) in her study of metacognition and children in information problem solving, in which both concurrent and retrospective techniques were used. Moore justifies this approach by saying that "not all parts of the library information retrieval process are amenable to think aloud interview techniques" (p. 6) Table 5 provides details concerning the use of *Think Alouds* and *Think Afters*.

Table 5: Verbal Protocols: Think Aloud or Think After		
Protocol	**Think-aloud or Think-after**	**Application**
1) Three telephone interviews	Think Aloud	One interview in the beginning of the semester and two interviews in the middle (before the research paper was submitted).
2) One in-person interview	Think After	At the end of the semester (after the research paper was submitted).
3) Visualizing exercise (timeline)	Think After	At the end of the semester (at the same time as the in-person interview, after the research paper was submitted).
4) Written and/or audio journals	Think Aloud and/or Think After, depending on when the participant completed it.	Throughout the study, as the participant saw fit.
5) Follow-up interview with students	Think After	10 months after the completion of data collection, mid-way through data analysis

3.4.4 Data Collection Questions

The primary question guiding this research is: *What is the role of metacognitive knowledge during the information search process of adolescents?* Two secondary questions frame the study and provide conceptual categories for the design of the protocols, specifically in the development of the data collection questions:

1. Within the context of the search process, what are the qualities of adolescents' metacognitive knowledge?

2. How does the metacognitive knowledge of adolescents map on to the cognitive, affective and behavioral dimensions of the search process?

The hierarchy of research questions, ranging from general to specific, is often confused by researchers developing a research design. Punch (2000, p. 23) identifies three levels of research questions: general, specific and data collection questions. Each level must connect logically, by induction and deduction. That is, the questions must make sense whether they are asked from the top down or the bottom up. At the top level of the hierarchy, questions are abstract and use conceptual models to describe the problem. They are usually not themselves directly answerable. The secondary research questions become more specific, but they still reside at a conceptual level. Moving deductively down the hierarchy, the researcher begins to ask data collection question(s). This type of question is more concrete, detailed and points directly at the data needed to answer it.

Researchers, according to Punch (2000, p. 27), often confuse research questions with data collection questions: "A research question is a question which the research itself is trying to answer. A data collection question is a question which is asked in order to collect data in order to help to answer the research question". Data collection questions are questions the researcher asks her- or himself and should not be confused with the questions used in data collection protocols, such as interviews, questionnaires or surveys (although clearly the questions used with participants in the field must logically link back to the research questions). It is at the concrete level of data collection questions, that the transition is made from conceptual to operational. From the data collection questions emerge the data collection protocols that are used to actually collect the data. For example, one data collection question the researcher asked herself was, "What reflective questions do adolescents ask themselves during the search process?" In the field, this question was operationalized as the following prompt; "Can you think of three questions that you asked yourself (or are asking yourself) about looking for information on your topic." – a question asked each participant during the three telephone interviews.

In order to avoid confusion, Tables 6 and 7 show how the data collection questions are aligned to the larger research questions that guide the study. The data collection questions tried to capture three types of phenomena, and have been divided into three conceptual categories: *1) thoughts* (specifically, metacognitive knowledge and certainty/uncertainty), *2) affect* and, 3) *actions* (specifically, task initiation, topic selection, prefocus exploration, focus formulation, information collection, and presentation). In some cases, data collection questions were replicated across several research questions. These data collection questions provided a guideline for the development of the probes used in the data collection protocols.

Table 6: Research Question 1: **Research questions and data collection questions**
General research question: What is the role of metacognitive knowledge during the information search process of adolescents?
RQ1 **Specific research question:** Within the context of the information search process, what are the qualities of adolescents' metacognitive knowledge?
RQ1 data collection questions: 1) *What reflective questions do adolescents ask themselves during the search process?* (Conceptual category: 1) Thoughts). 2) *When do they ask them?* (Conceptual category: 1) Actions) 3) *Why do they ask them? (Conceptual categories:* 1) Thoughts; 2) Affect) *4) What do they feel when they ask them?* (Conceptual category: 1) Affect) 5) *What do adolescents understand about their own cognitive processes during the information search* (Conceptual category: 1) Thoughts) 6) *What kinds of metacognitive strategies do adolescents employ during the search process?* (Conceptual category: 1) Thoughts) 7) *When do they use them?* (Conceptual category: 1) Actions) 8) *Why do they use them?* (Conceptual categories: 1) Thoughts; 2) Affect) 9) *What do adolescents understand about the search process and the tasks associated with it?* (Conceptual category: 1) Thoughts) 10) *Does their understanding of their information problem change as they move through the search process?* (Conceptual category: 1) Thoughts)

Table 7: Research Question 2: Research questions and data collection questions
General research question: What is the role of metacognitive knowledge during the search process of adolescents?
RQ2 **Specific research question:** How does the metacognitive knowledge of adolescents map onto the cognitive, affective and behavioral dimensions of the search process?
RQ2 data collection questions: 1) *What do adolescents understand about their information topic when they reflect upon the search process?* (Conceptual category: 1) Thoughts) 2) *What do adolescents feel about their information topic when they reflect upon the search process?* (Conceptual category: 1) Affect) 3) *What do adolescents do when they reflect upon the search process*? (Conceptual category: 1) Actions) 4) *What types of self-prompts do adolescents use to help them understand their information topic?* (Conceptual category: 1) Thoughts) 5) *What do adolescents do when they prompt themselves with reflective questions about their information search?* (Conceptual category: 1) Actions) 6) *When, if at all, do adolescents achieve a focus on their information topic?* (Conceptual category: 1) Thoughts)

3.4.5 The Protocols

Five types of data collection protocols were used with the students in this study: 1) a series of three telephone interviews; 2) an in-person interview immediately following the submission of the essay 3) a visualizing exercise (a timeline); 4) written and/or audio journals, which were provided to the participants in a kit; and; 5) a follow-up interview conducted several months later. The in-person interview and visualizing exercise occurred at the end of the school term, after the research paper had been submitted. The questions and prompts used in the data collection protocols were designed to make explicit the three conceptual categories of *thoughts*, *affect* and *actions*. Tables 9, 11, 13,

and 15 show how each protocol is aligned with the conceptual categories of thoughts, affect, and actions. Metacognitive knowledge was specifically targeted by questions related to *why* and by *self-prompting questions*.

a. Telephone Interviews

Three telephone interviews were conducted with each participant over a three-month period. The telephone interviews were typically no more than 10 minutes long. The researcher took notes by hand and transcribed the interviews into a text document immediately after the interview. Interviewing by telephone, rather than in person, was preferable because it could be conducted in the evening and on weekends, and made the interview process easier for the participants. The telephone interviews caught the participants "live", in the middle of their research projects, and were therefore as close as data collection could get to an authentic "think-aloud" protocol without actually being in the participants' homes. A semi-structured interview schedule was followed during the telephone interviews. While most questions on the schedule were asked, often new questions would arise from the participants' comments. (see Table 8).

Table 8: Verbal Protocols: Telephone Interviews
1. Has your paper got a title? 2. What are you looking for right now? 3. Where have you already looked? 4. Can you think of three words describing how you feel about your topic right now? 5. Do you feel like you know where to find the information you need and how to get it? 6. Complete this sentence: When looking for information, I've been thinking… 7. Complete this sentence: The difficult part about looking for information right now is… 8. Complete this sentence: When looking for information sometimes it helps to… 9. Can you think of three questions that you asked yourself (or are asking yourself) about looking for information on your topic?

While convenient for the participants, trying to reach the participants by telephone was time-consuming for the researcher. For every participant actually reached by telephone, at least two to three calls had to be made and messages left. This accounted for almost 100 telephone calls by the researcher. Although a rough telephone schedule had been included in the kit that was provided to the participants, the timing was not always convenient for them, and the researcher had to call again. At times, text messaging was used to set up a telephone appointment.

Table 9: Conceptual Categories Addressed by Questions During the Telephone Interviews	
Conceptual category	**Question**
Thoughts	5, 6, 7, 8, 9
Affect	4
Actions	2, 3

b. In-person interview

At the end of the term, after the research paper had been submitted to the teacher, the researcher met with each participant in order to conduct a semi-structured interview, followed by a visualizing exercise (details about the exercise are provided below). The interview questions emerged from the telephone interviews and were framed by the six stages of the ISP model. This structure helped to correlate the qualities of metacognitive knowledge with the specific tasks, phases and dimensions of the ISP model. While the interview followed a general structure, points of interest did emerge and the researcher was not hesitant to ask questions that helped to reveal thinking processes and feelings experienced during the information-search process. The interview was audio-taped, later transferred to a digital format and then transcribed to a text document, using *iTunes* software as the media player. (see Table 10 for a sample of the questions asked during the in-person interview).

Table 10: Verbal Protocols: In-person Interview

1. How would you describe your style of looking for information?
2. What makes looking for information easier for you than it is for some people?
3. What makes looking for information harder for you than it is for some people?
4. When you were selecting a topic, what did you do to make it easier to find information? Why?
5. Once you had some information, what helped you explore your topic in greater depth? Why?
6. What helped you focus in on your topic? Why?
7. When you were collecting information on your topic, what did you do to make that easier? Why?
8. What helped you put all the information together into one paper? Why?
9. What does information mean to you?

Table 11: Conceptual Categories Addressed by Questions During the In-person Interview	
Conceptual category	**Question**
Thoughts	1, 2, 3, 4, 5, 6, 7, 8, 9
Affect	-
Actions	1, 2, 3, 4, 5, 6, 7, 8

c. Visualizing exercise (timeline)

The visualizing exercise (a timeline) occurred during the same meeting as the in-person interview. For the visualizing exercise participants were asked to draw a timeline and along this line describe four elements of their search process: 1) their *actions*, 2) the reasons *why* they took these actions, 3) the *questions* they asked themselves and, 4) the *feelings* they experienced. They were also asked to identify the point at which they felt they had a focus on the topic. In other words, the point at which they knew what they were looking for (see Table 12 below for a sample of the prompts used during the timeline exercise). The timelines were transcribed to a text document for the purposes of analysis (see Appendix E for an image of a timeline and Appendix F for the transcription of this timeline).

Table 12 : Verbal Protocols: Prompts for Visualizing Exercise (timeline) *

*Verbal prompts developed by the researcher.

1. Write the title of your essay
2. Draw a line along the length of the page. The start of the line is the point at which the teacher gave you the assignment. The end of the line is when you handed the assignment in to the teachers.
3. In black: Write what you did [the actions you took]
4. In blue, write down why you did it.
5. In green, write down what your feelings were when you took that action.
6. In red, write down the questions you asked yourself when you took that action.
7. Indicate with an x the point at which you found a focus on your topic.

Table 13: Conceptual Categories Addressed by Prompts Used for the Visualizing Exercise (Timeline)

Conceptual category	Question
Thoughts	4.6.7
Affect	5
Actions	3

d. Self-reporting Via Written Journals and Hand-held Tape Recorder

Each participant was asked to record in a written or audio-taped journal, in English or French, their thoughts, feelings and actions whenever they searched for information for their research paper. The option to choose either writing or talking into a tape-recorder (or both) was offered in order to facilitate participation. Each participant was provided

with a kit that included a notebook, a small handheld tape-recorder, a card with question prompts, and a letter from the researcher indicating the approximate dates that the participants would be telephoned (see Appendix E for an illustration of the kit). Results from the pilot study had suggested that focused prompts were needed in order to move participants beyond a strictly procedural description of their actions. While the journals were conceived as possible sources for "think aloud" data – that is, information about an event that is recorded at the time it occurs – in actual fact, there is no way to know at what point the journals were completed (see Table 14 for prompts for self-reporting).

Table 14 : Verbal protocols: Prompts for Self-reporting*

*Provided on a card in the pencil case and inside the journal

Whenever you look for information about your research project, *from anyone, in anyplace, in any way*, talk into the tape-recorder, or write in the journal.

As you talk or write, try to complete these seven statements:

1. Today's date is…
2. Right now I'm looking for information about…
3. I decided to do the following in order to find information:…
4. I decided to this because (explain the reasons)…
5. Questions I ask myself that help me look for information are…
6. This approach (what I decided to do) worked (or didn't work) because…
7. This approach (what I decided to do) made me feel…

The journals, whether completed in the middle of the process or after the fact, did provide a rich source of data on the participants' thoughts, feelings and actions. Of the 10 participants, seven chose to keep a written journal, two kept both a written and an audio journal, and one used the audio-journal exclusively. One student did not keep a journal of

any sort but provided the notes written in the course notebook, which included thoughts about the research topic. While most participants found writing in the journal more comfortable than speaking into a tape-recorder, the three participants who did use the hand-held recorder said it was more convenient when they were pressed for time. The audio journals were transferred to a digital format and then transcribed to a text document, using *iTunes* software as the audio output.

Table 15: Conceptual Categories Addressed by the Prompts for Self-reporting	
Conceptual category	**Prompt**
Thoughts	4, 5, 6
Affect	7
Actions	2, 3

e. Follow-up In-person Interview

Ten months after data collection for the principal study had ended, and mid-way through data analysis, four of the 10 students who had participated in the study agreed to be interviewed again. The interviews were semi-structured and were conducted in-person on campus. The purpose of the follow-up interviews was to present the participants (or at least four of them) with early results from data analysis and ask for feedback. Since the events under study had taken place almost one year before, the researcher asked the participants to consider the results in light of their information-seeking behavior in general (but in terms of school-based tasks). The four participants elaborated on the themes emerging from the study, offering further insight into adolescent metacognitive knowledge during the information search process.

3.5 Procedures for Data Analysis

Guba and Lincoln (1985, p. 334-335) describe a data analysis continuum for naturalistic inquiry that ranges from "inductive-generative-constructive-subjective" to "deductive-verificatory-enumerative-objective". The use of specific methods of data analysis

depends on where a study is located along this continuum. While there are two ends of the continuum, studies can fall anywhere along it depending on the research problem to be investigated. Interestingly, inductive methods of analysis have been compared to the principle task of librarianship – the organization of knowledge to make it accessible (Mellon, 1990, p. 69). Mellon suggests that qualitative methods are a natural fit for librarians, most being familiar with the task of bringing order from chaos.

At the extreme end of the "inductive-generative-constructive-subjective" end lies the technique of *analytic induction.* Goetz and LeCompte (1984) describe this strategy as a process of negative case analysis, meaning that the analyst looks for cases that *do not* match the emerging categories in order to expand the typography. The next method along the continuum is Glaser and Strauss' *constant comparative* method, a process of comparing segments of data within and across categories (Strauss & Corbin, 1990). Described by Guba and Lincoln (1967, 336) as "less extreme", the constant comparative method is a process of comparison and revision leading to clarification of the meaning of each category. Further along the data analysis continuum we find *typological analysis* (types of categories based on an a priori theory), *enumerative systems* (frequency counts) and *standardized observational protocols* (standardized, predetermined categories). This study is situated at the inductive end, but closer to the midway point of the continuum. Lewins and Silver (2007), describing different approaches to data analysis, note that inductive and deductive approaches "should not be viewed as dichotomously opposed or mutually exclusive" (p. 88). Many researchers, they point out, combine approaches. That is the case in this study, which began with predefined areas of interest but then moved toward a more grounded approach in order to uncover the web of qualities that underlie metacognitive knowledge. It should be noted that using a grounded approach does not necessarily translate to Grounded Theory (Glaser & Strauss,1967; Strauss & Corbin, 1990), an approach this study makes no claim to. As Lewins and Silver (2007, p. 84) point out, "many researchers work in grounded ways, without strictly adhering to the processes of Grounded Theory as they have been described."

3.5.1 Phases of Analysis

Analysis has been divided into two phases: (1) pre-data collection and; (2) post-data collection analysis.

a. Pre-data Collection

During the first phase of analysis (pre-data collection) a *typological analysis* of the literature – a deductive approach - resulted in the development of a coding schema based on the theoretical perspective underlying this study. From the typological analysis, three conceptual categories emerged; *thoughts, affect*, and *actions* (metacognitive knowledge is a subset of the *thoughts* category). These three broad streams were translated into a simple start-list of codes and provided the starting point for data analysis. (see Table 16 for the provisional "start-list" of codes).

Table 16: Provisional "Start-list" of Codes

• *Thoughts*: Evidence of metacognitive knowledge	MK
• *Thoughts* Cognitive Certainty	CERT
• *Thoughts*: Cognitive Uncertainty	UNCERT
• *Affect*	AFF
• *Action*: Task Initiation	ISPini
• *Action*: Topic Selection	ISPtopic
• *Action*: Prefocus Exploration	ISPexplore
• *Action*: Focus Formulation	ISPfocus
• *Action*: Information Collection	ISPcollect
• *Action*: Presentation (search closure)	ISPpresent

b. Post-data Collection

The bulk of analysis was done post-data collection. But before analysis could begin in earnest the data had first to be transcribed. Notes from the telephone interviews were transcribed immediately following the interviews. Text from the timelines was transcribed as well. (An example of how the timeline was transcribed can be found in Appendix F). The final in-person interviews, initially captured on mini-cassettes, were digitized and then transferred to the iTunes media player. They were then transcribed to a word processing file. All data were then imported to a qualitative data analysis software application (Atlas.ti 5.2) and one Hermeneutic Unit was created (the "container" for all the data and coding). During coding, the data was segmented, or chunked, into meaning units that lay at the sentence and paragraph level. Three types of codes were used – *descriptive, interpretive* and *pattern* (Miles & Huberman, 1994, p. 57) - each representing a progressive drilling down through the data.

Descriptive codes are concrete and based on a predefined area of interest. There is little interpretation involved in descriptive coding; the researcher is simply connecting a class of phenomena to the evidence in the data. In this study, descriptive coding began with the original start list of codes and expanded to include new coding, often derived in vivo – that is, using the language of the participant. The descriptive codes were used principally as a means to locate evidence of thoughts, affect, and actions in the data. The specific nature of thinking, feelings and actions was, however, not interpreted at this early stage. In order to uncover finer distinctions in the data it became necessary to adopt a more interpretive approach, particularly for the coding related to metacognitive knowledge. *Interpretive codes* add meaning to data. In this study, data that was previously coded descriptively as "metacognitive knowledge", or even more broadly as "thoughts", took on a new, deeper meaning when recoded interpretively. For example, Participant 3 spoke of "whipping" himself into shape and ignoring information that was interesting but not relevant - evidence of his awareness of the importance of self-control and the role of motivation. This text, previously coded under the broad category of metacognitive knowledge, was coded interpretively as "(mk) control".

As analysis progressed, new codes emerged. Sixty-three codes were assigned to the category of metacognitive knowledge and 64 to affect. (However, the 6 codes for the ISP model, identified a priori, were used with no adaptations or additions. This was because it is not this study's purpose to develop the ISP model further). During coding several new unanticipated categories emerged (for example, the social aspects of searching, the format of the information source, and the type of search strategy used). These new categories linked to metacognitive knowledge, affect and the tasks in the search process, and added precision to the emerging picture of metacognitive knowledge during the information search process. Other categories became redundant as coding progressed. For example, the codes used to represent metacognitive knowledge of self, task and strategy were quickly dropped because they were so broad that they applied to almost every instance of metacognitive knowledge. In total, 291 codes were assigned to the data.

Working with such a large number of codes can become unwieldy if many of the codes are redundant. Furthermore, the interpretive nature of the coding related to metacognitive knowledge meant that there was always the possibility of misinterpretation and the incorrect application of the code. To avoid these problems, operational definitions for codes in the conceptual category of metacognitive knowledge – the primary focus of this study - were developed as each code was created so that the meaning was clear, they were understood to be distinct entities, and they were applied to the data consistently. Definitions were concrete and grounded in the data, often using the actual words and actions of the participants to explain the meaning of the code. For example, the working definition for the metacognitive knowledge related to using a cognitive short cut to help develop understanding (code used: (mk) short cut), roughly sketched out, was the following;

> "Knowing tactics that will help to move the search forward more quickly and efficiently. How to skip over some steps in the search - a shortcut. Knowing when to apply a shortcut tactic. Knowing when using a shortcut will be helpful and when it won't. Example: "Talking to people with expertise or who simply know more than you (P1)".

Pattern codes, the third level of coding, are more inferential and explanatory. They are generally assigned after descriptive and interpretive coding have been applied and help to pull together a lot of material. Pattern codes for the conceptual categories of metacognitive knowledge and affect were derived using a manual approach – by printing the codes, sorting them into piles (each pile representing chunks of related data), and labeling them – the label representing attributes of metacognitive knowledge or affect. The process of sorting resulted in 15 categories of metacognitive knowledge, which were re-assessed and later reduced to 13. The 13 categories are: *knowing your strengths and weaknesses, knowing what you don't know, scaffolding, building a base, parallel thinking, understanding curiosity, communicating, changing course, understanding time and effort, balancing, understanding memory, pulling back and reflecting* and *connecting.* These attributes answer the research question: *Within the context of the search process, what are the qualities of adolescents' metacognitive knowledge?* A second research question, *How does the metacognitive knowledge of adolescents map on to the cognitive, affective and behavioral dimensions of the search process?* is about relationships between conceptual categories and had to be answered by querying the Atlas.ti database. This was done in one of two ways: 1) by asking for sets of co-occuring codes in order to look for overlap between categories; and 2) by combining descriptive and pattern codes from two different categories into a totally new data set (called a "super code" in Atlas.ti). For example, to discover when a particular attribute of metacognitive knowledge comes into play during the search process, the category of metacognitive knowledge labeled "communication" was combined with coding for the tasks in the search process. Using this method it was revealed, for example, that the participants (as a group) used talk as a metacognitive strategy at least 17 times when they were selecting a topic to research, more than at any other time in the search process. This is just one of many queries undertaken to test the data and reveal patterns *between* conceptual categories.

3.6 Role of the Researcher

The researcher is a professional librarian with several years' experience working with young people. While this professional experience can lend "theoretical sensitivity" - the insight or ability to give meaning to data (Strauss & Corbin, 1990, p. 41) - the researcher in this study took a more neutral stance and did not play a participating role in the students' information search process nor in classroom activities. The reasons for this are the following. First of all, it prevented the researcher, a librarian, from inadvertently guiding the students' search process. Secondly, the longitudinal nature of this study precluded any continuous on-site observation. And finally, it was not known where and when the students would conduct their searches. CEGEP students are more autonomous than high school students and it was expected that some of the search process would occur outside the school environment. Most of the participants in the study did in fact report searching for information at home, in the evenings and even during early pre-dawn hours!

3.7 Limitations

Due to the small sampling size, generalizations beyond the context of the study will be difficult to infer. The 10 participants in this study were high academic-achievers in a Montreal-area private school, and their behavior may not reflect that of the general population. As well, their behavior may have been shaped by the type of information task assigned to them by the teacher. The results of this study are specific to an area of domain knowledge – the history of western civilization – and are not generalizable to other domains of knowledge. In addition, the extent of the students' prior domain, information system and metacognitive knowledge, in relation to other students of their age, were not known as the qualitative methods to be used in this study precluded the use of a control group or wide sampling procedures. Only 2 of the 10 participants in this study were male and therefore the study presents no findings regarding gender-based behavior.

3.8 Efforts to Assure the Quality of Conclusions

Methods for assuring the quality of the study were undertaken throughout the research process – from the initial design of the study through to the final presentation of the results. Four criteria of trustworthiness are generally used in naturalistic research: *confirmability*, *dependability, credibility* and *transferability* (Guba & Lincoln, 1989; Miles & Huberman, 1994).

3.8.1 Confirmability

Defined by Miles and Huberman as "reasonable freedom from unacknowledged researcher biases" (1994, p. 278). It also relates to the replicability of a study. Efforts were made to produce a study that was as free from bias as possible through the following methods:

- The researcher did not play a role in the classroom and was did not work as the librarian at the CEGEP where the study took place.
- The study's methods and procedures are described in detail and in sequence.
- Data collection protocols were open-ended and phrased in value-free ways.

3.8.2 Dependability

Dependability relates to quality control, consistency, and stability over time. Methods used to assure the reliability of the conclusions are:

- The theory underlying the study was clearly identified.
- Methods used to collect and analyze the data were clearly connected to theory. Specifically, the conceptual categories driving this study – metacognitive knowledge, cognitive certainty/uncertainty, affect, and actions – were clearly identified and then used to shape data collection questions, the data collection protocols, and finally, coding during the data analysis phase.

- The data collection protocols were tested in a pilot study, where it was discovered that some of the questions needed to be re-phrased in order to reveal a deeper layer of thinking.
- The researcher kept detailed memos in order to keep track of thoughts and insights.

3.8.3 Credibility

Credibility, as Miles and Huberman explain (1994, p. 278), is about the truth value of the conclusions and whether "we have an authentic portrait of what we were looking for." The term "plausibility" is often used in this context. The researcher used the following methods to assure the credibility of the conclusions:

- The study took place in the context of the participants' everyday lives, rather than in a laboratory setting.
- Thick, rich description was used as a means to provide evidence that is grounded in the participants' own thoughts, feeling and actions.
- Triangulation within and across data sources.
- The presentation of the data is consistently linked to the categories determined a priori, thus providing a bridge between theory and evidence.
- Some of the areas of uncertainty for the researcher were identified (for example, the difficulty identifying Focus Formulation, as predicted by Kuhlthau's ISP model) as well as negative or discrepant evidence.
- Peer-debriefing with four of the 10 participants in subsequent interviews.

3.8.4 Transferability

Transferability, according to Miles and Huberman (1994), is the extent to which the study's conclusions can be transferred to other contexts. Not to be confused with generalizability (or external validity), transferability relates to the study's ability to fit to

other situations. Miles and Huberman refer to this as "fittingness" (p. 279). The degree to which the results of a study can be applied to different contexts depends, of course, on what those contexts are, and it is for the future researcher, and not this one, to determine what elements might be applicable. To assist future researchers in this task, the researcher used the following methods:

- A strong connection to a theoretical stance throughout the study that will help future researchers compare and contrast the results of this study with others.
- Thick, rich descriptions that can allow future researchers to determine the transferability of the study findings to other settings.
- Limitations of the study were discussed in order to help define the scope and boundaries.

3.9 Ethical Considerations

Ethics approval was granted by the Ethics Review Board of the Faculty of Education, McGill University, for the period of November 5, 2005 to November 5, 2006, and extended for one year until November 5, 2007. Ethics approval from the two colleges (pilot and principal studies) was also sought and granted (See Appendices A and B for a copy of the ethics approval).

This study follows the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Human Subjects*, the code of ethics underlying research at McGill University (http://www.pre.ethics.gc.ca/english/policystatement/policystatement.cfm). The research will respect human dignity and will not expose the participants to risk or harm.

In keeping with the principles of ethical conduct, the purpose and methods of the study were explained, in person, to each participant so that free and informed consent would be obtained. In cases where the participants were under the age of 18, the free and informed consent of parents or guardians was sought. Participants were able to withdraw from the study at any point.

The data from the study will be treated in a way that assures the privacy and confidentiality of the participants. Alpha-numeric codes have been substituted for the names of students in order to preserve their anonymity.

Chapter 4: Results

4.1 Introduction

4.1.1 The Information Search Process as Story

This chapter tells the story of 10 young people as they journeyed through the information search process and how the nature of their metacognitive knowledge helped or hindered them. The genesis of this story lies in the research question: *What is the role of metacognitive knowledge during the information search process of adolescents?* This study investigated three separate but intertwining dimensions of the information search process – *thoughts*, which includes metacognitive knowledge and cognitive certainty/uncertainty, *affect*, and *actions* (the tasks in the search process – task initiation, topic selection, prefocus exploration, focus formulation, information collection, and presentation) in order to reveal a deep and rich picture of the nature of adolescent metacognitive knowledge during the information search process. Two secondary questions, reflecting a wide angle approach, were also investigated: 1) *Within the context of the search process, what are the qualities of adolescent metacognitive knowledge?* and; 2) *How does the metacognitive knowledge of adolescents map on to the cognitive, affective and behavioral dimensions of the search process?* Because the three questions are so closely intertwined and, in order to present the participants' story of their journey in an authentic manner, the answers to them all are interwoven throughout the chapter.

As with all journeys, the information search process has a beginning, a middle and an end. The "journey" was launched with a goal or target in mind – an essay comparing at least two aspects of a topic in the history of western civilization. At times the goal, for these 10 students, seemed ill-defined and open-ended. Nonetheless, some sort of end was envisioned. The decisions made and the steps taken to complete the journey made up the major part of the journey, the middle passage between the launch and the arrival. While all the students in this study arrived at the destination, each one completing their research assignment on time, the journey they took to get there was an often circuitous

route that was mediated by both the presence and absence of metacognitive knowledge. Laced throughout their experiences was a layer of conflicting feelings which pushed them but also held them back from the final destination.

The research identified 13 attributes, or categories, of metacognitive knowledge related to the information search process (henceforth referred to as ISP metacognitive knowledge) that came into play throughout the search process. The 13 categories are: *knowing your strengths and weaknesses, knowing what you don't know, scaffolding, building a base, parallel thinking, understanding curiosity, communicating, changing course, understanding time and effort, balancing, understanding memory, pulling back and reflecting* and *connecting.* These categories lay the groundwork for a taxonomy of adolescent ISP metacognitive knowledge. The nature of each category identified in this study, as well as how it intervened in the search process, is described and analyzed in Sections 4.2.1 to 4.2.13. Table 17 lays out the taxonomy in a table format, showing each category of ISP metacognitive knowledge and its attributes. Appendices G to S provide the rules, or definitions, that guided coding.

4.1.2 Representation of the Story

The story of how a group of adolescents moved through the information search process, the role that metacognitive knowledge played in the journey, and how it related to their thinking and feeling, is told in this chapter through the use of words and numbers. The bulk of the chapter uses the participant's words in order to paint a fuller picture of the nature of the participants' ISP metacognitive knowledge and to provide evidence for the themes that emerged in this study. It should be noted that the lack of a representative example in this text for *each* participant in *each* category does not necessarily mean that metacognitive knowledge was lacking. While thick, rich description is desirable in a qualitative study, not every example can be reproduced in the final report. Furthermore, many of the examples actually fit into more than one category and so, in the interests of avoiding redundancy, examples are only used once. This is an interesting finding in itself

because it means that there could be more than one type of metacognitive knowledge at play at any given time. While most of the examples presented in this study show positive evidence of metacognitive knowledge, negative cases are also presented in an attempt to show the diversity that exists in adolescent metacognitive knowledge.

Numbers also helped to tell the story. Although qualitative research is usually associated with words, not numbers, the researcher takes the position that numbers can say a lot about qualities. As Miles and Huberman (1994, p. 253) point out, in qualitative research "a lot of counting goes on in the background when judgments of qualities are being made...When we say something is "important" or "significant" or "recurrent" we have come to that estimate, in part, by making counts, comparisons, and weights." Numbers in this study will show how a particular category of metacognitive knowledge is distributed over the course of the search process (how it was used) and will show how certain categories of metacognitive knowledge were used more often in comparison to other types, suggesting a preference for one type over another (for example, readers will see that "*Building a base*" came into play more often than "*Understanding memory*"). But numbers can be deceptive. For example, while "Building a base" is grounded in the data more frequently than "*Understanding memory*", a look at how the categories of metacognitive knowledge are distributed amongst the 10 participants shows that roughly the same number of participants actually used both types (nine out 10 used "*Building a base*" while eight out of 10 used "*Understanding memory*"). In other words, some participants may have demonstrated this knowledge more often than others. This suggests that although there are standard approaches to solving an information problem, users adopt these approaches in individualistic ways. Perhaps more interesting is how they go about doing so. Frequency counts alone, while helping to complete the picture, certainly cannot tell the whole story.

4.1.3 Making Connections to the Theoretical Framework

Throughout this study, attempts were made to make connections between ISP metacognitive knowledge and the broader theoretical framework provided by Kuhlthau's (1991) ISP model. For example, each type of ISP metacognitive knowledge is described and discussed in relation to the six stages in the ISP model. Section 4.6 discusses insights related to the use of Kuhlthau's ISP model as a framework for studying adolescent metacognitive knowledge, and adaptations or an expansion of the model are suggested.

Many of those who study metacognition have noted how difficult it is to actually define this construct. Attempts to refine our understanding of what it is and how it "behaves" are ongoing. The problem may be that there are still too many details left to fill in. In an attempt to contribute to this task, Section 4.5 explains how the 13 categories of ISP metacognitive knowledge discovered in this study relate to the general model of metacognitive knowledge (Flavell, 1979; Garner & Alexander, 1989; Pintrich, Wolters & Baxter, 1996; Anderson & Krathwohl, 2000).

4.2 A Taxonomy of Adolescent ISP Metacognitive Knowledge

The 10 participants in this study were found to have a wide range of metacognitive resources which they used to complete their information-seeking task. Gaps in the participants' knowledge were found, but perhaps more interesting, concrete evidence of the awareness and application of metacognitive knowledge was woven throughout each participant's story. This is perhaps not surprising. The participants were academic achievers who had conceivably gained their success through the active use of metacognitive knowledge. It is known that metacognitive knowledge is not the exclusive domain of mature adults (especially if that metacognitive knowledge is domain specific). Even young children between the ages of three and five have "theories of mind" (Flavell & Miller, 1998) and metacognitive knowledge about the demands of cognitive tasks (Kuhn, 2000). If young children have been shown to think metacognitively, then a complete absence of metacognitive knowledge in academically-able 16 and 17-year-olds should not be the expected outcome for this particular study.

So the question remains: What *was* the nature of the metacognitive knowledge of the 10 participants in this study. The qualities of their metacognitive knowledge during the information search process are presented in Table 17, and are described more fully in Sections 4.2.1 to 4.2.13, as well as in Appendices G to S.

Table 17: A Taxonomy of Adolescent ISP Metacognitive Knowledge: The 13 categories and their attributes

Balancing
- Filtering information
- Finding an equilibrium
- Awareness of the weakness of a strategy
- Weighing the options

Building a base
- Browsing
- Doing the groundwork
- Broad to narrow search strategy
- Finding synonyms
- Scanning
- Seeing the big picture
- Mapping

Changing course
- Adapting the topic
- Ending exploration
- Shifting the search strategy
- Simplifying the search strategy

Communicating
- Talk as a metacognitive strategy
- Who do I talk to?

Connecting
- Clarifying
- Connecting information
- Part to whole thinking
- Break apart and rebuild strategy
- Narrow to broad search strategy

Knowing that you don't know
- Knowing that you don't know
- Prior Knowledge
- General knowledge of self
- My weaknesses

Knowing your strengths and weaknesses
- How I learn
- Prior knowledge
- General knowledge of self
- My strengths
- My weaknesses

Parallel thinking
- Double thinking
- Future thinking
- Planning

Pulling back and reflecting
- Reflecting
- Take a break from the task
- Following-up a lead
- Reviewing

Scaffolding
- Mapping
- Modeling expert thinking
- Modeling the structure of information objects
- Using a pathfinder
- Using meta-tools

Understanding curiosity
- Conflict and curiosity
- Role of motivation
- Role of interest

Understanding memory
- Highlighting text
- Note-taking to aid memory
- Post-it notes to aid memory
- Remembering

Understanding time and effort
- Concentration
- Control
- Crutch
- Investment in time and effort
- Laziness
- Principle of least effort
- Patience
- Persistence
- Understanding the role of effort
- Using a short cut
- Understanding the effort required to summarize

The metacognitive knowledge identified in this study was not universal amongst every participant. Table 4.1 shows how many participants actually demonstrated each category. The numbers were found by reviewing each category of ISP metacognitive knowledge

and looking for evidence of use *at least once* by each participant in the study. These numbers do not represent intensity of use (whether one participant used a type of ISP metacognitive knowledge more than another participant did). This is primarily because the unit of study for this research is the *group as a whole*, and not the individual students. The numbers in Table 18 also do not tell of *when* in the search they used ISP metacognitive knowledge – at the beginning, the middle or the end. The timing of each type of metacognitive knowledge is detailed in Table 19. (Note: Tables 18 and 19 list the 13 types of metacognitive knowledge alphabetically. This was done in order to assist the reader in retrieval. However in Sections 4.2.1 to 4.2.13, where the 13 types are described in detail, the organization is conceptual so that the story of the information search process flows in logical progression).

Table 18

How Many Participants Used Each Type of ISP Metacognitive Knowledge?

Type of ISP metacognitive knowledge	***Evidence of knowledge (# of participants)***
Balancing:	10 out of 10
Building a base:	9 out of 10
Changing course:	10 out of 10
Communicating:	10 out of 10
Connecting	10 out of 10
Knowing that you don't know:	5 out of 10
Knowing your strengths and weaknesses	10 out of 10
Parallel thinking:	10 out of 10
Pulling back and reflecting	6 out of 10
Scaffolding:	10 out of 10
Understanding curiosity:	8 out of 10
Understanding memory:	8 out of 10
Understanding time and effort	10 out of 10

Table 19 shows when, and how frequently, the participants used each of the 13 types of ISP metacognitive knowledge during the information search process. The table is organized in six columns, each representing one of the six stages (or tasks) in the ISP

model; task initiation, topic selection, prefocus exploration, focus formulation, information collection, and presentation.

Table 19

When did the participants use the 13 types of ISP metacognitive knowledge?*

****Grounded in the data. Numbers in brackets represent the number of times coded, not the number of participants.***

Task Initiation	Topic selection	Prefocus exploration	Focus formulation	Information collection	Presentation
• Knowing that you don't know (1) • Pulling back and reviewing (1) • Scaffolding (1)	• Balancing (3) • Building a base (13) • Changing course (1) • Communicating (17) • Connecting (6) • Knowing that you don't know (9) • Parallel thinking (7) • Scaffolding (6) • Understanding curiosity (2) • Understanding time and effort (6) • Using your strengths (7)	• Balancing (23) • Building a base (38) • Changing course (12) • Communicating (7) • Connecting (18) • Knowing that you don't know (14) • Parallel thinking (14) • Pulling back and reflecting (6) • Scaffolding (19) • Understanding curiosity (8) • Understanding memory (5) • Understanding time and effort (19) • Using your strengths (11)	• Balancing (9) • Building a base (7) • Changing course (6) • Communicating (4) • Connecting (5) • Knowing that you don't know (3) • Parallel thinking (6) • Pulling back and reflecting (0) • Scaffolding (25) • Understanding curiosity (2) • Understanding memory (1) • Understanding time and effort (5) • Using your strengths (3)	• Balancing (26) • Building a base (24) • Changing course (13) • Communicating (12) • Connecting (37) • Knowing that you don't know (10) • Parallel thinking (24) • Pulling back and reflecting (6) • Scaffolding (23) • Understanding curiosity (5) • Understanding memory (7) • Understanding time and effort (31) • Using your strengths (11)	• Balancing (8) • Building a base (2) • Changing course (1) • Communicating (10) • Connecting (8) • Knowing that you don't know (3) • Parallel thinking (43) • Pulling back and reflecting (1) • Scaffolding (4) • Understanding curiosity (4) • Understanding memory (5) • Understanding time and effort (6) • Using your strengths (2)

4.2.1 Knowing your Strengths and Weaknesses

In order to use your strengths you must first know what they are. Sometimes your strengths can only be revealed when you analyze your weaknesses. Self-knowledge is directly related to self-assessment, the ability to critique one's own cognitive and affective states being a commonly accepted attribute of metacognition. The following codes were grounded in the data and mapped to create the category called "Knowing your strengths and weaknesses": *How I learn, Prior-knowledge, General Knowledge of Self, My Strengths, My Weaknesses.* (Definitions for the codes in this category can be found in Appendix G). "Knowing your strengths and weaknesses" fits into the broader theme of "self", one of the three basic components in Flavell's (1979) original model of metacognitive knowledge (the other two components being "task" and "strategy"). During data collection, the participants' awareness of their strengths and weaknesses was revealed in two ways: 1) through the use of specific verbal protocols during interviews that targeted "self-knowledge" and; 2) through the participants' explanations as to why they followed a particular course of action. Table 20 shows how "*Knowing your strengths and weaknesses*" was distributed throughout the six stages (or tasks) of the ISP. A table such as this will be provided for each category of ISP metacognitive knowledge.

Table 20
Evidence of "Knowing Your Strengths and Weaknesses"

Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task initiation	0
Topic Selection	7
Prefocus exploration	11
Focus formulation	3
Information collection	11
Presentation	2

Asked what makes looking for information easier for them than it might be for some people, many of the participants were initially stumped by the question. Upon consideration, several did identify strengths they felt might actually help them look for information (of course, whether these perceptions of strength are based on evidence or wishful thinking is a question that cannot be answered within the scope of this study). Their answers were in general terms and not related to specific phases in the search process. For some, their strong points were related to the cognitive tasks of remembering, filtering, and processing text found in paper-based resources like books and encyclopedias, in computer-based environments like the Web or full-text articles online found via the databases subscribed to by the college. For Participant 3 (P3), the ability to filter irrelevant information – to look at "what's important in a document" was a valued ability. P2, on the other hand, thought her retentive memory figured strongly in her assessment of her own strengths because it helped provide the knowledge base needed to launch her search. She explained:

> "If I see some documentary or I read something in a book or I read something on an encyclopedia, it just seems to stay so when I started looking for specific information I already had the basics that helped me."

P7's self-assessment was shaped by her view of her knowledge base, which in her case had been built by reading, not remembering. Reading had resulted in a large vocabulary that she used to search more efficiently:

> "I'd say maybe because I've read a lot and I have a wide choice of adjectives and words I can use. I can search different alternatives."

Ability to use, and interest in, computers was cited as both a weakness and a strength. P7 saw herself as a book person, preferring to process information through paper-based media rather than computers. This, in her view, was a weakness because searching in the 21st century necessarily involves the use of a computer. In answer to the question, what makes looking for information harder for you than it is for some people, she replied, "I

don't necessarily enjoy online searching. I'm not a ram addict. I don't enjoy it that much." On the other hand, P9 felt his comfort level with computers, due to his unique previous experience, helped him; "I've been searching for books since elementary school." (Note: most elementary school libraries in Quebec do not have automated catalogues and even if they do, OPACs are often not available for student use, therefore many students do not have school-based access to online catalogues until high school).

While these participants associated "strength" with cognitive abilities, others understood it to be related to character or personality. P5 thought her persistence and diligence were important factors in her success:

> "I guess the fact that I'm willing to look in different places and take the time to look everywhere and not just settle on any random information."

Persistence was also a positive characteristic for P4. She left no stone unturned in her pursuit of information and this thoroughness was helpful:

> " ... I like to look things through. I like to check things over a lot. Maybe this could sort of have to do with that. Like how I check each book a couple times by different sections..."

In terms of weaknesses, two students cited "perfectionism" as something that makes looking for information harder for them than it is for some people. "I guess I'm a little, I'm a perfectionist and I need to find exactly what I'm looking for," explained participant P5. Perfectionism also got in the way for P1 because it created frustration; "I guess I'm a bit of a perfectionist. I really want it to work so its like, well where is it and I don't really want to accept that its not in the library and so its like, I want it!"

Self-awareness of strengths and weaknesses affected the participants' actual search behavior. For example, during *Exploration* P1 reported that she had begun searching for documents in the college library, looking for both books and journal articles. While she

was able to find journal articles on her topic, she had trouble finding articles she could actually make sense of and use (something required for the assignment). She knew they were not appropriate for her because, "articles from journals are really quite useless at my level. They expect you have a fountain of knowledge". Clearly, she understood that she did not have the requisite knowledge needed to comprehend them. She continued on the topic of the mismatch between her own knowledge and the assumptions of writers, "They go on this itsy bitsy topic they've been studying for three weeks or I don't know, months."

In another case, awareness of a strength affected the way one participant processed the text in the information sources. P9 knew he was a fast reader and stated that "I can read pretty quickly compared to most of my friends". This was helpful knowledge because as the deadline for the project fast approached, he found a need to revise his search and did not have time for a careful reading of sources. He confidently used a scanning technique during *Collection* to quickly process the information, skimming through text, looking for "certain words that pop out at me." But the same participant identified a weakness – what he called "laziness" – and in this case, an awareness of a weakness did not actually trigger a change in behavior. From the beginning of the term until the end of the project, P9 claimed that "laziness" (which led to procrastination) was his biggest weakness. Even though he had predicted this behavior in the early weeks of the school project, this awareness did not change the outcome – he compressed *Collection* and *Presentation* into one stage the night before the paper was due.

4.2.2 Knowing That You Don't Know

"Knowing that you don't know" is a type of self-knowledge and is related therefore to "Knowing your strengths and weaknesses" and to the larger category of self in Flavell's general model of metacognition. There are, however, differences between "knowing that you don't know" and "knowing your strengths and weaknesses". While "knowing your strengths and weaknesses" is dependant upon one's ability to put a name to what you know and then taking advantage of it, "knowing that you don't know" is a state in which

you can identify a gap in your knowledge base but you cannot always say what that gap is. In other words, you cannot put a name to it. In the context of information science theory, "knowing that you don't know" is associated with Belkin's (1980) anomalous states of knowledge (the ASK) and Dervin's (1986; 1999) sense-making framework. Both models suggest that information seekers are prompted by an awareness of a gap between order and chaos. As simple as it may seem, "knowing that you don't know" is a critical piece of metacognitive knowledge during the information search process because it alerts the information seeker that there is a problem and it is time to revise or make adjustments to the search strategy. This category was arrived at by the combination of four sub-categories coded as *Knowing that You Don't Know, Prior Knowledge, General Knowledge of Self* and *My Weaknesses*, the definitions for which are provided in Appendix H. Table 21 shows the groundedness and distribution of "Knowing that you don't know" throughout the search process.

Table 21

Evidence of "Knowing That You Don't Know"

Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task initiation	1
Topic Selection	9
Prefocus exploration	14
Focus formulation	3
Information collection	10
Presentation	3

Several students felt overwhelmed during *Task initiation*, when the assignment was first presented to them by the teacher. But what was it about the project that created anxiety? One participant felt it was knowing that there is so much that you *didn't* know, explaining, "Every time you really get involved with a research project, I get the feeling you discover how much there really is to know and that can be really overwhelming" (P3).

During the next phase, *Exploration,* the participants discovered the boundaries of their topic. Since discovery is the purpose of the second phase of *Exploration,* it is custom-made for people who *do not* know. Discovery at the broadest level of the topic seemed easy for many of participants, and rather than being a threat, the gap in knowledge was expected. However, as the topic became more granular, discovery became more difficult. Finally, the void in knowledge presented a wall, a signal to some of the participants that new strategies were needed. One participant tackled this barrier by looking for synonyms, saying that, "The thesaurus is my best friend" (P5) – the new approach being to find new vocabulary.

"Knowing that you don't know" was a driving force during the *Collection* phase of some of the participants' searches. In the case of P7, although she had begun the search process with what she already knew, looking for information on Cleopatra & Hatshepsut (two well-known Egyptian queens), she later realized that she might be missing information on queens who she knew *nothing* about, reporting in her journal; "Right now I'm looking for information about queens (that I may not have heard of) who exercised power during the earlier dynasties of the New Kingdom." To fill in this gap in knowledge, she returned to one of the library's databases and, not knowing the names of these queens she searched using truncated keywords - Egypt*, women, power*, politic* - in order to cast a net that would hopefully draw out specific names of queens. So in this case, it was knowing that she *did not* know the names of queens that instigated and shaped a new search strategy.

The final tasks in the Information Search Process, once sources have been gathered, are to read, interpret and organize them. This happens during *Collection* and *Presentation.* One participant realized there was a gap in knowledge related to methods for processing and organizing information. Although he had read the information, he had trouble retrieving it later. As a result, he said in a telephone interview, "I understood I didn't have a clear idea of how to take notes. It was difficult to find what I wanted" (P9). He then revised his technique, using stick-on notes to highlight significant information within the document.

Writing a research essay was a new and difficult experience for many of the participants in this study. The essay had to be structured around a hypothesis and the writer's argument supported by evidence from the literature. As is usually the case in research papers, the participants were asked to cite their sources – a new and unpracticed skill for many 17 year-olds and one that made the *Presentation* phase of the Information Search Process as worrisome as any other stage in the process. Knowing that she did not know how write a research essay, and forecasting future problems, P4 decided to act. She went to see the teacher early in the semester, even as she explored her topic because, as she wrote in her journal, she "wanted to know how to go about writing the essay since I have never written anything of this sort before." Had she not realized a gap in this particular knowledge she would not have seen the teacher.

Although the gaps experienced were unique to each participant, as the examples above illustrate, knowing that there was something amiss, that some action needed to be taken, was an important force in triggering a decision or move during the information search process

4.2.3 Communicating

This attribute of adolescent metacognitive knowledge involves the use of people as information mediators and information sources during the search process. Quite simply, it is knowing that talking to people is a useful cognitive strategy. Talking to people serves many cognitive purposes during the search process. "Talk" can help to clarify points of confusion about conflicting information or it can help to unite information into a cohesive unit. "Talk" can also be a quick source of information, helping to build a knowledge base, or can provide a road map for the next steps in the process. The "Communicating" attribute was derived principally from one code – *Talk* – defined in Appendix I. This category of metacognitive knowledge was linked to social aspects of the information search process, which was a new "family" of coding that emerged during analysis. Table 22 shows the groundedness and distribution of "Communicating" throughout the search process.

Table 22 *Evidence of "Communicating"*	
Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task initiation	0
Topic selection	17
Prefocus exploration	7
Focus formulation	4
Information collection	12
Presentation	10

Information seeking can be seen as a solitary process – if one has an information problem one searches, for example, the library's catalogue, the book shelves, online databases or web portals, *alone*, for a solution. And yet the students in this study used information mediators frequently and in a deliberate manner to help them solve their information problems. Interestingly, the role of information mediator was filled by people in the participants' everyday lives – their parents, siblings, grandparents, neighbours and family friends – and not so much by the librarian, the one person whose very job it is to mediate between information and users. In some ways, parents, family and friends were more than just a bridge between the participants and the information – they *were* the information source. Given that we have no record of the actual conversations that took place between the participants and the people they talked to, it is difficult to know where the mediation role ended and the information source role began. Nevertheless, the participants turned to people in their network of relationships because they knew it was a good strategy for helping them to make sense of the problem. Knowing that the strategy exists, when to implement it and why, represents a certain type of metacognitive knowledge. Table 23 shows who the participants talked to and when. While the table provides a sense of the "who" and the "when", it does not provide a picture of the "why" and "how". To complete the picture, a more thorough description follows.

Table 23

Use of Human Information Mediators During the Information Search Process

Tasks in the ISP	***Number of participants who used human information mediators ("talk") during the ISP.***	***Who did they talk to?***
Task initiation	-	-
Topic selection	8 participants	Peers (1), mother (2), both parents (1), grandmother (1), sister (2), cousin (1), neighbour who is a knowledgeable adult(1), teacher (1)
Prefocus exploration	3 participants	University professors (3)*, Mother (1), Father (1) Teacher (1) *All interviewed by the same participant.
Focus formulation	3 participants	University professor (1), Teacher (1) Mother (1)
Information collection	7 participants	Mother (3)*, Teacher (3), College librarian (2)** *One mother is completing her MLIS degree and works in a university library. **Represents a one-to-one conversation between the participant and the librarian. The librarian also came to the class to teach locating skills (using the library portal, searching the online catalogue and data bases)
Presentation	2 participants	Teacher (2)

a. People as Information Mediators

Interaction with information mediators was not reported during the first stage of the ISP, *Task initiation*, perhaps because this is a passive stage where the student simply receives the assignment from the teacher. During *Topic Selection*, however, the participants actively sought and enjoyed the advice of those around them. Three factors seemed to drive this decision: the accessibility of the information mediator, his or her expertise in the topic, and an interest in the participant. For example, P6 thought she might want to look at the history of western civilization through the lens of philosophy, but the topic was large and needed to be narrowed somewhat. She began her search by going to her mother because "she was a person who had read philosophers" and "she was there and I knew she would help me". Asking a family member for help was a deliberate use of a metacognitive strategy for this participant because she knew her mother "would be able to answer my specific questions as opposed to me looking for the answers for my questions on the internet or in books". In other words, using her mother as an information mediator offered the participant a quick and easy method to help clarify her thoughts on the topic – a cognitive shortcut.

The topic of philosophy was also of interest to P3. Although he knew he wanted to frame the research paper around the broad topic of philosophy, he still needed to work out some of the details. Early in the search process, less than two weeks after the research project had been assigned and before a specific topic had been chosen, this participant identified "talk" as a useful strategy. When asked to complete the sentence, "When looking for information sometimes it helps to…", he replied, "Ask for help". Who would he ask? "The reference librarian. My sister who studies philosophy at university." At the end of the term, the participant represented his search process in a timeline and confirmed that the search was launched by talking to his sister to see "if the project makes sense". Interestingly, although talking to the librarian was forecast as a useful strategy, in the event it does not seem to have actually happened. In any case, the sister filled the role of subject expert and talking to her was a deliberate use of a cognitive strategy to provide

some clarification on the topic. What is metacognitive about this approach is knowing that the strategy exists and implementing it at the appropriate time.

Other participants also shared their thoughts with family and friends as well. The first step in P7's timeline was to "Discuss possible topic choices with my parents, sister & cousin for input & ideas". Why? Because "I had no ideas for topics, but knew that their suggestions would be original. Used their experience in research". This decision was driven by the self-prompting question, identified by the participant in her timeline as "Who has experience in writing research paper & has a large store of knowledge to discuss with me?" So, in this case, expertise in doing library-based research was the key, although a background in the topic area also played into the decision to turn to others, demonstrating that this participant recognized that she was weak in two areas of knowledge – the subject domain and the information-seeking domain – and that interpersonal communication with those who do have expertise is a useful method for filling in the gaps in knowledge.

Sometimes it is surprising who can fill the role of information mediator. In the case of P9, a neighbour stepped in to help. The participant, who at this point had not made any decisions regarding the topic and indeed felt "desperate" about it, turned to a neighbour who "knows a lot about history and was always up for a discussion" In this case the neighbour's expertise in history and an openness to discussing it were two factors in the decision to talk about it. (Qualifying his understanding of the neighbour's expertise, the participant later explained that the neighbour reads a lot and has a large home library). Figuring he "would be able to handle most topics", P9 chose a topic suggested by the neighbour that "seemed interesting."

As the students moved forward in the information search process, family members continued to play the role of information mediator. Participant 10 was quite clear on her topic on the history of libraries and so, when she turned to her mother – who she identified as a librarian at a local university – during the *Exploration* phase of her search, it was to ask for her mother's help in identifying specific resources on the topic so that

she could narrow down the focus. Her mother "brought the books from the university" and "emphasized what I should look for."

The mixed roles of mother and information professional raised ethical concerns (and some anxiety) for this student – was it right for her mother to gather the information resources on her behalf? Was her mother doing her homework? This conundrum raises an interesting question regarding the role of information mediators – family or not. How far should a mediator go in providing information resources for a student? For information seekers, knowing that a parent with expertise may help to move one forward in the process by helping to clarify the information or modeling good practices in information gathering may be a valuable piece of metacognitive knowledge. On the other hand, it may be counter-productive, with the parent ending up carrying too much of the cognitive load, actually doing the heavy-lifting when it comes to information-gathering and thus preventing the student from learning.

Family members did not provide the only counsel for these students. Moving from *Exploration* into *Focus Formulation*, P1 turned to three professors at the local university – they were also family friends and acquaintances – after having explored the literature somewhat because she "was trying to make generalities" and "there's a lot of things that aren't stated in books". Furthermore, "articles from journals are really quite useless at my level. They expect you have a fountain of knowledge." Knowing, then, that she lacked the requisite knowledge needed to explore the topic further and arrive at some focus on the topic, she turned to people who *did* have that knowledge. In one quick stroke, the experts were able clarify some puzzling points the participant had about the information.

Reaching beyond the comfortable network of family and friends was a useful strategy, but those who did it, or who at least considered it, also knew that they had to know more about the topic before they contacted the expert so that they could ask the right questions. While they decided to reach out to experts, they knew the best time to do it was at the tail end of *Exploration*. Early in the search process, P3 considered talking to an art history teacher at the college but did not because, at that point in time, he did not "feel informed

enough to talk to them yet." In the event, he did not in fact carry through with this plan. As P1 says, "I couldn't do the interviews [with the professors] without looking through books."

Moving from *Focus Formulation* to *Information Collection*, participants again turned to information mediators for help. Some students at this point had already begun organizing their essay into sections. They knew that the information they had already gathered was incomplete or did not make sense and so they discussed the gaps with others. Three of these interactions occurred with a parent and resulted in the collection of more information. P10's mother, the university librarian, brought home more books from the university for her daughter, while the mother of P7 found a useful bibliography at the end of a fiction novel she had just finished reading, a novel that happened to be on the same research topic her daughter was studying (one wonders if there had been an earlier conversation about this particular novel that had inspired the participant to follow this topic). The participant then used the bibliography as a tool for collecting in-depth information on the topic. P2 found information resources in the book collection housed at her mother's design firm – a lucky coincidence given that the student's topic was on architecture.

The teacher and college librarian also helped to fill in gaps during the *Information Collection* stage of the search process. The teacher's role at this stage was not to recommend specific information sources, but rather to help organize the paper so that the participants would be able to make sense of the information already gathered. P5 noted that her visit to the teacher, conducted even as she continued to collect information from the Web, was prompted by a desire to understand how to format (or outline) the paper.

Interestingly, it is during the *Information Collection* stage that the college librarian fulfilled the information mediator role by identifying and locating specific tools and resources for two students who reported speaking to the librarian in one-to-one interchanges.

During the last phase of the search, *Presentation*, two participants turned to the teacher to help them construct a meaningful synthesis of the information they had already gathered. P6 said her visit to the teacher at this late stage of the game was prompted by a need to know how to "to incorporate this information into the ideas I already have from other sources." Likewise, P7, who had begun her search by talking to her parents, sister and cousin, ended the search process by talking to the teacher. Finding it difficult to incorporate the mass of information she had collected into a neat outline, she emailed an outline to the teacher and they then met to talk about it. Even though the participant suspected that there was too much information, she needed the teacher to confirm her suspicions and to help reduce uncertainty. This was expressed in an exchange between the researcher (LB) and P7 during the final interview:

> LB: "What helped you put all the information together into one paper?
>
> P7: I jotted down ideas. Made a pre-outline that I added to. I split it up into four parts. My introduction and introduction with the background and then I had...their contributions to religion and finally I had...and then I found out that was much too much
>
> LB: How did you find that out? Did the teacher say?
>
> P7: Ya, I emailed her and then we talked about it and even I could see there was way too much information to fit into one paper."

P6 was also not shy to approach the teacher during this last phase of the search process:

> P6: "I thought that I had enough sources at this point. But from the minute I started writing I knew I was in trouble.
>
> LB: And then you saw your teacher?

P6: Ya, I saw her about two or three times from this point to the end. So when I saw her...sometimes I had little questions on the material itself because we...I asked her about these little minor details because I knew she would tell me what was actually the fact...I also asked her about my plan and how I should structure my whole essay. She helped me a lot with that because it was hard to condense all the information that I had."

Both P6 and P7 expressed uncertainty about their own thinking during *Presentation*, the final phase of the information search process. In the case of P6, this uncertainty was in terms of both her understanding the message being delivered by the information *and* her ability to put the multiple sources of information together. The eight other participants in this study expressed concern over their ability to pull it all together but in the final analysis, they did not go to the teacher for help with the task.

Uncertainty may be common among young people working on their first research paper. Generally, the participants in this study understood that they were confused and knew that talking through the problem with a knowledgeable other at some point in the process was a dependable cognitive strategy for clarifying thoughts.

b. People as Information Sources

The line between information mediation and information source is sometimes difficult to distinguish when the mediator is someone with expertise in a subject. This can be problematic because it presents a conundrum for someone who uses communication as a metacognitive strategy to "shortcut" their way to knowledge. Why bother "looking it up" if the expert says it is so? On the other hand, by what standard is the expertise of the information-mediator determined? The credibility of an author is an important aspect in determining the reliability of information. Is an information source credible just because you trust it? This aspect of using communication a metacognitive support emerged when P6 prompted herself with the question:

"Is the information I obtained from my mother biased or is it based on actual facts?"

Although she questioned the reliability of her mother as an information source, ultimately she believed her mother could offer something that document-based information sources could not – intelligent, sensitive and focused interaction. She explained how the meaning of information was clarified:

"The encyclopedia did clarify a few points I was uncertain about and it helped me generally to complete the ideas I needed. However, my mother offered me a more cohesive and logical explanation of these ideas and was able to better understand my questions and respond to them specifically."

Her mother, then, was able to provide targeted information in a way that no documentary source could. Continuing, the participant explained why she used two types of information sources – encyclopedias and her mother:

"This approach worked because I had both a source that presented me with historically accurate data and a source which could logically rationalize this information had I not been able to do so myself."

4.2.4 Scaffolding

Knowledge of metacognitive strategies, knowing when to apply them and being able to anticipate their "pay off", is a critical piece in the metacognitive knowledge toolkit. The students in this study, perhaps knowing full well that they "didn't know", actively implemented a range of metacognitive strategies, one of which was "scaffolding". In the context of this study, "scaffolding" refers to the act of searching for and using a cognitive support, or reinforcement, to help map out a conceptualization of the information environment, and is not quite the same thing as the scaffolding first defined by Bandura (1977), in his theory of social learning. Scaffolding, according to Bandura, represented an

interactive relationship between expert and novice. Experts provide the scaffolding for novices and gradually remove the support system as the novice learns to function on his or her own. In the context of this study, however, scaffolding is rather more broadly defined to represent the support structures that the participants used to help them develop a schema of the information environment. For the students in this study, it did not matter where the structure came from – a person, a book or even *Wikipedia* - the important thing was its availability at the right time, providing some signposts to help guide them through the information search process.

"Scaffolding", as an attribute of metacognitive knowledge during the information search process, is an amalgamation of four overlapping, sub-attributes, defined further in Appendix J: *Modeling Expert Thinking* (usually had a social component to it); *Modeling the Structure of Information Objects* ("objects" refers to documents); *Using a Pathfinder* and *Using Meta-tools.* Table 24 shows the groundedness and distribution of "Scaffolding" throughout the search process.

Table 24

Evidence of "Scaffolding"

Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task Initiation	1
Topic Selection	6
Prefocus Exploration	19
Focus Formulation	25
Information Collection	23
Presentation	4

Perhaps knowing that they "didn't know", the students in this study looked for supports that would help them map a conceptualization of the information environment. The scaffold provided them with a big picture that showed the units of information in the topic area as well as the relationship between units of information. Examples of the

participants' knowledge of the power of "scaffolding" abound throughout, beginning in the *Topic Selection* phase of the search process.

P10 used her mother's knowledge as a support. After having scanned a few topics, P10 still "had no idea" which one to choose. She used two criteria to make her decision: "what field am I most interested in?" and "are there specialists in this field that I can consult?" In the event she chose the history of libraries as her topic and (perhaps not coincidentally) her mother was a librarian – a resident expert as it were. As evidenced in Section 4.2.3, the students were not shy to take advantage of the perceived expertise of others during the early stages of the search process. For example, P9 talked to a neighbour, P3 talked to a sister, P2 talked to a parent and grandparents, and P7 discussed the topic with both her parents, a sister and a cousin.

Human expertise was not the only source for structure and support. Several of the participants deliberately used the structure of a document to help guide them. During *Topic Selection*, P4 said her first move was to look in books:

> "I'm very calm about it. I have to see – I'll look through each book for signs like the cover – like the title of it –then I look at the contents and a little from inside and from there I'll filter out what I need."

Books, for some, provided better structure for mentally mapping a topic than a website. Talking about how she was going about eliminating topic options, P6 explained why she was using books rather than the Web:

> "I feel that books on this topic would probably be a better source of information than a website, since it [the book] would have to be older and be better structured than a website."

But a few participants found the Web to be helpful in providing structural support. P7 used a timeline on the Web, a visual representation of history, to help her pinpoint a time

period in Ancient Egyptian history to investigate. This was still at the *Topic Selection* stage because the particular "angle" and "aspects" would need to be determined through further exploration and focusing. She searched on Google to find a timeline, using the keywords "Egypt", "timeline" and, "pharaohs". Explaining why this was a useful strategy, she explained that "Timelines of major events would give an overview of the economic/political situation in Egypt during the New Kingdom." P9 also preferred to use the Web to scaffold his emerging understanding of the topic. "My starting point was *Wikipedia*", he explained. "It's not accurate but it can give me a brief overview. It's not great but it's not completely false." In his journal he elaborated on the role of *Wikipedia*:

> "I decided to use the taboo *Wikipedia*...Comparing this to the book for Instanbul, I was able to draw some conclusions. I filled out the rest of my half page with information from the Constantinople Encarta link. I knew that *Wikipedia* was not a reliable source, but I needed information quickly. In my final paper I will not be using information from *Wikipedia*. I just needed a brief outline of my topic."

Outline seems to be the operative word here. The timeline and *Wikipedia* both mapped the structure and content of a particular information environment.

As the students moved into the *Exploration* phase of the information search, they drew more heavily upon their "scaffolding" knowledge. Again, books played a big role. P2 deliberately looked for "well categorized chapters", explaining that she concentrates mainly on their "organization" and "the differences and new elements, if applicable." The structure of books was used knowingly and deliberately by P4 as a means to transfer a model of the topic and use it to help move her toward the next step, *Focus Formulation*:

> "What helped me a lot was to figure out the structure – the organization of the book. Like I say, I look in the table of contents and I'll see what section relates to my topic and I not only look at that but I look at other sections to see if they organize it by time or if they organize it by sort of section of...like, is it religion in one place, caste in another? I sort of look to see, because I need to find my time

> period as well, because I have to see if I have to look in just one section or if I have to look everywhere for different topics but in the same time period...So that's what I do. I look at the structure of the book then I find sort of key areas that I should read into more."

The structure of books helped several students during *Focus Formulation* as well. Asked to identify something that helped her focus in on her topic, P7 explained how the organization of one book helped her:

> "Well there was one book in particular. I really liked the way it was organized. It had two chapters that were related to my topic and then I looked at how they explored that. I looked at the introduction and it explained how they could deduce all this from the artifacts and then it went on to the facts...and it came back to queenship in general."

Tools contained within books, such as bibliographies and indexes, acted as pathfinders – a kind of travel guide to the information environment – and several students actively used these tools as a scaffold. The index provided ideas for vocabulary, which helped to indicate the direction to take in an online keyword search; according to P1, indexes were "amazing funds of information", because when "stuck" one book would "pave the pathway for many others and I was on a roll."

Specific *types* of books were important. Some acted as meta-tools because their very purpose was to synthesize and distill information. This type of book was therefore a good starting point for *Exploration*. One participant (P2) said she starts with "the Eye Witness books. They're good for factual stuff." ("Eye Witness" books are a series of highly visual non-fiction titles written for an audience aged eight to 12, but which are read and enjoyed by adults as well). The course text book was also useful because it presented "dumbed down information. They kind of simplify it. Give you names", according to P3. Presumably, the names provided by the textbook provided keywords that the participant used to explore the topic in greater depth.

By the *Collection* stage, the participants had a full understanding of what they were looking for and they now surged forward to gather information from within the sources they had identified. Again, they used the structure of the information source to simplify and guide their quest because, as P1 said, "I'm looking at books with chapters because its easier to use than just books with lots of text."

"Scaffolding" was a useful metacognitive strategy as the participants moved from *Collection* toward *Presentation.* At this point the participants needed to begin thinking of how to structure their essays and several turned to information sources – specifically books – as potential models. Asking herself, "where can I find an organized plan of my topic?", P7 was thinking about how to write her essay and kept her eye open for a suitable example from the literature, even as she gathered information. The participants expressed great concern about how they were going to pull together all the information they had found into a cohesive unit. Even with the support of a scaffold, how would they make the cognitive leap and connect it all? Nearing the end of their search, they wondered if it all made sense. It seemed that specific strategies for organizing information were required. These are discussed in the section, *Connecting.*

4.2.5 Building a Base

The information search process is often perceived in metaphorical terms as a process of construction, where one makes sense of information step by step, brick by brick (Kulhthau, 1991; Dervin, 1999). As with all construction, knowledge that emerges from the information search process must be built upon a strong foundation that can support the structure that rests upon it. The realization of this metaphor was fully expressed in the actions of the participants in this study. The metacognitive knowledge related to these actions has been labeled by the researcher as "building a base". It refers to the strategic use of exploratory tactics to help build foundational domain knowledge.

While the attribute of "scaffolding" described in the previous section is certainly an attempt to build knowledge, it is different from "building a base" in that "scaffolding" is a deliberate use of a pre-existing structure to help map the information environment while "building a base" is a more open-ended exploration of the environment, akin to browsing. Furthermore, "scaffolding" can be used at either the beginning or the end of the process, but "building a base" tends to be a first move (although it can certainly be implemented later in the process if the information seeker has followed a false lead). Initiated by "knowing that you don't know" and the intuitive understanding that information seekers must begin at the beginning, it is derived from the blend of seven overlapping sub-attributes, described more fully in Appendix K: *Broad to Narrow Search Strategy, Seeing the Big Picture, Doing the Groundwork, Browsing, Scanning, Finding Synonyms* and *Mapping*. Table 25 shows the groundedness and distribution of "Building a base" throughout the search process.

Table 25

Evidence of "Building a Base"

Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task Initiation	0
Topic Selection	13
Prefocus Exploration	38
Focus Formulation	7
Information Collection	24
Presentation	2

During *Topic Selection*, several of the participants said it was helpful to begin the search at a broad level, in order to see the big picture. Not only were they aware that they worked this way, they also knew why. Asked, "When you were selecting a topic, what did you do to make it easier to find information?" P1 answered, "I went from big to small." P4 echoed this approach, saying that the trick to selecting her topic related to

how she used books; "I use something really broad and then narrow it down. I decided where in the world I wanted to do and then the next step was what time period and then from there it was what interests me..." She elaborated on why she worked from broad to specific:

> "For me to pinpoint one thing out of nowhere... I feel like I don't have enough information. If I just pick a word off the top of my head, I need to know background information so I find when I go from broad to specific. I start of with India. Ok, so now I know where I am. Then I go "time periods" so now I know when in time I am - what age I'm in and then I narrow it down to what they were thinking in that time period."

The Web, it seemed, served the "broad to narrow" strategy well. P7 explained how she browsed websites to get a feel for the topic area:

> "I just looked through really broad sites. I wasn't going for details yet and I sort of had an idea of what I was interested in - the topic - so I was just looking for information that was out there...I didn't look at articles. I just looked at web portals, some general information."

Once decisions had been made as to the research topic (at least at a broad level), the students now moved to the *Exploration* phase of their search. They began to explore the information environment in greater depth, but still with an eye to building a basic foundation of knowledge. To do this, they emphasized the importance of seeing the big picture, of looking for general rather than specific information. The Web was a good tool for building a knowledge base, according to P9, and he deliberately used it for this purpose; "I'll use the Net as a basic overview. That's what's mostly provided by the Web. If I want more specific details I go to the library." But P1, on the other hand, had no time for the Internet. It had "failed her in Grade 10" and she now had "an aversion" to relying on it for large projects. Her approach to exploring the information environment

was to go directly to the shelves where books on music history were housed. Facing the rows of shelves, she:

> "Read the titles of the books and picked out all the books that were general music history. I avoided books that focused on a particular era or, even more, a particular composer. First of all, because I hadn't picked any specialty so it would be impossible to pick out. Second of all, because experience has taught me that it is much more reasonable to take broad books and then read chapters that focus on my topic."

P2 also acknowledged that building a knowledge base was essential and books were her tool of preference. As she explored the books on her topic, she asked herself "Will this give me the base I need to move on?"

Building a base of knowledge was a critical metacognitive strategy to help move the students from *Exploration* to *Focus Formulation.* Describing how she transitioned from one stage to the next, P6 narrowed the focus from several topics to one quite specific topic by first starting broad and then moving to the specific, in essence, building the foundation for her search:

> "I did some research on each of these topics - mostly on the Internet - so I looked up websites and when I found a bit of information I went on the website of the college library and I found books. Basically...in the following two weeks I got those books and I had to read them and I think by now I already had a hypothesis formed and my topic was clearly one topic in my mind and I knew what I was doing so then I could narrow down my research. I started eliminating a lot of the websites and the books and all the useless stuff I had found in the beginning - I mean they still helped but I needed something with more detail. After I did that I started getting into the books and information that I had which was hard because I had a lot of different sources."

During *Collection*, it was important to begin focusing on the specific. However, P2 felt that widening her knowledge base continued to be a valuable strategy and she anticipated searching "online" to do so because, as she explained:

> "Expanding the databank is just as necessary as narrowing down to a concise topic. I have to know the big picture in every little detail so as to be able to concentrate on a few of those details and be able to explain how the rest of the details influenced it/them."

Similarly, P7 felt that information sources – in her case, books – would provide "a fuller picture…than just separate articles that will deal with just one aspect". She would have "the big picture and then go into specifics by chapter". P3 understood that he was learning as he was looking for information – a kind of learning on the job, as it were. Describing his style of looking for information, he said his method "becomes more organized as time goes on, while my project's subject has become more refined. I'll start off kind of not knowing exactly what I'm doing and as times goes on it'll become more and more organized."

Developing a "big picture", at least for these students, seemed to be an essential move during the information search process. Without an understanding of the "big picture" how can you understand where the smaller components fit in? Whether using books or the Web as a starting point, it seems that for these young people it was important to take the time to get a feel for the lay of the land and to build a foundation of knowledge, an approach that suggests a metacognitive awareness of a gap in their blueprint of the information environment. They continued to add pieces to the model – brick by brick, as it were - even as they moved into the final phases of the search, knowing perhaps that knowledge construction during the information search is a continual, iterative process.

4.2.6 Connecting

Connecting is a combination of nine sub-categories that were used in coding, details of which can be found in Appendix L: *Clarifying, Connecting information, Fill in Gaps in Information, Mapping, Part to Whole Thinking, Break Apart and Rebuild Strategy, Narrow to Broad Search Strategy, Specific details* and *Visualizing.* Together, these attributes represent a type of metacognitive knowledge related to understanding how to make sense of information and build knowledge. Participants who used this type of knowledge saw knowledge building as a process of construction and they understood that in order to make sense of the disparate pieces of information they had gathered, strategies for making connections needed to be implemented. Although related to *Building a base* and *Scaffolding* (because it is about finding ways to model and construct knowledge), this category of metacognitive knowledge is distinct because it is about the specific task of creating links between pieces of information. Much of this activity occurred in the final stages of the information search process.

One could conceive of *Connecting* as a linking process – the act of defining the relationships between nodes in a mental map. If each piece of information found in a search represents a node, then the relationships that bind them together represent the links. During the course of information seeking many nodes may be found but, unless linked together, the information seeker will not understand how all the nodes fit together into a whole. *Connecting* is dependent on *Knowing that you don't know*, an attribute of metacognitive knowledge that triggers the steps involved in linking information. Information seekers who know that they *don't* know say to themselves, I have all these pieces of information but how do I connect them? What steps can I take to connect them? Table 26 shows the groundedness and distribution of "Connecting" throughout the search process.

Table 26 *Evidence of "Connecting"*	
Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task Initiation	0
Topic Selection	6
Prefocus Exploration	18
Focus Formulation	5
Information Collection	37
Presentation	8

Making connections was primarily initiated during the *Information Collection* phase of the search, which the latter phase of information gathering. As the participants experienced some information overload *and* the deadline to pull all the information into one neat essay approached, they began to consider ways to tie up the loose ends and gain some cognitive clarity on how they would present their topic.

Early in the process, when asked in a telephone interview what questions he prompted *himself* with, P3 answered, "What do I want? Where do I find it?" But almost seven weeks later, and just two weeks before the essay was due, he was asking himself how he would connect the information; "How I can make the links more coherent or obvious?" He now understood that his conceptualization of the information was more important than having to find more.

Several students made use of meta-tools to help them make connections. We saw this in the previous section, *Scaffolding*, but it was all the more prominent when they were trying to organize their information in the latter stages. Two weeks before the final essay was due P6 checked an encyclopedia to clarify the meaning of two Greek terms for love: "agape" and "eros". There was confusion over how the terms were used in ancient Greek philosophy and therefore how to present this information in her essay. She turned to an encyclopedia that she had referenced in her critical bibliography assignment, showing an

awareness of her own cognitive confusion regarding the meaning of the Greek terms. Not only that, it also demonstrated knowledge of an approach that would be quick, easy and reliable: "The encyclopedia did clarify a few points I was uncertain about and it helped me generally to complete the ideas I needed." Another student (P2) thought to use her textbook as a meta-tool, as a means to help make critical connections: "I am also considering my textbook to be able to localize my elements of change in history, also to tie them in with contemporary events and or events."

P6 followed another tack in her attempt to make linkages; she focused on details. Standing back and looking at the "big picture" might mean missing critical connections and so she "looked for each part separately and that way I could find that single detail and it would be very well explained. It would be better explained than if I found one big source which would explain the three of them but wouldn't go into detail." Another student, P7, also looked for details rather than general knowledge. She returned to some of the websites she had found earlier because the links within each website led to topic-specific web pages; "I've decided to use the resources on some of the websites that I've found because some of them have links to pages that sort good web pages by subject so I'm using those to find new more specific information."

Sometimes comparing one information source to another, putting information in stark relief, helped. On the one hand, it filled in gaps; on the other, it showed where common elements lay. P7 explained this method in some detail:

> "I also found I was finding the information in different contexts so I was able to link it to more aspects and that was really useful to me. Because the articles I was finding before talked specifically about each queen but maybe more Hatshepsut, her life, her ascent to the throne. But for the lesser known queens, like Tai, I didn't necessarily have a lot of that type of information and coming across relevant passages to her in articles that talked about the Egyptian economy at the time or the wars or the letters that were found on Stele. That was really useful. The approach made me feel like I was getting somewhere so it made me pretty

happy. And I was also quite interested because of the new contexts that were coming up that I hadn't even thought about and I could now incorporate into my paper."

Methods for creating connections were sometimes quite idiosyncratic. P9 knew that he needed to pull everything together but it needed to be done quickly. Using post-it notes helped to connect the dots, as it were! First, he located and gathered 10 books. Using the table of contents and index, he then scanned through each book quickly, identifying information of interest and leaving a Post-it note as a marker. He then outlined his paper, following "general trends" (or themes?) and returned to the books, using the "post-it pages to fill in the gaps." This method must have helped because he concluded by noting; "Actually finding the info to fit my focus."

Not unsurprisingly, some of the participants found writing to be a good method for connecting information and clarifying ideas. For P1, writing was inspiring; "I either write stuff down or I speak to people to clarify my own ideas. Whether I type or write by hand, my hand can't keep up with my thoughts." But, as she mentioned, talking to people also helped. She decided to talk to three specialists in the field. It seemed the experts were able to fill in information gaps in ways that documents could not because "sometimes its so obvious to authors that they don't put it in". In her journal she explained how the interviews were used to fill in the gaps and connect the information she had already gathered into something meaningful:

"After having read some of my material, and skimmed a lot, I had made a few conclusions and a few questions arose in my mind about things that weren't clear to me. So I had many questions to ask them."

She continued:

"I used the interviews to bring all my material together and make it more continuous...It helped resolve issues without spending hours searching and

shifting through books. I found it really helpful to get a general and yet somewhat precise idea of my research topic. After talking to them, I really knew where I was going."

Visualizing the connections was helpful to one student. To help pull all the information together, P4 spread the books on her desk, each one opened to the relevant pages, so she could see the whole. Using this technique she was able to see how her own ideas fit into the lay of the land:

"I had all my information right in front of me and then from there I was able to put it together. I was also able to look over the whole idea, as a whole, from there I could put in my own, like I could see how it linked to my hypothesis."

The physicality of books and the space provided by the desk allowed for this highly visual and tactile approach to building connections.

For some students, the connections came slowly because the information they had found was contradictory. P9 struggled with this ambiguity, as he wrote in his journal, asking himself with frustration "Where does the truth lie?" The only solution was to look for more information in order to fill the gaps. He used a compare/contrast method to help him make connections; "Finally found clarification, corroborated current, reliable stories, allowing me to etch out a mental plan and start writing." Making connections affected his attitude toward the task. He added to the above: "Happy (?) that I had finally found the info I needed."

It seems that many of the students in this study had special tricks to help them find links between information. In fact, not everyone took a studied approach to making connections. P8's approach was more serendipitous and less conscious of how information linked together. Calling her approach "jumping around research", she explained how it worked:

> "It's not very organized. I go with the flow. Let's say I find something and then I'll go through the information afterwards and then I'll like, oh spot that word, oh a keyword, and then start a new research. You know, you jump around and oh, I want to go there! And then you come back and you make a link..."

Making connections, at least for this student, was not planned; the connections simply emerged.

Connecting, as well as the two categories discussed earlier - *Scaffolding*, and *Building a Base* – represents a highly interactive, "learn as you go" approach to information seeking. The students learned about their topics as they proceeded through the search process, using the information they found as both a learning tool *and* as content for their essay, a finding that is confirmed by other studies that looked at adolescent information-seeking behavior. For example, in a study that explored how 574 students in Grades 6 to 12 construct knowledge, it was found that the students' understanding of their research topic was transformed as they progressed through the search process (Todd, 2006). Chung and Neuman (2007) found that students' searches were less analytical and more open to discovery precisely because their exploration *was* a learning strategy. Metacognition and openness to discovery are not necessarily contradictory. Indeed, the students in this study consciously and deliberately used many tools and strategies to help pave the way for open-ended discovery, suggesting that a less planned, analytical approach does not necessarily mean a lack of metacognitive awareness.

4.2.7 Understanding Curiosity

Curiosity is an intellectual need, a desire to know. In the context of the information search process, curiosity propels us toward inquiry and discovery. But there can be dangers associated with too much curiosity during the information search process because too much time spent exploring can actually prevent answering the very question that launched the search. As Bates (2002) colourfully explained, "Curiosity may lead to browsing behavior...Curiosity has killed a few cats". Connecting the browsing and berry

picking behavior of human information seekers to the sampling and selecting behavior of animals foraging for food, Bates (2002) acknowledged that there is a trade-off inherent in the information search process - the necessity of finding " a balance between too much and too little curiosity in a species". Too much curiosity can lead one into dangerous territory; too little can lead to hunger. This seems to be an apt analogy for the conflict experienced by the participants in this study, who often found themselves forced to make stark choices between their need to discover versus their need to fulfill the requirements of the school assignment. The regulation of this conflict represents a special type of metacognitive knowledge which has been labeled by the researcher as *Understanding curiosity.* This category is multi-dimensional because the coding relates to both metacognitive knowledge and affect (and, as always, tasks in the information search process). To investigate the tension between curiosity and obligation, a "super code" was created in Atlas.ti by combining "conflict" and "curiosity". Two other codes represent understanding of the affective dimension of the search process; *role of motivation* and *role of interest* (see Appendix M for definitions of these codes).

At its heart, *Understanding curiosity* is about understanding the role that curiosity plays during the information search process - knowing *how* it gets you started, knowing how *much* curiosity you need, or knowing what happens when you are *not* curious. It also involves a risk/benefit analysis that hinges on understanding how far curiosity can take you before it becomes a liability, rather than a benefit, for the task at hand. Understanding this hard truth was for some of the participants in this study a painful thing – while they loved exploring their topic, they knew that curiosity had to be curtailed in order to move on. A few of the participants did not grasp the relationship between curiosity and control and, as a consequence, gathered too much information and then found it difficult to compress it into a neat package.

With *Understanding curiosity*, the link between affect and the search process was laid bare. Although curiosity is a cognitive state, it is so closely associated with emotion that when asked to think of three words to describe how they *felt* about looking for information on their topic, eight of the 10 participants used the words "curious", "interested" and "intrigued" to describe their feelings. Contrary to the expectations of

many educators and librarians – for whom curiosity is seen as a *good* thing – the participants in this study frequently juxtaposed curiosity next to terms related to negative feelings, such as nervous, worried, anxious, frustrated, overwhelmed, and aggravated. Table 27 shows the groundedness and distribution of "Understanding curiosity" throughout the search process.

Table 27

Evidence of "Understanding Curiosity"

Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task Initiation	0
Topic Selection	2
Prefocus Exploration	8
Focus Formulation	2
Information Collection	5
Presentation	4

a. Curiosity About the Topic

Curiosity and interest in a specific topic was a critical factor in the decision-making process during *Topic Selection.* At this point, curiosity outweighed other considerations. P4, talking about how she felt about her research topic, explained that it was "intriguing" and that she had "always wanted to know about ancient India." Her topic selection, then, addressed an intellectual need to know. Later, when exploring the topic, she found herself "reading through chapters, I just wanted to read the whole book. I wanted to explore the whole book. It all interested me." But this interest presented a problem. While thirsty for information on ancient India, she was still cognizant of a need to control the information gathering, saying her interest and curiosity was "balanced with need". As much as she wanted to read books from end to end, she new that at this early stage in her search, what she really needed to do was cast a wide net and gather as many sources as possible. As she said, "the problem was that at that point I wanted a variety of sources". Gathering

information from *within* sources was for the next step – *Collection* – and she knew she needed to wait.

Controlling curiosity is important but knowing what role it plays in the search process is also critical. P9 understood how curiosity motivates and chose his topic accordingly. During his first telephone interview he articulated this awareness:

> P9: "It helps to have a subject that interests you. When I'm looking for something I find much less information if I'm not interested. This is true for most things. Homework that doesn't appear like homework is easier.
>
> LB: Would you choose to search for something that is harder but more interesting or easier and boring?
>
> P9: Harder. I'm always looking for a challenge. I really dislike boring stuff. In subjects that bore me I do worse. When it's interesting it's like the reward."

Later P9 chose a topic suggested by his neighbour, saying, "rather than randomly choosing one, I chose one he suggested that seemed interesting."

During *Prefocus exploration*, after the broad topic had been selected, the participants delved into the information. Often they found themselves wandering through reams of information. It was all so interesting and they wanted to experience all of it. But was it useful to be so curious? In terms of the task at hand, P2 thought not. Asked during the final interview what makes looking for information harder for her than it is for other people, she cited her curiosity:

> "Before I know it I have spent three hours on *Wikipedia* reading information that doesn't have anything to do with my paper."

She went on to explain why she considered her curiosity a weakness:

> "When it comes to writing the paper itself, I lose time. In the long run I'm pretty sure it will pay off somewhere because it's information stored in my head and it will help me do research for later on but at the given moment it's not helping me focus, its not helping me concentrate, because I'm just too interested in stuff - randomly...I realized that whatever I find I would always find it interesting. There's hardly anything you could present to me that I would not find interesting. It does have its drawbacks."

P6 also found herself reading nonstop. While definitely enjoyable, and potentially beneficial in the long term, it was not necessary or even useful for fulfilling the requirements of the school assignment:

> "I'm very interested in this topic. I kept reading even though - I remember once there was a little part in the introduction which I thought about using but I didn't stop there - I kept on reading - which took me about an hour and a half, so I lost a bit of time just reading and that does make a difference. That helps my general culture. It doesn't help my project."

Perhaps it was this same awareness that helped P4 to focus on her topic during *Prefocus exploration.* She got caught up reading, "even if its not on my topic", but stopped herself by asking "Is this information actually on my topic or subject?"

P3 also knew the limits of curiosity and interest when it came to school assignments:

> "Sometimes I have to tell myself that it's not just an interest project or just for like intellectual curiosity or whatever, that I have to actually see what I need."

Controlling curiosity was, in the estimation of many of the participants, an important skill. Sadly it seems, ignoring the pleasurable aspects of information seeking is what actually gets you ahead. P3 thought that self-discipline was necessary. Asked what

makes looking for information hard, P3 found that "whipping myself into shape" was difficult. As he explained during the final interview:

> P3: "A lot of things interest me and especially on a subject that kind of interests me, I have to kind of ignore all these sub-titles and chapters that interest me and sometimes I'll just get lost and start reading a chapter that will probably not be relevant.
>
> LB: And that's not a helpful thing?
>
> P3: Most of the time it's not. It's time-consuming and yes it's fun but it's not helpful for my project."

For P1, exploring her topic was a guilty pleasure and one that perhaps should not make her feel so good. It needed to be controlled. She had just gathered a selection of books on her topic and waited anxiously to read them. In her journal she described her mix of feelings:

> "My current state which is grinning from ear to ear in anticipation of reading all these books laid out around me. It is odd to say but I felt like I was wasting time at the library and I should stop indulging myself too much since I was having so much fun."

Reigning in interest and curiosity in the topic related to decisions about relevance and usefulness. Weighing the options was a painful experience. For P6 it was *the* most difficult question she asked herself during the search process, saying, "the hardest question I had to ask was how much of this information I could actually use and how much is just things that interest me but don't apply to my topic."

Moving onto to *Collection*, the participants now focused on their topics and began to gather specific information. The deadline for the assignment was looming and for many

of the participants, time became of the essence. During the final interview P9 talked about the role of interest during the *Collection* stage of the search process. Interest and curiosity, according to him, were irrelevant at this point. They were suppressed in order to complete the task at hand, which was to collect and prepare the information in time for the deadline:

> P9:"I had no time to be interested or not."
>
> LB; You lost your curiosity?
>
> P9: Well no. I was still curious. I tried not to think about being curious. I would still like to know for myself but it wasn't important that I was interested."

P3 described a similar closing down of curiosity. He became less open to discovery and less forgiving of irrelevant information during the *Collection* stage of the search. He asked himself, "How can this help me for my essay? I'm using a different point of view. I'm more selective, straightforward. Less forgiving. I can't get completely absorbed."

Focusing on her topic, P4 also ignored information that was interesting. This seemed to be a good strategy because it allowed her to find a nice selection of sources for her project, a positive outcome that made her feel happy (as indicated by the insertion of a happy face on her timeline):

> "I focused on what I needed rather than on what seemed interesting, but may not have pertained to my subject. Is this information relevant to my topic? I finally had a good start →I have a narrowed down topic, and now I have books to help me advance with my research ☺."

Pulling the information together into an organized product is a difficult task for most information seekers, but for one participant in this study the task of *Presentation* was particularly challenging because of unregulated curiosity:

> "I got so sidetracked by everything that was interesting but I didn't organize well enough. The problem with my outline was that there was so much that I started following it and then halfway through I'd already written half of it I realized that I can't spend so much time on these things so I kind of have to cram everything else into other parts."

The sense that interest and curiosity were hindered by the boundaries of the task imposed by the school assignment was expressed by P7. Commenting on the project in general, she described the conflict between interest and obligation;

> "I really did find myself limited by the project. I knew that if I didn't stop myself I would never be able to put it together - it would go in all directions so I really had to let go of that. Not even going to bother looking at that. It's not going to help me."

The decision to limit exploration – a decision taken by all but two of the participants - was evidence of a metacognitive awareness of, on the one hand, the demands of the cognitive task and, on the other, their own cognitive need for intellectual stimulation. A limitless exploration of the information environment would feed their curiosity but, in their estimation, would ultimately impede the overall search process in the sense that they would not complete the task on time.

b. Curiosity About the Process

Thus far there has been an apparent assumption that curiosity relates to interest in domain knowledge, in other words, the topic. But this study showed that a secondary form of curiosity exists. Several of the participants found the problem-solving process equally compelling. They were curious about how the project would unfold. Starting with a blank slate, they wondered how they would solve the problem of finding the right information and then packaging it into a coherent whole. For example, P5 expressed a sense of

"where is this going?" when she said, "I feel curious as to the direction it will take when I start writing."

Following her interviews with experts in the field, P1 spoke of a mix of satisfaction and curiosity in the process, saying, "I was intrigued as in I had put one foot forward and I had more to go." P2 explicitly divided her curiosity into two categories – the topic and the process. When asked early in the term to think of three words to describe how she felt, she said:

> "Moderately excited.
> Curious about topic.
> Curious about how I will deal with it.
> Two kinds of curious."

Clearly, this participant had a lot on her mind. Given the requirements of the school assignment, regulating curiosity was a critical metacognitive task.

4.2.8 Understanding Time and Effort

Successful outcomes are often the result of sustained effort, attention to detail and a consistent level of persistence. Woven throughout the data is evidence that the participants understood the connection between effort and results at a general level but that this understanding did not always translate into action. In other words, "knowing" did not always relate to "doing". The problem was perhaps related to the participants' understanding of the task at hand – completing a research paper for college. While they understood that effort generally pays off *in life*, many of them simply did not see the specific task of searching for information as something that required effort. This points to a lack of metacognitive awareness related to the cognitive demands of the information search.

Another facet of effort is the understanding associated with knowing when *not* to invest effort in a task. While effort is often necessary in order to complete cognitively demanding tasks, sometimes the wisest action to take is to do nothing (or at least very little). Taking a shortcut, or doing something that simplifies the process, may certainly require less effort and if by doing less one avoids wasting cognitive effort then it is a useful strategy. After all, why walk all the way around the block to get to the neighbour who lives behind you when cutting through the backyard will get you there more quickly and with less effort?

The question of finding a balance between useful effort and wasted effort was explored in this category of metacognitive knowledge, labeled *Understanding time and effort*. It is the compilation of 13 sub-categories, explained more fully in Appendix N: *Concentration, Control, Crutch, Investment in time and effort, Laziness, Principle of Least Effort, Patience, Persistence, Knowing the Right Time to Apply a Strategy, Understanding the Role of Effort, Understanding Effort Required to Summarize, Using a Short Cut, Skimming Text.* Table 28 shows the groundedness and distribution of "Understanding time and effort" throughout the search process.

Table 28

Evidence of "Understanding Time and Effort"

Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task Initiation	0
Topic Selection	6
Prefocus Exploration	19
Focus Formulation	5
Information Collection	31
Presentation	6

Across the board, there was a clear link between feelings of stress and anxiety and notions of time and effort. Not unexpectedly, the more the participants perceived that an

investment in time and effort was required, the greater the stress and anxiety they felt. While in general the participants thought metacognitively about time and effort, some in fact did not consciously connect their stress and anxiety to effort and time. For example, asked to think of three words to describe how she felt about her topic, one participant (P5) said, "stressed" and a "bit excited. The topic is super detailed. I can spend lots of time on it." But then when asked how she felt about looking for information on her topic, she said simply, "Pretty easy."

a. Managing Time

Knowing when to time effort – in other words, *when* to apply a strategy that requires little time and effort versus *when* to apply a strategy that does - is an important piece of metacognitive knowledge. The notion of an investment in time often came up in the participants' thoughts, demonstrating a conscious awareness of the connection between effort and outcome. How much time should be "spent" on the task? Would this time "pay off"? Key decisions were made based on time factors. But which strategy would actually save time and effort? Many of the participants assumed that searching the Internet (the open Web), using a search engine like *Google*, would be the fastest and easiest approach. Perhaps this was based on lack of previous experience, because of the 10 participants in the study, only half seemed to have previously completed a project that required some sort of literature review, making it difficult for them to forecast the amount of time and effort required to find the kind of information needed for this school assignment. P5 decided early in the process to search the Internet from home, assuming that it would be, as she said, "quick and easy". But this was not to be the case. Later in the term, during *Collection,* she realized she needed more specific information. Now the Web created frustration, not comfort, because the expectancy of speed did not translate into results:

> "The websites aren't as useful because I feel like the books are more reliable, and the websites do not cover everything in as much detail. It is a lot faster to find the information I am looking for through the internet, but I still don't mind spending that extra time looking for published sources. I find I am more impatient when I

am looking for information on the internet because I am expecting it to be fast, and because it is fast I am expecting to find more."

It seems that during the latter stages of the search, at least for this student, time and effort equaled reliability. At the same time, the Internet, an information source known for its speed, turned into a liability because of its unanticipated drain on time. The impatience expressed by the participant expresses a miss match in her understanding of the cognitive task and what she understood to be the cognitive effort needed to complete it.

One student drew on her previous experience with research projects to plan how she would "spend" her time. P1 said she had done several indepth research projects in high school, including a few science fair projects. As she explained, looking for information was easy for her because she'd had "practice" – a not unreasonable assumption. She did seem to have an understanding of the nature of the task and the effort required because she anticipated how much time it would take to read all her materials. She gathered numerous books and articles early in the term and launched right into reading them as soon as possible. Earlier, during *Topic Selection*, when she had been asked to think of three questions that she asked herself, P1 proposed the following:

"What is my topic?
What is my topic specifically?
How much am I willing to read?
How much time do I have?"

The first two questions demonstrate an attempt to focus on the topic. The latter two questions show that, while trying to make sense of the information, she was also trying to estimate the time and effort required to handle any topic she chose.

Managing time well is a crucial skill for students. With obligations and deadlines to consider, how much time one devotes to each task, as well as when to work on it, becomes a critical decision. School projects that last the term present a particular "time

management" problem for many students. P4 described how difficult long term deadlines are:

> "That's what I find difficult about long term projects because its always the last on my list of priorities. Everything else comes first because its due earlier. It always gets pushed to the end."

The act of delaying effort because of the demands of other classes was frustrating for P3, preventing him from exploring and focusing on the topic – two critical stages in the information search process. Only time and effort could overcome the gap that he felt in his understanding of the topic. Asked what helped him explore and then focus in on his topic, he said it was:

> "...almost a time thing. I would have done more if I could have and it was just after a concentrated period of mid-terms and that ended and, ok now I have time to do research, to read, and that's when I had time to read and by reading that's when I got a better idea what my project is about actually."

But it was frustrating to delay effort. He continued:

> "I had a lot of books for a long period of time but not enough time to read. It was frustrating, because I knew there was all this great stuff right on my desk that I couldn't access so I had to take the time to actually spend time reading."

So for this student, forcing himself to concentrate on his information sources was a key factor in moving forward in the process, providing evidence of a metacognitive awareness of the role of time and effort during the information search process.

P10 understood quite clearly the connection between time and effort, on the one hand, and negative feelings of stress, on the other. Asked how she felt when exploring information on her topic, she answered, "Stressed. Afraid I can't find enough sources."

But how should she overcome these feelings? She answered simply, "work". And indeed, she was able to complete her research essay, hand it in on time and, according to the student, do a good job of it.

It is not the case that all participants in this study managed their time effectively, although many did. What they lacked in understanding about the nature of time and effort in relation to their cognitive task at hand, they made up for in creative solutions for dealing with unanticipated results.

b. Principle of Least Effort

A well known concept in Information Science is the *Principle of least effort*, or *Zipf's Law*, which states that humans naturally follow the path of least resistance (Zipf, 1949). They will trade-off the benefits of one action if, in following another course of action, there is a calculated reduction in the amount of effort expended. It is a useful principle for explaining why information seekers willingly choose the less reliable but easy-to-access information source over the dependable but harder-to-access source (for example, using *Wikipedia* rather than books from a physical library) or why people might choose a friend rather than a trained librarian for help finding information. Related to (and possibly the reason behind) the *Principle of least effort* is the decision-making strategy of "satisficing" or, making do with a solution that is good enough rather than the optimal choice (Simon, 1976). The *Principle of least effort*, at least on the surface, seems to be diametrically opposed to thoughtful, reflective learning. And yet, when one considers the outcome, perhaps "least effort" behavior is a highly metacognitive approach. If there are other more taxing activities during the information search process, then it makes sense not to waste time on smaller problems that have a simple solution. P2 explained her reasons for choosing a book from home rather than searching the Web:

> "I originally wanted to have a website as my 5th source, but I had to realize that finding good websites takes hours, which I again lacked. I already asked the teacher if I could have a Hungarian book and she said yes, so I wanted to have

one just for the fun of it anyway. So I made the quick decision of the easy-to-get Hungarian book over the hard-to-find Anglophone site."

Another strategy for getting the most out of a little effort is the act of skimming text. Several students said they consciously decided to scan texts quickly rather than read deeply, showing an awareness of the cognitive load required by certain types of reading. After carefully reading two books, P9 realized that he wouldn't have time to continue this tactic. Calculating time and effort led him to decide to skim the remainder. P9 explained his decision:

"I started with two books and I basically read most of them and I found out I was running out of time because I was taking everything I saw on the topic. So continuing at that rate I wouldn't have finished on time - because this was a bit last minute - so for the rest of them I read through them quickly and put post-its on all the pages that might be pertinent and when I was actually writing it I just went back, saw this page."

Another participant (P4) saved time and effort by first skimming through the table of contents "to see which ones had subjects that I needed" and then glancing "through the pages to see which ones would give me the most information". There was a clear rationale for this action; "I found that this method worked because I saved plenty of time reading all the books to find exactly what I wanted". But, as with all "least effort" strategies, there is a trade-off, a cost to pay, and P4 was aware of it:

"This method may have led me to miss sources that may have helped me → because as soon as I looked at the table of contents and found nothing I liked, I put the book away."

During *Collection*, P4 used post-it notes to save time and to help structure her thinking – a multi-purpose metacognitive approach. "I think this method should work, because I am

taking into account the amount of time I have left as well as I am trying to make it easier for myself to organize my thoughts."

The *Principle of least effort* was clearly at play the night before the essay was due, when P9, realizing the materials he had already collected from the college library and the Internet weren't adequate, decided to go to a local public library. Why? It was easy. It was on the subway line so it was easy to get to, it was open to the general public so he didn't have to sign up for a library card, it had a large collection so he had a reasonable expectation of finding books on the shelves, there was a lot of space to work in so it was easy to find an empty desk, and it was open late in the evening so he could access the materials at the last minute. Some would argue that leaving the project until the evening before was not very metacognitive of this student but he had uncannily predicted this very behavior during the first meeting with the researcher, early in the term. Clearly he understood his methods, perhaps using them to his advantage.

4.2.9 Understanding Memory

Exploring an information-rich environment, such as a large academic library, an electronic database, or just surfing the Web, is like deep sea fishing: The information seeker casts a wide net into a big ocean and draws in all manner of information sources. Not everything in the net is useful but sometimes this is not known until many of the sources have been sorted. By this time, some information seekers forget where the critical pieces of information are located. They are perplexed - where *did* they see that reference? If they have not used techniques to help them find their way back to the information, it could be lost to them forever.

Remembering where information is located is an important part of the information search process. Understanding the role of memory in information seeking, knowing that it is difficult to remember everything, knowing how one's *own* memory works and, knowing how and when to use specific strategies in order to help one remember where information is located so that it can be retrieved later, are all important metacognitive aspects of the

information search process. Remembering is no doubt assisted by a strong conceptual understanding of the information environment, but since novice information seekers do not always have this, they must depend on the little tricks that help them remember the pathway back to relevant information. In acknowledgment of the important role of memory during the information search process, at least for these 10 young students, the category of *Understanding memory* has been developed, a merging of five sub-categories used in coding, the definitions for which can be found in Appendix O: *Remembering, Highlighting text, Note-taking to aid memory, Post-it notes to aid memory, Self-strengths* and, *Self-weaknesses*. Table 29 shows the groundedness and distribution of "Understanding memory" throughout the search process.

Table 29

Evidence of "Understanding Memory"

Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task Initiation	0
Topic Selection	0
Prefocus Exploration	5
Focus Formulation	1
Information Collection	7
Presentation	5

Memory issues are not typically associated with adolescents, but many of the young people in this study found that they *did* lose track of information and that this was a hindrance to the search. It was not their sense that *they* were lost but that the information was lost, buried somewhere in the pile of information that they had selected. Asked what is the difficult part about looking for information, P1 replied; "The sheer amount of it. Making mental notes." Here one gets the sense that the problem is not so much that there is a lot of information, but that the mental exercise of keeping track of it is a burden.

Most of the students used cognitive strategies to shore up their memory – the inference being that if they used these strategies, they must have realized at some level that they needed to. Several students left markers, such as highlighting text or using post-it notes, to guide them back to the information. Others took handwritten notes. Some unfortunately only realized post-search that they should have used better techniques to help guide them back to the information.

Only two students seemed consciously aware of their own memory capacity, talking about how much information they could store. P2 felt her strong memory was a definite strength during the search process (as discussed in Section 4.2.1). P1, on the other hand, felt her memory (or more specifically, her type of memory) was an obstacle. Although P1 had worked on research projects in high school, she had never had to cite sources to the degree required for this essay. The new experience worried her. In her words, she was "freaked out about footnoting" because she did not have the kind of memory required to keep track of everything; "I don't have a photographic memory, so I won't know where they [quotes] come from." This acknowledgement of a weakness prompted her to ask:

> "How am I going to remember where I got my sources? Some people will say oh I remember exactly I got it on this page and this book because they have like a photographic memory but I don't. I really don't have a photographic memory. Like I remember stuff but mostly kinetically. I'll remember the information without knowing exactly word for word. If I hear it I can remember it word for word. But if I'm reading it I'll remember the idea...I do have a certain photographic memory...I think I read it on this page and then I hadn't cited it. I wrote it was in one book but I didn't write the actual page number and then I translated it so I couldn't even to "find" it in my document so I couldn't even go use it..."

This questioning triggered a change in behavior. She began using what she called the "star system" to mark the text she wanted to cite. While P1's self-questioning shows a certain metacognitive awareness (or at least, a metacognitive belief) about herself, the

anxiety she felt demonstrates that she did not have a strategy to aid memory readily available in her metacognitive toolkit. In the event, she figured out a method to keep track of her sources and moved on.

Highlighting text is associated with reading comprehension strategies and indeed it may have led to a better understanding of the text, but in this study, it was also used as a retrieval technique, perhaps because the students realized they could not possibly recall where all the information was located. P5 photocopied specific pages of the books she had selected and then highlighted important passages. She then typed the passages into bullet point form, integrating them directly into her essay as quotes. In this way she used a technique for remembering as a technique for making connections as well.

Several students used note taking to aid memory. Like highlighting, note taking is associated with reading comprehension strategies because it helps to clarify meaning. It also helped P4 document where her sources came from. During *Prefocus exploration* P4 was actively note taking as she read, in large part to help her retrieve the information later, realizing perhaps that to leave the search undocumented might mean starting all over again. She explained her reasoning for note taking:

> "Now, I am reading and taking notes on the books I got last month...I found this method to be helpful → I hope that when it comes time to actually write my essay, I'll be able to just go straight to my notes and get the information I need. Also, with my notes, I wrote certain page numbers so I will have a reference to go back to when I'm writing a particular section."

In one case, note taking caused concern. P10 realized that it was an important time-saving strategy, so much so that she worried about how best to do it. In the timeline exercise she asked herself, "Should I take a lot of notes or less? Which aspects should I focus on in my notes? Are these the best quotations I can find?" Her feelings related to this question were mixed. She felt "Confused; frustrated, sometimes happy."

P9 realized after the assignment was over that he could have used a few techniques for recalling where the information was. He had previously read the material but when it came to constructing the essay, and retrieving the information from the books, he forgot where it was located:

> "Searching the books, I vaguely remembered where I had seen info, but because I had not written it down, I wasted time and confused myself re-searching the same books."

Fortunately P9 figured out a quick and efficient strategy to assist memory retention (as discussed in *Section 4.2.8.2).* He decided to use post-it notes at the last minute, explaining; "I put post-it notes and I plan on going back when I actually need to have more information but for now it's more of a bibliography." P4 also used post-it notes, principally because it was easier than taking notes. "I have done much more research, but I find it time consuming to take notes with the little time I have left to write my essay. Now, I stick notes into the books and I have written my introduction."

In this section we have seen how two distinct attributes of metacognitive knowledge can overlap. For example, strategies related to *Understanding memory* were also used to help connect ideas (*Connecting).* This provides evidence of the rich and multi-faceted nature of metacognitive knowledge during the information search process.

4.2.10 Pulling Back and Reflecting

Taking the time to back away from a problem and think about it was evidenced by the thoughts and actions of six of the 10 participants, making this one of the weaker types of ISP metacognitive knowledge represented in this study. Perhaps this is more a reflection of the tight deadlines and heavy workload carried by the students in this study than it is of any strength or weakness in ISP metacognitive knowledge - eight out of the 10 students said they felt very pressed for time. As little more than half of the students showed an awareness of the metacognitive benefits of reflecting, reviewing and just stepping away

from the problem, this category presents itself as much as a gap in knowledge as it is a strength.

The category of *Pulling back and reflecting* was derived from the synthesis of four codes (or sub-categories); *reflecting, reviewing, following-up a lead,* and *taking a break.* (See Appendix P for definitions). Reflection, a common theme in the literature on metacognition, has been collected under the larger umbrella of *Pulling back and reflecting* because reflection was expressed as a physical pulling away or gaining distance from the problem, rather than as a specific period of "reflecting". Table 30 shows the groundedness and distribution of "Pulling back and reflecting" throughout the search process.

Table 30

Evidence of "Pulling Back and Reflecting"

Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task Initiation	1
Topic Selection	0
Prefocus Exploration	6
Focus Formulation	0
Information Collection	6
Presentation	1

The first reaction to the assignment, for some participants, was one of worry. The assignment was complex, in a new domain of knowledge, and it required new skills in building arguments by using evidence drawn from the literature. But stepping back and reflecting on the task was a helpful maneuver for P6. At first she was "shocked" by the assignment, but once she stopped to think about it, she then realized that her interest in the topic could sustain her. She felt relieved. She explained:

> "I felt worried because she mentioned it was seven pages. I felt I'd never be able to write it. But then I thought about my topic and I felt better - interested, and a bit more confident because it would be something that interests me and I knew about it so I knew I could actually write about it."

Reflection helped her get in touch with her feelings and motivation. (on a deeper level, this shows an awareness of self – an understanding of the role of motivation in her learning). Thinking about what she already knew also gave her confidence, more motivation to continue. Another participant (P1) also realized the importance of stepping back from the problem, saying it was important to begin by "thinking about what you already know".

Several students indicated an awareness of a particular cognitive strategy designed to build some space for reflection around the problem, called in this study "taking a break". Putting some distance between oneself and the problem helped to provide clarity – perhaps because it simply allowed for a sustained period of reflection. When asked to complete the sentence, "When looking for information sometimes it helps to…", it seemed that for some students, simply taking a break was important. P6 made the following suggestion; "Just take a break. Be a little distant from it. Because when you read too much you might share the author's opinion." This was echoed by P7, who said, "Take a break. I'll be working in the evenings. I'll have to sleep on it." P4 found that creating distance helped to reduce stress and brought the search back into focus. Her advice was to "leave for an hour. I find when I'm working on it too long it gets frustrating and I stop focusing" (P4).

As an alternative to taking a break, some of the students found that reviewing and revisiting information was a good way to step back from the process, albeit in a limited way, and get some perspective. These strategies reflect the knowledge that revisiting information already found can help to improve understanding of the topic. In revisiting the information, one is pulling back from the search, making some space for reflection about results already obtained.

Given that the students had the whole term to complete one research paper, it seems paradoxical to suggest that they had little time to reflect. Did they actually have no time to sit back and think through the problem? The answer may be tied to larger questions related to the college's educational program and standards, as well as the activities and obligations the students had for the five to six other courses they were required to take during the same semester. It may be that, as a whole, the demands of their studies were so great that it really was difficult to carve out moments of reflection. But for those students who *did* find it hard to step back from the problem, perhaps the problem was really one of not knowing how.

4.2.11 Changing Course

The young people in this study demonstrated active use of a type of metacognitive knowledge that falls under the term *Changing Course.* Used to guide the choice of a new search strategy when the search is stalled or less fruitful than expected, it is derived from the combination of four overlapping sub-categories, each one grounded in the data - *Adapting the Topic, Shifting the Search Strategy, Simplifying the Search Strategy, Ending Exploration.* (See Appendix Q for definitions). Table 31 shows the groundedness and distribution of "Changing course" throughout the search process.

Table 31

Evidence of "Changing Course"

Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task Initiation	0
Topic Selection	1
Prefocus Exploration	12
Focus Formulation	6
Information Collection	13
Presentation	1

Information seekers who decide to change course realize that tactics and strategies previously applied either did not work or only worked up to a point. In other words, a new course of action is required. *Changing Course* is therefore dependant on the ability to assess one's status during the search process. *Changing course* is also representative of the ability to plan and predict an outcome because it reflects evidence of thinking ahead to the next step. Without this type of metacognitive knowledge, information seekers will not adopt changes to their approach and will continue along an unsuccessful path toward an uncertain future. All of the students in this study changed course at least once during their searches. The question is, did they change course willy-nilly or did they consciously chart a new line of action that would help them move forward? For most, a change in tactic or strategy was deliberate, coming at a critical time in the search, and accompanied by a reasonable explanation as to why they did it.

What does *Changing course* during the information search process look like? Often it involved the tactic of adapting the topic to match the information environment. One example was when P3 questioned his topic selection after having explored the information a little. He had started out wanting to compare the ancient Greek view of nature with ancient Greek philosophy and art, but discovered that the initial conceptualization of his topic did not fit. One question he asked himself during the early stages of the search was, "Does it make sense or fit in, or do I have to switch topic?" Instead of changing the topic, he adapted it, dropping nature and adding political systems. P5 also adapted her topic, saying that she was "forced to tweak my research topic slightly seeing as I wasn't finding enough information on ancient Egyptian astronomy."

Changing course might involve a change in search terms. P5, conscious that there are different means to tackle the same problem, explained why changing search terms is useful; "Finding many different ways of saying what I am looking for helps to find more information". P7 used the advanced search in the college library's catalogue to no great success; "I couldn't think of enough synonyms/related words to substitute in my search when no results were found for some trials". She realized her vocabulary on this specific

topic was inadequate – it did not match the indexing terms used in the catalogue. In her journal she noted that a different tactic was required:

> "I need to rephrase the keyword I use to search according to the books I found (ex: I was using "ancient" in my search, but noticed that some books were categorized "pharaonic" Egypt, so using this in my search would improve the probability of finding references)."

The same student used another approach to direct a change in her search. She switched to a new search tool. P7 wanted a visual representation of how the power of female rulers had evolved alongside the evolution of Egypt. Specifically she was looking for maps:

> "I'm looking for information about how the foreign politics of Egypt changed over time and maybe how women related to that and how their power evolved and to find information I decided to try Google again but with the image search so I'm looking for maps and other depictions that might be helpful in showing the expansion or loss of territory that Egypt had over time."

Google's web search (which she referred to as a "text" search) had yielded little so P7 decided to try Google's image search. While she needed images to help her understand the broader context, as evidenced by the above quote, there was an ulterior motive at play here; the links found through the image search actually led to full websites with more information! P7 explained her reasoning for using Google's image search:

> "It seems like a different approach to finding information and good sites. Sometimes I found that when I tried the text search I didn't come out with the results I wanted but using the links to the images will sometimes give me a link to a relevant website."

P1 shifted her strategy in a different way, moving from searching the catalogue to browsing the shelves and then back again to the catalogue, deliberately looking for ways

to broaden her understanding of the information environment. She explained, "First I have to use the computer to find the general section (Dewey 780.9 in this case). I browse for a bit, pick out books. Then the computer comes back in handy, I get ideas as to series or collections."

Sometimes the shift in tactic and strategy was dramatic. For example, P3 took a step backward, deliberately choosing to use sources that were less advanced (in his estimation) but easier to understand. He had gathered a wide selection of books on philosophy from the college library but some (or all – this is not clear) of the books were primary sources. He decided to pull back and search within basic history text books, where information was "dumbed down", because:

> "They summarized...not that well...but it helped. It helped me to step back, to go back to something that is way more simplified."

Realizing that the cognitive load needed to interpret primary sources was greater than that needed to make sense of an easy-to-use text book, this student knowingly reversed the course of his search in order to advance it.

Most of the change in tactics and strategies made by the participants in this study related to information retrieval – the selecting and gathering of resources during *Prefocus exploration* and *Collection*. But the students also made adjustments to their topic selection, a tactic designed to make it easier to find and use information later in the search process.

4.2.12 Balancing

Balancing is the compilation of four sub-categories used in coding: *Filtering information, Finding an equilibrium, Awareness of the weakness of a strategy, Weighing the Options.* (See Appendix R for defintions). A broad category, it is principally about the cognitive task of making choices, sometimes between two desirable options, and knowing that

making choices helps to move you forward in the search process because if you *don't* make a choice, the search will be stalled. *Balancing* is also about weighing the options and making compromises. For example, choosing between feeding curiosity or finishing the assignment; choosing between precision or recall; choosing one of two interesting topics; finding a balance between "good" information and information that is "good enough". Since choice-making is inherent in the information search process, *Balancing* is an over-arching category that weaves its way throughout the search process and encompasses many approaches. But interestingly, it occurred predominantly in *Prefocus exploration* and *Information collection*, the stages where the students gathered and selected information, so *Balancing* is principally about choosing information. Table 32 shows the groundedness and distribution of "Balancing" throughout the search process.

Table 32

Evidence of "Balancing"

Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task Initiation	0
Topic Selection	3
Prefocus Exploration	23
Focus Formulation	9
Information Collection	26
Presentation	8

During *Topic Selection*, a balance had to be found between choosing a topic that was interesting and choosing a topic that was do-able. An important factor in choice-making was the metacognitive knowledge related to *Understanding curiosity*. For P1, the topic of "music style" was more interesting than "the social history of music". The tipping point in this balance was how the information sources she was using interpreted the terms "history of music", which encompasses a wide range of topics. Through the process of elimination, which was described by P1 as "I can't do that so I have to do that", she removed topics in the history of music that didn't fit within the scope of her history

course. Topics like music style didn't fit but the social history of music did, so by default, this became her topic: While "music style" was more interesting, "social history" was more appropriate. Making a choice, by weighing the options, helped to her move forward.

Once the topic had been chosen, the *Exploration* phase of the search began. For P1 the choice now was about how to find a balance between exploring enough information to launch the project versus exploring too much information and getting dragged down – a metacognitive cost/benefit analysis. In the past, P1 had explored her topics by reading a wide selection of books cover to cover, but for this project, the tactic "proved fruitless," she explained, "since I could not find time to read through them and the style tended to be more academic and beyond my comprehension. I have had to overcome my eagerness at finding material and narrow down my readings." As a result she was much more selective in her initial choice of information sources. For another participant, the problem was not her own approach but the narrow parameters of the essay. P10 explained how the necessity to filter, to find a balance between good information and bad, and make choices, was defined by the project, saying the problem was really about "how to write a small paper. You have to summarize."

During the *Collection* phase of the search process P3 understood that choosing information necessarily means that some information must be eliminated. There were choices to be made and he set out to do so. He had chosen his sources (principally books) and he now had to gather information from within them, saying "halfway through my project the focus was less on the research of finding new sources but more about finding the information within the sources. From maybe halfway on it was mostly looking within the sources I had rather than finding new ones." He now read with purpose, more interpretively, and in his own words, "with an angle", so that useless information could be filtered.

A feature of *Balancing* is knowing that a cognitive strategy can have a secondary effect that is counter-active. For example, scanning through text, a technique used heavily

during *Collection*, is one way to quickly eliminate irrelevant information. It may be a good approach for choosing information but it has a downside – it can also mean that you have missed important information without knowing it. P4 glanced quickly through some books on the shelf in the library, searching the table of contents and index. She knew there was a cost to filtering information by scanning, explaining in her journal, "I have no idea whether or not the book had something [else] that would help me." There is a sense here of finding a balance between the lesser of two evils – collecting enough useful information versus missing information that might be relevant.

The participants were sometimes taken aback by what they saw as bias in the information. They were surprised that information that would normally be called "reliable" and "credible" – information from scholarly books and peer-reviewed journals – actually presented divergent, seemingly biased views. Perhaps the students expected straightforward answers to their queries. P9, looking back on the search process in his timeline, expressed his frustration at the ambiguity of the information. Midway through the term he wrote in his journal:

> "Why are some biased? Where could I find current, unbiased info? What EXACTLY happened? Were the Muslims tyrants? Or benevolent? What roles did Christians play in Ottoman society. Confused by contradiction. Seek clarity."

Just two weeks before the end of the term, he was still confused by the contradictions and asked himself:

> "Still WHAT HAPPENED? Between the Muslim and Christian interpretations. Where does the truth lie?"

The solution was to weigh two sides of the argument and make a judgment, a difficult if sometimes frustrating step. Given his situation, P9 realized near the end of the search process that he had to complete this key cognitive task; he needed to compare and

contrast the information, weigh its strengths and weaknesses, and make a decision. This realization was linked to a metacognitive awareness of the task that needed to be done:

> "I don't like biases but if I have biases from two sides, if I can see some common ground, then it helps. As a historian, you're trying to find sources without biases, but sometimes seeing two sides helps."

P8, like P9, found the act of weighing the integrity and value of information quite frustrating. Describing what she did when faced with a difficult choice:

> "I'm going to reread, reread, reread and then "Aw-w-w" I'm going to go on the Internet". I based this on books and the internet was complimentary. And then it confirmed what I read. If what they said on the Internet was not the same thing I would be like, "Aw-w-w..."

Measuring bias (or at least what the participants determined to be bias) was particularly difficult when dealing with ancient history. Time has erased the evidence and all that is left is myth and interpretation. The problem of making judgments about information in this context prompted P7 to ask herself questions:

> "Its [sic] difficult for me to find important facts that I can use because a lot of the books deal only with the popular myths about Cleopatra and her life and those aren't verifiable and they're often quite contradictory. This meant I often had to ask myself, Is this a fact that comes back re-occuringly[sic] in other books or is it just this author's interpretation of Cleopatra's myth?"

During the stage of *Presentation*, the metacognitive knowledge related to *Balancing* took on a different look. The problem now became one of packaging the information. For some, the process wasn't metacognitive at all, as in the case of P8. Even as she wrote the final paper, P8 continued to gather information from the Internet, using it to confirm what she had read in books. The thought process, according to P8, went something like this;

""Oh, I'm going to say it like that" and then you stop and you're like "Ok, I'm stuck there" and then you read and then you're like "Well I'm not sure so I'm going to go on the Internet to see what they said about that. Maybe I'm going to be able to...a sentence" and then "oh I want to say that too"" A confusing process. Asked what helped her, P8 was not sure; "I don't know really what helped me. Maybe God or something like that." It was a mystery.

Balancing has a strong evaluative component to it and although there was evidence that the students were aware of the cognitive complexities of the task of choosing *and* that they had an ability to make critical choices, many of the students actually found this aspect difficult. The problem for them, however, was not just that there was too much information – what is commonly called "information overload" – but that there was a choice between a few equally credible but contradictory sources. Perhaps for the first time in their lives, the students faced an information problem whose answer lay in shades of grey, rather than in black and white.

4.2.13 Parallel Thinking

One of the first analytical tasks undertaken by the researcher, once data was collected and transcribed, was to read through the transcripts and identify tasks (or stages) in the information search process. Presumably, the actions taken by each participant would identify where they were in the process. In practice, this proved to be difficult because, while the participants said they were doing one thing, they were often thinking about another. So which stage were they actually in?

A type of "double-thinking" emerged during analysis. The participants' thinking was not exclusively "in-the-moment"; while doing one thing (and thinking about it) they were also thinking about something else. They frequently reviewed the past and predicted the future – even as they acted in the present. Some of this thinking represented deliberate planning - thinking about the next steps to take or forecasting one or two stages down the road. At other times, the thinking was more of an envisioning of the outcome or merely a

vague curiosity about how the information search would unfold. To capture the image of two streams of simultaneous thought, the term *Parallel Thinking* has been applied to this category. It is derived from three codes (or sub-categories): *Double Thinking, Future Thinking* and *Planning.* (See Appendix S for definitions).

Parallel thinking is advantageous to information seekers because it helps them think about where they are *and* where they are going at the same time. After all, it is difficult to plan an outcome if you don't know where you are at the moment (although perhaps given this scenario, one could predict disaster). Equally, it is difficult to assess where you are at the moment if you don't have some idea of why you need to be there. Parallel thinking was most closely linked to *Collection* and *Presentation* the final stages in the information search process, even though, in terms of actions, the participants were still located in early stages of the search. In other words, the participants were clearly anticipating outcomes even as they worked their way through the first tasks in the search process. To varying degrees, all the participants demonstrated parallel thinking.

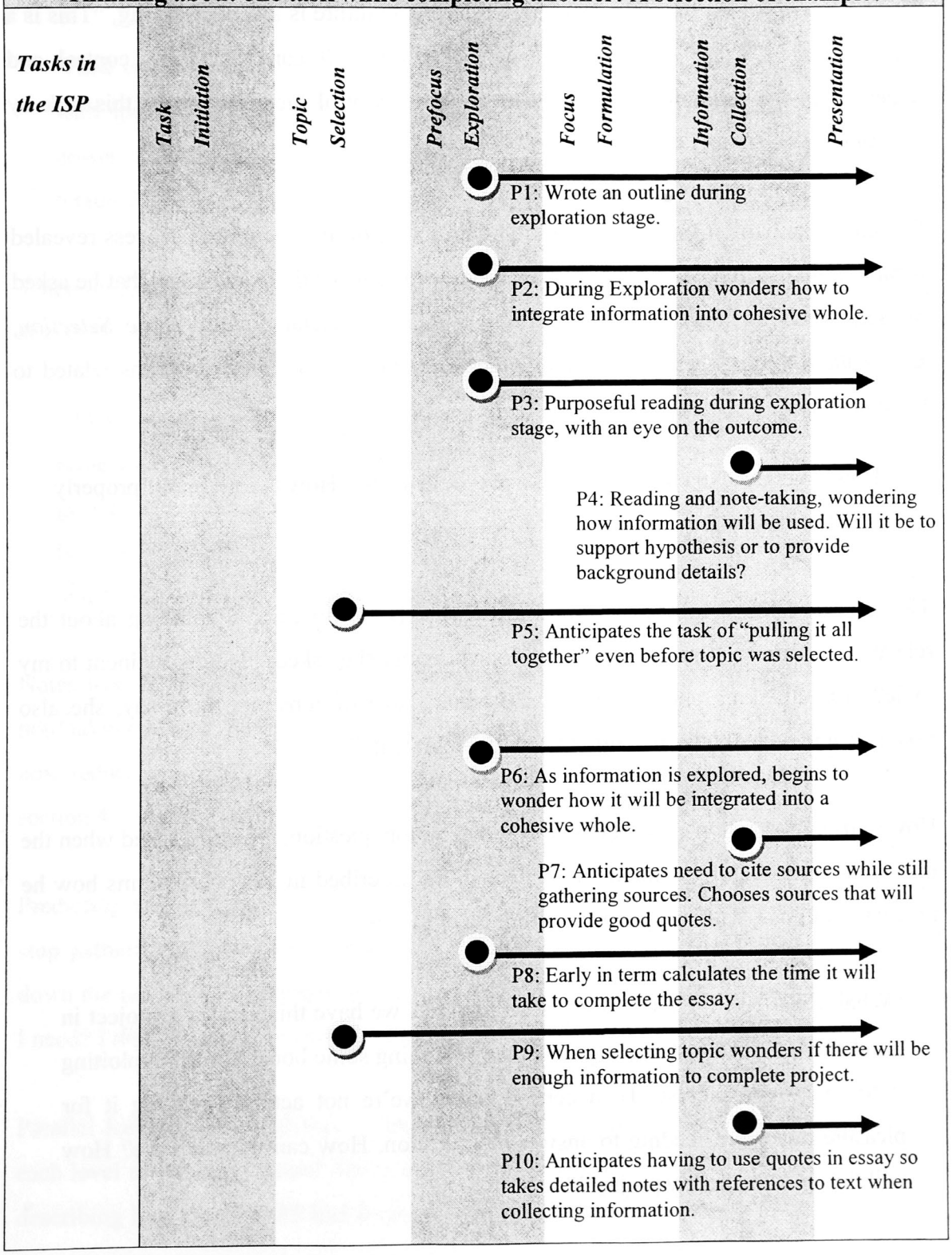
Table 33 shows the groundedness and distribution of coding for "Parallel thinking" throughout the search process. It is important to note that the coding for "Parallel thinking" was only applied when there was evidence of thinking about two or more stages in the ISP *at the same time*. The dual nature of this type of metacognitive knowledge is illustrated in Table 34.

Table 33

Evidence of "Parallel Thinking"

Tasks in the ISP	***Grounded in the data.*** *Numbers represent the number of times coded, not the number of participants.*
Task Initiation	0
Topic Selection	7
Prefocus Exploration	14
Focus Formulation	6
Information Collection	24
Presentation	43

Table 34
Patterns of Parallel Thinking:
Thinking about one task while completing another: A selection of examples



In terms of metacognitive knowledge, what parallel thinking represents is a sense of agency - an awareness that there is a link between the action one takes now and the outcome that results from it. Parallel thinking also represents an awareness of the cognitive demands of the task. Thinking ahead to the future is a way of saying, "This is a complicated task that requires some consideration". It can also show control and planning, in the sense that it says, "I'm going to control the outcome of this task by planning my next moves."

Questions the participants used to prompt themselves during the search process revealed parallel thinking. Asked in a telephone interview to think of three questions that he asked himself when looking for information – generally associated with *Topic Selection*, *Exploration*, *Focus Formulation* and *Collection* - P3 instead raised questions related to the final stage – *Presentation*:

> "How I can make the links more coherent or obvious? How to interpret it properly so that it's useful, not distorted?"

The questions asked by P2 also showed two levels of thinking. Wondering about the relevance of information she was *currently* gathering, she asked, "Is this pertinent to my topic?" But, thinking ahead to when she would have to construct the essay, she also asked, "Can I actually use this info? Could I integrate it?"

How to use information down the road was a common question, typically asked when the information was being explored and collected. P3 described in very clear terms how he read with purpose, with an eye to the future, saying:

> "When I was reading I was always wondering - we have this idea of a project in mind and we're almost reading a chapter or reading some book, almost exploiting it for our own interest. To a certain extent we're not actually reading it for pleasure but we're reading to answer the question, How can this help me? How will this help me do my project?"

Predicting the usefulness of visual information was as difficult as predicting the usefulness of text. P7 wondered how she could use a graphic she found through Google Image Search:

> "How can I use the information I've gained about how the women were shown with specific implements to denote some kind of power, like priestly power or power more approaching the pharaoh's power. What can I see of that in this picture?"

When reading and note taking, P4 considered not only the future use of information but also the future cognitive load related to the task of recalling all the details:

> "As I wrote notes, again, I constantly looked for what would help me with my project in terms of what information will help me prove my hypothesis, what will give good background information and what is irrelevant. I found this method to be helpful. I hope that when it comes times to actually writing my essay, I'll be able to just go straight to my notes and get the information I need."

Notes were also on the mind of P10 when she wondered how detailed and accurate her note taking should. Notes serve to filter and synthesize information and poor note taking *now* reduces the usefulness of information *later on*. (P10's note taking is discussed in section 4.2.9).

Predicting affective states played a part in parallel thinking. P6 wondered if she should stop gathering information *now* because she wanted to avoid being in a state of panic down the road due to information overload. She asked; "How much more information do I need? I don't want to be overwhelmed."

Parallel feelings were a feature of parallel thinking – a distinct feeling was attached to each level of thinking. Asked during the first telephone interview to think of three words describing how she felt, P5 had positive feelings, saying she felt " excited, interested in

what I'm researching" But when she considered the future her feelings were negative - "a little bit anxious about finding all the information and pulling it together."

Given that a large component of parallel thinking is about predicting outcomes, an obvious question to ask might be, did the participants' "future thinking" translate into action that affected the outcome? While it is important to keep in mind that this is not a cause and effect study, it is, however, possible to say that, while all the participants exhibited parallel thinking, there was sometimes a mismatch between what they knew metacognitively and what they actually did. For example, P9 questioned from the beginning whether he would find enough information to complete the project – showing an awareness that the cognitive task of finding information was a big piece of his project - but in fact he was so confident that there *would* be that he did not discover the answer to this question until the night before the assignment was due! P2 worried about integrating all the information into a coherent whole even as she gathered it but, when asked to assess her own work at the end of the term, she expressed disappointment, saying that she was not happy with the essay. Part of the problem, according to her, was that she spent too much time thinking about it!

> "I end up thinking a lot and not doing much and thinking and thinking and making plans. A lot of my plans are never carried out. The thinking process which is the intellectual part is more interesting than actually doing it. I like to plan a lot."

It seems then that there are other factors at play when parallel thinking occurs.

4.3 Affect and ISP Metacognitive Knowledge

Woven throughout this chapter have been stories of how the students thought, acted *and* felt as they searched for information. For the young people in this study, the complex process of finding, choosing and using information was accompanied by a tremendous array of feelings. At the descriptive level of analysis 64 codes emerged, for the most part

drawn in vivo (that is, from the words of the participants themselves), to describe the range of feelings experienced during the search process. These feelings ranged from panic to joy, confidence to fear, and happiness to hatred. Interestingly, there seems to be a balance between the positive and negative feelings experienced. Additionally, positive and negative feelings were frequently experienced simultaneously, suggesting incongruence and conflict during the search process. Metacognitive knowledge is aligned with both negative and positive affect. Table 35 shows the wide array of feelings associated with the search process.

Table 35
Affect During the Information Search Process

Positive 26 terms used		*Negative* 38 terms used		
Accomplished (1)	Fun (10)	Afraid (1)	Hate (1)	Sad (2)
At ease (1)	Happiness (13)	Aggravated (1)	Hesitant (2)	Scared (2)
Breakthrough (2)	Interest (60)	Anxiety (11)	Impatience (4)	Shock (1)
Confidence (23)	Intrigue (2)	Apprehension (1)	Irritant (2)	Skeptical (2)
Control (2)	Motivation (2)	Bored (2)	Lack of interest (3)	Stress (19)
Courage (1)	Passion (11)	Confusion (20)	Lazy (2)	Surprise-neg (2)
Determined (1)	Pride (1)	Desperate (1)	Library anxiety (2)	Suspicious (2)
Discovery (7)	Reassured (2)	Disappointed (2)	Nervous (4)	Unconfident (1)
Embrace-Confusion (2)	Relaxing (1)	Discouraged (2)	Obligated (1)	Unmotivated (4)
Encouraged (5)	Relief (2)	Distant (3)	Overwhelming(10)	Un-preoccupied(1)
Enthusiastic (3)	Respect (self) (1)	Doubt (4)	Panic (4)	Unsure (3)
Excited (15)	Successful (1)	Dread (1)	Regret (1)	Wasting time (2)
	Surprise-pos (1)	Frustration (16)		Worried (10)
Total: 170		Total: 152		

4.4 Summary

The geography of adolescent metacognitive knowledge during the information search process was presented here in rich and thick detail in order to provide ample evidence of its nature, where its strengths and weaknesses lie, and how it relates to cognitive

certainty/uncertainty, affect and actions. Called "ISP metacognitive knowledge", it is a composite of 13 categories - *knowing your strengths and weaknesses, knowing what you don't know, scaffolding, building a base, parallel thinking, understanding curiosity, communicating, changing course, understanding time and effort, balancing, understanding memory, pulling back and reflecting* and *connecting.* The ISP metecognitive knowledge of the adolescents in this study was surprisingly varied and wide-ranging. However, although most of the adolescents in this study demonstrated each of the 13 categories of ISP metacognitive knowledge, they generally did so in idiosyncratic ways, so that it cannot be said that one pattern of metacognitive thinking overlays the entire Information Search Process model. Rather, an array of metacognitive tools emerged, to be used as required to solve the information problem of the moment.

Chapter 5: Discussion and Conclusion

5.1 Introduction

The purpose of this study was to uncover the thoughts, feelings and actions of a group of adolescent students as they searched for information in order to paint a picture of the metacognitive landscape during the information search process. The picture that emerged was of 10 young people who exhibited a surprisingly high use of metacognitive knowledge to help them navigate through a complex world of information *and* a complex web of feelings and uncertainty. This chapter begins by looking at this picture through the lens of the research questions that drove the study. It then discusses some of the larger issues to emerge from the study, specifically as they relate to the field of LIS. The theoretical, methodological, and practical significance are then presented, followed by a section that summarizes the findings and suggests areas for further research.

5.2 RQ1: Within the context of the search process, what are the qualities of adolescent metacognitive knowledge?

5.2.1 The Taxonomy of Metacognitive Knowledge

RQ1 was answered principally through the identification and rich description of the 13 categories of ISP metacognitive knowledge that were used by the adolescents who participated in this study. These categories are: *knowing your strengths and weaknesses, knowing what you don't know, scaffolding, building a base, parallel thinking, understanding curiosity, communicating, changing course, understanding time and effort, balancing, understanding memory, pulling back and reflecting* and *connecting.* Figure 4 represents the 13 categories of metacognitive knowledge that emerged from this study. The 13 categories of ISP metacognitive knowledge were not used uniformly by all the students, all the time; instead the patterns of use were unique to each participant. What emerged from this study was not a neat pathway of metacognitive knowledge

during the information search process, but rather, a multi-faceted, circuitous, sometimes tangled pattern. While the participants thought and acted in metacognitive ways, they did so at a micro level as problems emerged and not necessarily as a tool for envisioning a fully formed outcome. A lack of an overall pattern may be a weakness of the students in this study in particular but, as has been suggested, it may also be a weakness common to *all* information seekers, each of us being novices every time we approach a new domain of knowledge. If this is the case, then a healthy array of tools in the metacognitive knowledge toolkit is the most useful asset to have when exploring unknown territory.

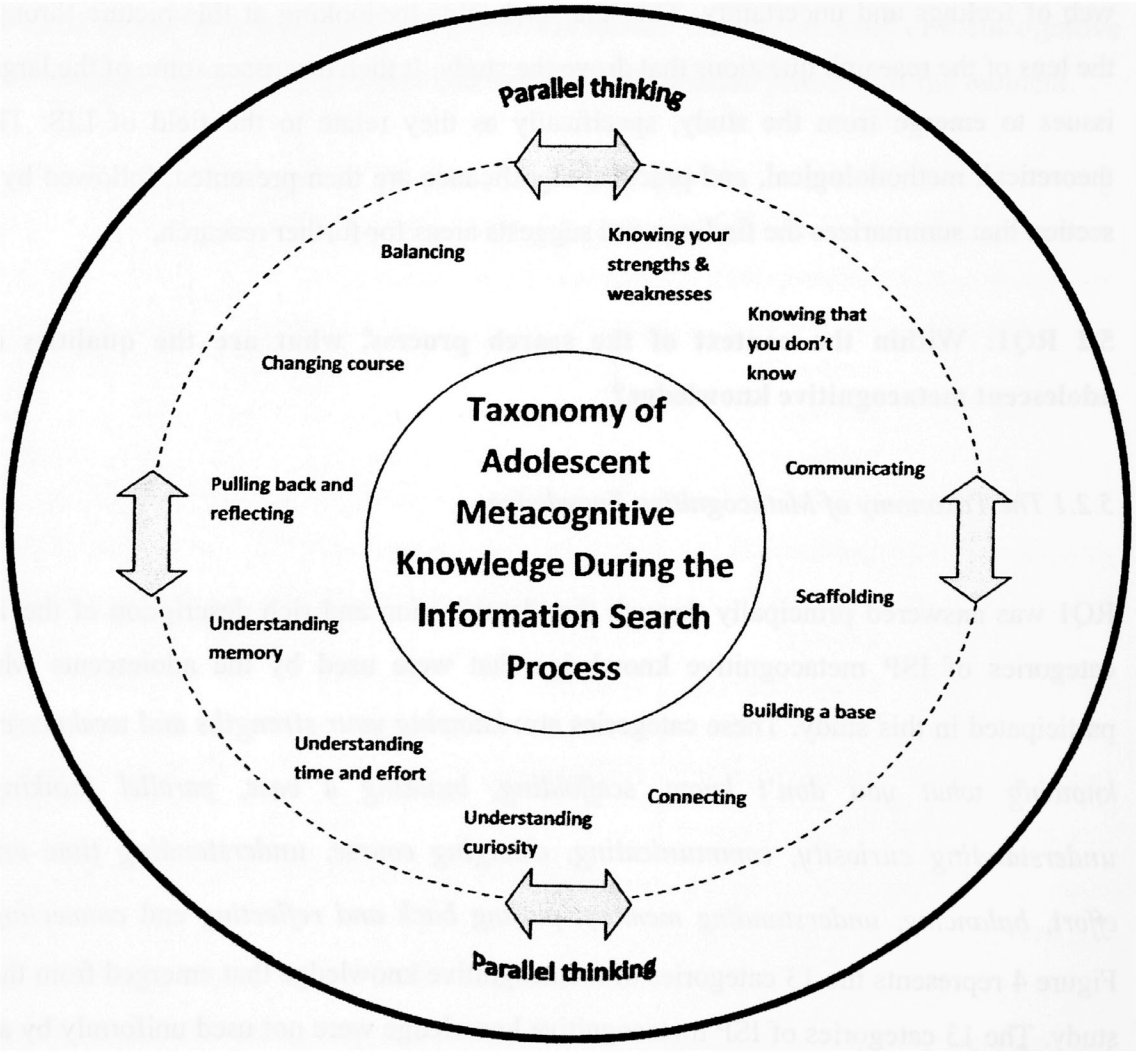


Figure 4:

Adolescent metacognitive knowledge during the Information Search Process

5.2.2 Gaps in ISP Metacognitive Knowledge

Gaps are as much a quality of knowledge as are strengths. It is important, therefore, to identify where there was a lack of metacognitive knowledge during the information search process in order to answer RQ1 more completely. On the whole the students in this study approached their information problems in a thoughtful manner and were able to trigger a variety of metacognitive strategies for tackling the challenge at hand. As their searches progressed, they seemed to be aware of the cognitive costs and benefits to choosing one action over another. They were also able to assess their own understanding of the information problem, and when the timing called for it, generally they were able to regulate and control their thinking *and* feelings. Not every instance of ISP metacognitive knowledge was in evidence for every student, but in those cases where it was, it often seemed to be "in the moment", initiated as specific problems emerged. Even though most students did think ahead to the final stage, *Presentation* (as evidenced in the section on *Parallel Thinking*), what the students did not understand was the nature of the cognitive task at its broadest level, making it difficult to anticipate and plan. To put it bluntly, they did not know what they were getting themselves into.

The reasons for this gap are twofold and both are related to experience. The first is a lack of experience in solving information problems (specifically in using interpretive skills to judge the "rightness" of information). The second is that they were dealing with a blank canvas, as it were, related to the information environment in the domain of history.

In terms of the first - experience in solving information problems - it is important to note that teacher librarians are not common in Quebec schools so few, if any, of the students in this study would have received explicit instruction on the research process (having a teacher librarian in the school does not mean that there was teaching involved, as this is not required of librarians in Quebec). Most likely, the students in this study would have received training related to locating materials (i.e. how to use the catalogue, how to search indexes) rather than the broader aspects of the search process. Much of the students' experience in solving information problems may have come through their

inquiry-based classroom activities, guided by a classroom teacher. As the scope of this study does not extend into the students' previous learning experiences, it cannot be known how well their teachers actually taught information competencies. But from the words of the students in this study, very few had ever experienced complex information problems. Most found citing authors and proving a hypothesis through evidence from the literature to be a new and highly challenging experience. To do so, meant finding the "right" information, and in the context of history, this is not always easy.

Even though the students in this study understood and applied the usual rules for evaluating the reliability of information – knowing the author's intent, the credibility of the source, currency and accuracy – they had trouble when faced with two reliable but conflicting sources. Which source is "right"? The students expected there to be one right answer and indeed, were surprised and frustrated when two seemingly reliable sources contradicted each other. It seems then that the missing piece – the gap - in their understanding of the cognitive tasks associated with the search process was the "interpretive" piece – a reflection perhaps of a gap in their understanding of the search process as an intellectual exercise and perhaps in the ways that they had studied history in high school.

The gap in metacognitive knowledge was also shaped by a lack of domain knowledge in the area of history. Not all topics are created equal and some students chose topics that were more complex than others. In this study, topics related to the history of philosophy and religion were particularly challenging for the students because of the level of interpretation inherent in the information (one wonders if the teacher took this into account when grading the papers). Perhaps the students knew their topics were complex and deliberately sought them out in order to challenge themselves. But one suspects they had no expectation of the complexity of the information environment related to their topic and were therefore unable to choose topics that matched their expectations of the cognitive task that lay ahead. Conversely, they could not adapt their expectations of the cognitive task because they had no idea what the information landscape looked like. The result was frustration. One participant expressed his worry over the surprising complexity

of his topic. He was pressed for time and he did not know whether to blame himself or the topic for the chasm he had to cross in order to achieve his goal:

> "The topic is still really interesting. But from the standpoint of the project, there's not much time. I'm not sure if it's the topic's fault or my fault... There's a big step between the text [the information] and what I need to look for."

High school students in Quebec do study history, most notably in Secondary IV (Grade 10) when they study Canadian history. Encounters at school with the history of western civilization might have occurred during the early grades of high school but, most likely, would not have involved an indepth analysis of the information environment. Unless a student had a personal interest in the history of western civilization, he or she would have launched the search with a weak conceptual knowledge of the information environment. This would account for the students' active attempts to learn even as they sought information, through the use of metacognitive knowledge related to *Building a base*, *Scaffolding* and *Connecting* – a kind of "learn as you go" approach to solving information problems.

5.2.3 Linking ISP Metacognitive Knowledge to a General Model of Metacognitive Knowledge

Introducing the concept of metacognition earlier in Chapter 2 of this dissertation, it was explained that metacognitive knowledge is generally accepted as consisting of three distinct components: strategic knowledge (knowing what cognitive strategies to use); knowledge about cognitive tasks (knowledge about when and why to apply cognitive strategies) and person variables (self-knowledge related to knowing one's strengths and weaknesses, and awareness of motivational beliefs). For the sake of theoretical precision *and* usefulness, it would be profitable to link the taxonomy that emerged from this study to the general model of metacognitive knowledge. As well, making connections to a broader model enriches our understanding of the specific qualities of ISP metacognitive knowledge and therefore helps to answer the question posed by RQ1. In coding the data,

the researcher realized that the metacognitive knowledge observed in this study often fit into all three of the general model's categories simultaneously. In other words, one type of ISP metacognitive knowledge could represent *at the same time* knowledge of self, strategy and task, making a direct one-to-one linkage difficult. Nevertheless, there were dominant tendencies, tested by combining the codes for self, task and strategy with the codes for ISP metacognitive knowledge. Table 36 lists the dominant tendencies.

Table 36 Relationship of ISP Metacognitive Knowledge to the General Model of Metacognitive Knowledge	
Adolescent metacognitive knowledge during the ISP	**...through the lens of the general model of metacognitive knowledge**
Knowing your strengths and weaknesses:	Principally... Knowledge of one's own cognition (self)
Knowing that you don't know:	Principally... Knowledge of one's own cognition (self)
Understanding curiosity:	Principally... Knowledge of one's own cognition (self) *and* Knowledge of the cognitive demands of the task (task)
Understanding memory:	Principally... Knowledge of one's own cognition (self) *and* Knowledge of the cognitive demands of the task (task)
Understanding time and effort	Principally... Knowledge of the cognitive demands of the task (task)
Parallel thinking:	Principally... Knowledge of the cognitive demands of the task (task)
Balancing:	Principally... Knowledge of a cognitive strategy and how it relates to self (strategy)
Building a base:	Principally... Knowledge of a cognitive strategy and how it relates to self (strategy)
Changing course:	Principally... Knowledge of a cognitive strategy and how it relates to self (strategy)
Communicating:	Principally... Knowledge of a cognitive strategy and how it relates to self (strategy)
Connecting	Principally... Knowledge of a cognitive strategy and how it relates to self (strategy)
Pulling back and Reflecting:	Principally... Knowledge of a cognitive strategy and how it relates to self (strategy)
Scaffolding:	Principally... Knowledge of a cognitive strategy and how it relates to self (strategy)

To map the connections between ISP metacognitive knowledge and the general model of metacognitive knowledge even more closely, the concepts of self, task and/or strategy were linked to the working definitions attached to each attribute in the taxonomy of ISP metacognitive knowledge. The working definitions were created during coding and are grounded in the data. Following each definition there is a notation in brackets indicating whether the knowledge is related to self, strategy or task (Appendices G to S provide the definitions for each attribute within the larger category of ISP metacognitive knowledge). Sometimes an attribute has two or three definitions attached to it. This demonstrates that the attribute could have been divided into even smaller units. If this had been done, it might have been possible to align the taxonomy that emerged from this study more clearly with knowledge of self, strategy and task. However, since the study included well over 291 codes, it was decided that further sub-division in coding might lead to confusion.

5.3 RQ2: How does the metacognitive knowledge of adolescents map on to the cognitive, affective and behavioral dimensions of the search process?

5.3.1 Cognitive Uncertainty and ISP Metacognitive Knowledge

RQ2 actually has three parts to it, each reflecting a specific phenomenological domain or dimension of human experience – the cognitive, the affective and the physical. Cognitive uncertainty fits into the cognitive dimension. Uncertainty during the information search process, as defined by Kuhlthau (2004, p. 92), is "a lack of understanding, a gap in meaning, or a limited construction" and implies a lack of focus on the research topic. The application of metacognitive strategies for diagnosing one's own uncertainty during the search process and taking steps to alleviate it represent evidence of ISP metacognitive knowledge. Did these students use metacognitive knowledge to help bridge the gap between uncertainty and certainty?

As a group, the participants in this study did use metacognitive approaches to deal with their uncertainty, but the approaches were triggered in the moment, as an emergency

response, rather than as a well-formed plan. This is perhaps a reflection of the gap in knowledge related to both procedural and content-area knowledge. The participants were working with a blank canvas. Not knowing what they were getting into, the only approach left to them was to micro-manage uncertainty via the application of specific cognitive strategies. Perhaps this is the only approach for any information seeker who is dealing with new areas of information.

The gap in content-area knowledge sometimes meant that the best metacognitive strategy for dealing with uncertainty was to turn to people who did have content-area knowledge (*Communication*). P1, for example, read much of the material she had gathered but was still confused about the meaning of the information, still "trying to grasp" the subject and "find generalities". Prompted by her own question "what does this mean?", she telephoned three experts in the topic of musicology – professors at a local university – who she hoped would help to clarify her understanding. This action was launched by a sense of cognitive uncertainty. Other approaches the students used were to deliberately make connections (*Connecting*), to filter and weigh the value of information (*Balancing*), to consider the time and effort required to complete specific tasks in the search process (*Understanding time and effort*) and to think about ways to remember masses of information *(Understanding memory).*

Uncertainty for these students did not always come in the shape of a "lack of understanding", as defined by Kuhlthau (2004, p. 92). The gap in content-area knowledge sometimes led participants to attribute their cognitive confusion to factors external to their own thinking, such as, for example, the undiscovered territory of the information environment. The problem was not that they were confused, it was that they were uninformed – they simply did not know what was out there. Was the information environment large, they wondered? Was it small? Would there be enough information to research the topic? P7, for example, was only comfortable with her topic once she had confirmed that there was enough information to complete the essay. She marked an X on her timeline to indicate that this was the point at which she was finally able to focus on her topic. Uncertainty turned to certainty for P6 when she decided there was, "enough

reliable info to support & to prove it? [the hypothesis]" This decision made P6 "less anxious".

For others, uncertainty was driven by the formulation of a usable hypothesis (as represented by a research question), and not by their ability to make sense of information. The hypothesis drove the search so a hypothesis that made no sense translated into a search that made no sense. Asked if she had chosen a title for her essay (a reflection of a focus on a specific topic), P2 answered, "Not really. I'm not sure about the hypothesis." For this student, eliminating uncertainty was about defining the research question via a tightly formulated hypothesis. As P2 said, it was about "trying to refocus. What was my hypothesis before wasn't really a hypothesis. I'd like to narrow it down." But narrowing the hypothesis meant first exploring the information. For P2, reducing uncertainty about the hypothesis meant she first had to build up her knowledge base (*Building a base*) and only then, weigh the options (*Balancing*) because, as she explained, "First I need to expand it before I narrow it down."

Uncertainty, according to the ISP model, is associated with understanding the meaning of information, the tipping point between uncertainty and certainty happening during *Focus Formulation*. According to the ISP model, during the latter stages of the search - *Collection* and *Presentation* - it is assumed that uncertainty has been dealt with and the information seeker can move on. In this study, however, uncertainty relating to the final stages in the search process loomed large. The students, thinking ahead to when the information would need to be synthesized and packaged into a product, worried that they did not have the skills and knowledge needed to create a cohesive unit, this being for many their first experience at writing a detailed research essay. More specifically, they were unsure about how to construct an outline that would reflect the compare/contrast nature of the assignment and they were confused about the rules for citing sources. Many students acknowledged this sense of confusion and took steps to alleviate it, either by visiting the teacher for clarification, talking to parents about the next steps in the process, or by looking for information about how to write a research paper.

Uncertainty, as it emerged in this study, took on many faces and was about more than an ability to construct a personal understanding of the meaning of information. As a result, there is no single pattern of metacognitive approach for dealing with uncertainty. Rather, the participants chose approaches that fitted the problem of the moment and dealt with uncertainty in individualistic ways.

5.3.2 Affect and ISP Metacognitive Knowledge

The second component of RQ2 relates to the affective dimension. This study found that the participants experienced a complex web of both positive and negative feelings and that the two poles of feelings were frequently experienced at the same time. The principal role of metacognitive knowledge vis à vis affect during the information search process was to resolve conflicts between positive and negative feelings. As has been shown, ISP metacognitive knowledge mediated in the conflict between interest and curiosity, on the one hand, and the urge to neglect interest and "move on", on the other (discussed in detail in Section 4.2.7, *Understanding curiosity*).

Metacognitive knowledge also mediated in conflicts that caused cognitive confusion and in turn, negative feelings. The ISP model predicts high levels of anxiety during *Prefocus exploration*, due to cognitive confusion over the exact focus of the research topic. This was the case for the students in this study. Faced with a sense of cognitive confusion, the choice was to persist or quit. Metacognitive knowledge intervened to guide the students toward solutions that would help ease confusion. One solution, for example, was to implement the metacognitive knowledge related to *Communicating*, as in the cases of P1, who talked to three experts in the field to clarify some finer points on her topic, or P6, who talked to her mother because she could "logically rationalize this information had I not been able to do so myself." *Communicating* may have had an affective component to it as well, talking to knowledgeable others being a good way to sooth feelings of panic and anxiety.

While the ISP model predicts higher anxiety up to the point of *Focus Formulation*, this study found there was high anxiety experienced at the tail end of the search process as well, during *Presentation*, and that it was related to the mechanics of packaging the information, such as how to use references and cite sources. The students continued to express negative feelings during the latter stages of the search process, even as they wrote their essays and presumably after they had achieved a focus on their topic. Their concern at this point related to procedural issues, such as preparing an outline that fit the guidelines of the teacher or citing sources correctly. Metacognitively speaking, they dealt with these issues by talking to the teacher (*Communicating*), reviewing notes from the teacher (*Pulling back and reflecting)* or even launching a new search for information about presentation style (*Changing course*).

5.3.3 The Tasks in Information Search Process and ISP Metacognitive Knowledge

The tasks in the information search process - task initiation, topic selection, prefocus exploration, focus formulation, information collection, and presentation – represent the actions that information-seekers undertake in order to complete a search and therefore address the third component of RQ2, the behavioral dimension. Matching the 13 categories of ISP metacognitive knowledge to specific tasks in the ISP model proved to be difficult, if not impossible. While *some* of the categories of ISP metacognitive knowledge did have tendencies toward one or two specific stages (for example, *Communicating* was used quite heavily during *Topic Selection*, *Building a base* occurred principally during the earlier stage of *Prefocus exploration*, *Connecting* was most likely to happen during *Information collection*, and *Parallel thinking* was highly focused on *Presentation*), overall it cannot be said that one type of metacognitive knowledge is the exclusive domain of one task in the ISP. Why is this? It is a reflection, perhaps, of the global nature of metacognitive knowledge and its transferability to different contexts and different tasks in the search process.

Although this study did not set out to test or re-design the ISP Model, the experience of using it to code the data provided the researcher with some insight into its nature.

Framing the study around the six tasks in the ISP model actually proved quite difficult at times and it is worthwhile commenting on the reasons for this.

The participants in practice moved back and forth between *Prefocus Exploration* and *Information Collection* in a highly iterative manner. The non-linear nature of the search process has been confirmed in other studies. Kracker & Wang, for example, suggested that an "iterative" variable be added to the model in order to address its spiral nature (Kracker & Wang, 2002; Kracker, 2002). Chung and Neuman (2007), in their study of high school students' information seeking, also found that the tasks of gathering and selecting (related terms for *Exploration* and *Collection*) repeated themselves in a dynamic, non-linear way. One reason accounting for the non-linear nature of the search process may have been the course requirement to produce a critical bibliography early in the semester, which forced the students to explore *and* make hard decisions about information almost simultaneously.

Another issue to emerge from the coding was the difficulty in identifying exactly when *Focus Formulation* was achieved. The participants identified on a timeline the point at which they felt they had achieved a focus on their topic. For some, *Focus Formulation* seemed to happen at the end of the process, as they delved into their sources and started to lay out a plan for the essay. This was the case for P3. Marking his focus formulation with an "X" on the timeline, he then noted. "Copying notes/quotes. Organization of my text". Three participants said they formed a focus more than once, P6 reporting three times. But their topics did not change substantially, suggesting a gradual move toward understanding rather than a radical shift in topic. Looking at the frequencies of the ISP tasks one sees that *Focus Formulation* is dwarfed in comparison to the frequency of coding for its neighbours, *Exploration* and *Collection*. One reason for this may be that the students did not achieve a focus on their topic – they simply jumped ahead to the next stage. But another reason might be that *Focus Formulation* is cumulative rather than a specific point in time. It is therefore difficult to identify it as a discrete stage in the search process. *Focus Formulation* seems to emerge well into the latter stages of the search process (as witnessed by the students who felt they had a focused understanding of their

topic only after they started preparing an outline or for some, even after they began writing) so only the teacher reading the final essay could be in a position to assess whether a focus had been achieved.

Another finding was that there were different *genres* of search embedded within the larger search process. The ISP model as presented in the literature seems to present a one-to-one relationship between the search process and the information need. In other words, the beginning, middle and end of the process represent one unit driven by one purpose. This study found that embedded within the search process were several genres of search, each one representing a qualitatively different information need. (the idea of *genre* is used here to mean a type of search). Some examples of the genres of search observed in this study are:

- "Author-biography" search: the students had to determine the credibility of authors in order be able to use an information source so they ran separate searches just to find biographical information on the authors.
- "Finding location of quotes" search: When gathering information, some students forgot to note where they had found quotes or important ideas. They had to re-run their searches, but this time with the purpose of finding specific text that they already new existed.
- "How to cite" search: Later in the project, many students had trouble understanding the technique for using quotes and citing sources. They asked questions like, How much should I cite? What do I do if the book was written in a language other than English? Do I use the original text or do I translate it? To answer these questions required yet another search to determine the "rules" for referencing sources.
- "Padding the bibliography" search: Wrapping up, some of the students realized they were missing one or two sources. Even though the essay was written, the teacher had said they needed 8 sources (they obviously used less to write the essay) so they launched a new search, essentially to find material to pad the bibliography.

Although each of these searches served the larger purpose of the school assignment, each was driven by a distinct information need.

It is hoped that the insights offered here into the nature of the ISP model will help to expand our understanding of the model. While new elements additional to the model were observed, and the pathway of the search process was more iterative than expected, the ISP model did, nevertheless, predict the information-seeking tasks fulfilled by the students. At some point, each of the students *did* go through *task initiation, topic selection, prefocus exploration, focus formulation, information collection* and *presentation*, but not in the expected or prescribed order.

5.4 Discussion

As this study is exploratory, its purpose is as much to raise questions as to answer them. Several interesting areas for discussion and further research emerged from this study. They are explored below.

5.4.1 From taxonomy to rubric: Next steps

At the start of this research project, a possible outcome seemed to be a neat model that would map metacognitive knowledge on to Kuhlthau's ISP model such that one could see how one type of metacognitive knowledge was perfectly aligned with one specific task in the ISP. This was to be not the case. Most types of metacognitive knowledge identified in this study were used across the ISP model, from beginning to end. While in some categories of metacognitive knowledge stronger tendencies toward one task in the ISP over others can be observed, it cannot be said that a direct one-to-one pattern between the six stages in the ISP model and the 13 categories of ISP metacognitive knowledge exists. As has been suggested earlier, this is probably due to the global nature of metacognitive knowledge.

For this reason, the 13 types of metacognitive knowledge presented here do not represent a general model of behavior but rather, a taxonomy of the range of possibilities that exist. Metaphorically speaking, the taxonomy represents a toolkit of intellectual skills, to be used as need requires. What the taxonomy does is to define and describe the general characteristics of each type of ISP metacognitive knowledge. Using this as a baseline, further research can expand the definitions to include *degree* and *intensity*.

The term "metacognitive knowledge", rather than the more general term "metacognition", was used quite deliberately in this study in order to emphasize the idea that metacognition is not just something people do, but something that people *know* to do. Indeed, Anderson and Krathwohl (2002), in their revision of Bloom's taxonomy, list metacognitive knowledge as one of four types of knowledge, the others being factual, conceptual and procedural. In the context of LIS, metacognitive knowledge, as a knowledge, is one part of the package that teachers, librarians and designers of interactive information systems must deliver to information seekers. The implications of this for how young people are taught to search for, choose and use information are tremendous. As a critical piece of the information literacy puzzle, metacognitive knowledge is content that needs to be taught, and if metacognitive knowledge is to be taught, then methods for teaching and assessing it must be developed.

5.4.2 Managing curiosity

This study found that ISP metacognitive knowledge was used to manage the conflict between curiosity and obligation, precisely because there *was* a conflict that needed managing. The implication of this conflict is interesting. Intellectual curiosity is the life blood of learning and, in Canada, one of the goals of the educational system is to promote this intrinsic desire to learn. To reflect this, teaching methods, classroom structures and information systems are designed in ways that invite or invoke curiosity. Given this framework, it seems paradoxical, and perhaps ironic, that the students in this study often associated curiosity with pain, not pleasure.

It has been said that there is no cure for curiosity[2] but the "imposed query" puts to rest this idea quite neatly, and this was never more true than for the participants in this study, who found it difficult, often painful, to balance their need to know with the need to produce. The students were free to choose their own research topic within the very broad framework of the history of western civilization, a domain of knowledge that was surely wide enough for each student to find something of interest. But this was not the problem. The students *did* find topics that interested them and they *were* motivated to explore their chosen topics. But while motivated by curiosity and the joys of discovery, they also found the regulation of curiosity to be a painful and paradoxically de-motivating experience. This is perhaps a reflection of the "imposed" nature of the school assignment. The very fact that there were boundaries placed around the discovery experience such as a deadline, restrictions to use credible, print-based sources, and the use of the essay as the preferred format for the expression of ideas, meant the task was just that – a task – and not an unrestricted pleasure. Since all school assignments are by their very nature, bound by some restrictions, educators, information professionals, and designers of information systems for young people are faced with an interesting conundrum. How can the "trade-off" between too much and too little curiosity be managed?

Curiosity during the information search process should not be seen as an "on/off" switch, as in, you are either curious or you are not. Instead, there are degrees of curiosity. We should view curiosity as running along a continuum that parallels the stages of the information search process. At one end of the continuum, curiosity drives information seekers; at the other end it becomes a potential threat. Curiosity during the early stages – task initiation, topic selection and exploration – is a fundamental ingredient. Metacognitively-aware information seekers who know this will nurture curiosity, support it and encourage it but, when that critical shift occurs in the latter stages of the search process, they will know to control and channel their curiosity. Metacognitvely-aware information-seekers will anticipate this shift and take steps to alleviate the negative

[2] "The cure for boredom is curiosity. There is no cure for curiosity." Dorothy Parker, (attributed). US author and poet (1893 1967).

feelings associated with curiosity at this stage. In this study, some of the participants re-focused their curiosity onto the problem-solving process. They wondered, quite simply, how the project would turn out. Perhaps it was the ability to shift the focus of their curiosity from the topic to the process that helped to move them forward.

5.4.3 Dialogue as a Metacognitive Strategy

This dissertation is being written during a time of great interest in Web 2.0, the social web, and a growing awareness of its potential effects on information seeking and use. This study serves to validate the interest in social software because it has shown that there is a social aspect to information seeking that filters through even to the metacognitive level of thinking. Kuhlthau's ISP Model of the information search process identifies three parallel dimensions – cognitive, affective and behavioral. The use of communication as a metacognitive strategy during the information search process suggests that there is a fourth dimension that is based in the social and cultural worlds of information seekers. Dealing with this social dimension required a specific set of metacognitive strategies.

The social aspects of information seeking have not gone unnoticed in the field of LIS. Recognizing the collaborative and connected nature of the digital world, Dresang (1999) proposed the adoption of a new research paradigm that looks beyond the traditional library, toward the informal information-seeking behavior of youth on the Internet. In another area of research, the notion of information gatekeepers – people who control the flow of information through communication networks – has been actively studied for several decades (for a recent review of the literature on gatekeeping see Lu, 2007). A renewed interest in informal information seeking, more recently referred to as everyday life information seeking – information-seeking for non-work or non-school-related purposes – has resulted in study into how information seekers use people as information mediators and information sources (see for example, McKenzie, 2003; Savolainen, 1995; Spink & Cole, 2001). A few studies have looked at the social aspects of adolescent information seeking. One such study looked at how 28 adolescent girls found information

solutions to their everyday life concerns related to relationships, education and work. They turned not to libraries but to the people around them – family, friends and teachers (Poston-Anderson & Edwards, 1993). Looking further at how adolescent girls seek information about jobs and education, Edwards and Poston-Anderson (1996) found that girls tended to approach their mothers and fathers before teachers, career counselors, and librarians. Shenton and Dixon (2003) also looked at young people, aged four to 18, and their use of other people as an information-seeking method. They found this strategy to be a frequently employed and highly successful method by which youngsters obtain information. Julien (2004) explored adolescents' decision-making for careers and found that they relied heavily on people they trusted rather than on documentary sources.

Given the seemingly natural inclination of young people to turn to knowledgeable-others in their lives for information, it is no surprise that communicating is an attribute of the metacognitive knowledge of the young people in this study. What is surprising is that this social aspect of metacognitive knowledge was implemented not in the context of everyday life but rather, in service to a school-based, information-seeking task, the purpose of which was to develop skills in finding and using formal documentary sources. This seems incongruous. After all, why should one turn to an informal information source when looking for a formal source? Perhaps the reason for this inconsistency lies in the way that "information" is defined. The kind of information that is used for the purposes of a school project tends to be what Bates (2006, 1039) has called "exosomatic information" – that is, "information that is stored externally to the body of animals" (the human being a type of animal). This is the kind of information we associate with the documents in a library or on the Web and it is what we train students to find. But the students in this study used a second type of information as well - "embodied information" – information which is "the corporeal expression or manifestation of information previously in encoded form" (Bates, 2006, 1035). This is information which is derived from a document and then expressed orally through language. Perhaps there is a need to broaden the set of information-seeking skills taught at school, providing the necessary tools needed to handle, and indeed take advantage of, "embodied information". Perhaps it is the case that metacognitively-aware information seekers deliberately go beyond the

traditional boundaries of information – the "exosomatic" – and seek help in other realms of information.

A re-configuration of our conception of "information seeking" may be needed to take account of this behavior in the training that young people receive vis à vis the information search process. When librarians think of the traditional research essay, they often interpret "research" to mean "finding a document" – a web page, a journal article or a chapter in a book – which is hidden somewhere inside an information system – a database, a library catalogue, a web portal, a search engine or a book. In direct contrast to this view, the participants in this study cast a much wider net and used the people in their world as information sources. Although one participant wondered about the reliability of her mother as an information source, most trusted their family and friends unquestioningly. It was a natural step for them and in metacognitive terms, perhaps the easiest step. As a metacognitive strategy, it was a move that paid off well because it lightened the cognitive load needed to find sources and helped them move forward in their search faster.

While the participants in this study used people as information sources, they equally used them as information mediators – that is, someone who provides a link between the information and the consumer of that information. The links were mediated via dialogue but the dialogue rarely occurred with the librarian. Perhaps this was due simply to the accessibility of family and friends. Or it could be due to a misalignment in the type of social interaction that the participants required and the social interaction that the librarian was prepared to give. The ways that librarians can intervene are many and one model, created by Kuhlthau, has mapped five levels of intervention to the six stages in the ISP model. They are, ranging from the lowest to highest level of intervention: organizer, locator, identifier, advisor and counselor (2004, p. 129-134). It is at the highest levels where conversation between librarian and user helps to clarify meaning and organize thoughts.

As an information mediator, the librarian in this study functioned principally at the mid-level in Kuhlthau's model of the zones of intervention - as a "locator" and "identifier" – but many of the participants sought out information mediators who could intervene at a higher level, as "advisors" and "counselors" (2004, p. 129-134). Perhaps the librarian was willing and able to offer a higher level of mediation but in the event, the participants did not seem to be interested in or even aware of the possibility of this sort of discourse with the librarian. Given that the participants had the wherewithal to use talk as a metacognitive strategy, the strategy was not employed with the one person who ought to really understand the information environment – the librarian. Although it seems natural that young people (or any information seeker, for that matter) would approach people from within their immediate circle first, people who are easily accessible and whom they trust, it does seem unfortunate that dialogue with the librarian was rarely part of the participants' metacognitive tool kit.

Perhaps there is a broader obligation for librarians here. The young people in this study were surrounded by people who had some level of expertise in the subjects being researched, people who read, who had home libraries or access to materials at work, or who were simply interested in what the participants were doing. The participants knew that dialogue with knowledgeable others was a useful metacognitive strategy but they also had the social resources needed to implement it. One wonders what might happen in those cases where a student has little to no social support. How useful is "talk" as a metacognitive strategy for people who have no one to talk to?

5.4.4 Enabling Knowledge Construction During the Information Search Process

Humans learn throughout life, not just as adolescents, and while it is true that knowledge is built upon knowledge, sometimes we do venture into new territory, encountering new domains of information. When this happens, information seekers, no matter what age, become novices all over again (Nahl, 1995). The students in this study were inexperienced researchers and historians, the two domains of knowledge (the search process and history) being relatively new, unexplored and unpracticed territory. They

responded in metacognitive ways, applying specific "learn as you go" strategies that helped move them forward. The interactive approach adopted by the students in this study suggests that support for knowledge construction was needed and therefore should be developed in information systems and services. Given the discovery-oriented behavior employed by the students in this study, it may be that the teaching of specific and discrete skills, such as how to use a particular database, are of less value than more general skills needed to explore and learn. One such skill required for discovery is the ability to generate good research questions – the questions helping to shape the orientation of the search. For some of the participants in this study, their search behavior was influenced less by uncertainty and confusion, and more by the nature of their research question (referred to by the students as a "hypothesis"), a finding that was confirmed in Limberg's (1999) study into the information-seeking behavior of 25 high school students. She found that the research question was the pivotal point of interaction between the subject content and the ways in which the students interacted with information. It was a circular relationship, with the formulation of the question influenced by the information gathered, and the question in turn influencing the methods used to search for information. So the questions information seekers ask have an impact on the outcome of the search. Search engines (and librarians) that emphasize question generation may do more to enable knowledge construction during the search process than they would with the teaching of micro-level skills needed to use specific information tools (skills that can become obsolete as the information tools change).

In terms of library service, this study points to the need for a higher level of intervention from librarians. As Kuhlthau (2004, p. 129-134) has pointed out, librarians should intervene as "advisors" and "counselors", acting as coaches rather than as information locators. The problem is perhaps more complex for information systems. How can the interactive nature of human communication be built into machines? The question of how to design responsive search engines that support learning in the midst of information seeking has been explored in the literature.

One such solution – that of pedagogical agents that are built into search engines - was explored by Beheshti, Bowler, Large and Nesset (2005). Pedagogical agents are computer-based avatars that "talk" learners through problem-solving in a particular domain of knowledge or topic area. The problem with pedagogical agents (such that exist), and intelligent search engines in general, is that their intelligence is related to domain knowledge. They are useful in so far as they reflect a specific topic area. It makes sense to provide tools that support knowledge construction in a particular domain of knowledge but the students in this study were also hampered by their lack of procedural knowledge. They had difficulty anticipating the demands of the cognitive task because they had simply had little experience with it before. While they were able to respond to problems as they arose in specific metacognitive ways, one wonders what might happen to students who cannot. The question that designers of intelligent search engines might more properly ask is, how can information systems help users think metacognitively when searching for information? In other words, how can information systems help users to learn about, anticipate, and plan for the cognitive tasks of finding, choosing and using information? To do so needs a plan, a blueprint. It is hoped that this study provides such a blueprint, pointing the way toward behaviors that intelligent search engines might want to model.

5.4.5 Enabling Motivation During the Information Search Process

In this study there was an interplay between metacognitive knowledge and affect, one role of metacognitive knowledge being to regulate curiosity. The question of how to support knowledge construction during the search process is made more complex when we stop to consider the role of curiosity. During the latter stages of the search the students in this study found it painful to reign in their curiosity in order to move forward in the search. But in the beginning their curiosity drove them. Clearly the role that curiosity plays in the search process depends on where the user is in the process. A one-size fits all approach to managing curiosity will not work.

This leads to several questions. For one, how can intelligent information systems be designed that reflect and respond to the changing role of curiosity during the information search process? For information systems designers who wish to provide scaffolds and methods for conceptualizing information environments, related questions might be, how far should scaffolding go, when should a particular support be triggered, and when should it be withdrawn? The problem might be this: In alerting the user to the complexities of an information environment, are information systems removing the mystery and excitement users feel when looking for information? Is laying out the environment in advance for users actually de-motivating? (The researcher is reminded of her daughter who, at the age of five, cheerfully hiked up a 2153-foot mountain precisely because she had no conception of how high it was). How can information systems reduce the "anxiety of the hunt" without removing the "thrill of the hunt"?

It seems to be a truism that that the more you know, the more you do not know. We often hear of experts in a particular field talk about how humbled they are by how little they know and how much more there is to discover. Most of the participants in this study, on the other hand, began their search blissfully unaware of the size and complexity of the information environment they were dealing with, confident in their ability to find information, and the alert was raised only after they had ventured into that environment. Most had the wherewithal to eventually recognize a gap in domain knowledge but it does raise the question, how much do you have to know before you "know that you don't know"? In order to enact the *Knowing that you don't know* type of metacognitive knowledge that is needed to guide information discovery, it seems, paradoxically, that information seekers must first build a foundation of "knowing". This presents a challenge for information professionals and educators who value active, motivated learning. Facilitating the transition from not knowing anything to knowing enough so that you "know that you don't know" may mean imposing some structure. But we may not want to design information environments that are so confined by structure that they end up as a mere shell of the real information environment and are unmotivating to explore. Perhaps the better approach for motivating information seekers (especially young people, inexperienced in domain and procedural knowledge) might be instead to provide

metacognitive scaffolds that will help users to construct knowledge but will still allow for unfettered exploration of the information environment.

5.4.6 Building Mental Models Using Information Sources

It seems interesting that in this age of digital resources, most of the participants in this study used books as their principal source for information. Perhaps this is a reflection of the nature of the information environment in the area of the humanities, particularly in the field of history, which may still be mainly book based. (The author, however, is skeptical about this point, having participated in a study that looked at Canadian history content on the Web (Bowler, Large, Beheshti and Nesset, 2004). A significant body of content was found, and this for a very specific user group, children aged five to 12). The use of books was more likely driven by the requirements of the assignment, which asked the students to find eight sources for their bibliography, only three of which could be websites (although they could still use full-text journal articles found online using an index). For a few of the students, using the books in the library was a revelation. Never had they realized that finding information could be so easy, so fast!

Nevertheless, when implementing their "scaffolding" strategies, most of the students in this study seemed to think that books would provide a stronger cognitive support than content on the Web. At least for these young people, the structure that is built into a typical informational book (a table of contents, chapter and section headings), the meta-tools that accompany it (the index, a bibliography, suggestions for further reading) and even the considerations that textbooks and encyclopedias give to reading and educational level, have not translated well into the web environment. Even if it is the preference and tendency of adolescents to look for information on the Web rather than in books, it seems that, at least for the 10 adolescents in this study, books still provided a better cognitive support. One wonders, though, what happens to those who are not as metacognitively-aware as these 10 young people were? And if the structure of books is so helpful, why has not it been incorporated into resources on the Web for young people?

The issue of "Web versus books" goes deeper than organization, design and layout. For at least one participant (P4) it was the physicality of books that was important because this allowed for a visual and tactile approach to building connections, an approach that she found particularly helpful. One wonders if this method of visualizing *all* the information, in its entirety, at one time is possible when information is mediated through a computer screen. And what happens when information is reduced to the size of a personal digital assistant – something the size of a cell phone? While accessibility to discrete pieces of information may be improved with handheld devices, methods for bonding the information into one organized unit may be lost.

5.5. Contributions to Knowledge

5.5.1. Theoretical significance

This study has significance for the discipline of LIS and more specifically, the research area of Information Behavior. By opening a window into this area, it contributes to the growing corpus of research on user-centered approaches to Information Behavior. The study contributes to our understanding of adolescent information seekers and provides a theoretical framework for the development of information systems and services designed specifically for young people, ages 16 to 18. It is hoped that this research will ultimately facilitate equitable access to information by enriching our understanding of how young people search for information.

On a broader level, the study contributes to our general understanding of adolescents. The study exposed adolescent thinking and problem-solving, and showed how feelings and social networks can affect adolescent behavior.

The study brought together four constructs that have rarely (if at all) been studied in unison (*metacognitive knowledge*, *cognitive certainty/uncertainty*, *affect* and *actions* during the information search process) and generated a new model of metacognitive knowledge in the form of an original and distinct taxonomy of ISP metacognitive

knowledge. In addition, the findings of this study will help to expand general models of metacognition.

Modeling of adolescent metacognition as it relates to information seeking may one day contribute to the design of more intelligent and ultimately, more effective, information retrieval tools for this user group. An information retrieval (IR) system that models the metacognitive processes of young users might help them to find meaning in information by providing the kind of support needed to help them monitor their own progress through the information-seeking process. But the purpose of designing an intelligent IR system that is modeled upon metacognitive knowledge would *not* be to create a tool that simply thinks for young people. IR systems that provide the user with opportunities to experience metacognition may lead to the transfer of metacognitive knowledge from the system to user, leading perhaps to smarter users.

Finally, this study may provide the basis for the design of library services appropriate for adolescents, such as information literacy instruction.

5.5.2. Methodological

This study tackled the difficult problem of uncovering metacognitive knowledge in a way that was as authentic as possible to the everyday lives of young people. The results therefore reflect metacognitive knowledge as it occurs in the real world, and not how it might look in a controlled, laboratory situation that may have little bearing on how users actually search for information. Using the methods outlined in this study, the researcher was able to uncover a wide spectrum of the participants' patterns of metacognitive knowledge, as well as their uncertainty, feelings and actions, during the information search process. The methods used to deal with the many challenges presented by this study may provide a methodological guideline for others who are designing user-centered approaches to the investigation of thoughts and feelings related to information behavior.

5.5.3. Practical significance

This study was conducted in a CEGEP, a post-secondary institution in the Montreal-area. The story of how 10 young people navigated the library at their CEGEP, as well as several local public and university libraries, says much about the state of library services and information-skills education provided to young people in the Montreal area. Not all the news was bad but the students did have moments of frustration and uncertainty related to new experiences operating in a complex information environment. This should suggest to educators and librarians working at the CEGEP level that greater guidance and support is needed. The results of this study also have implications for library services at the high school level, suggesting that steps should be taken to prepare students *before* they arrive at CEGEP. The results may point the way toward the design and delivery of local information services, such as for example, a more active role for CEGEP and high school librarians in the teaching of information skills.

5.6 Conclusion

The study identified 13 different attributes of ISP metacognitive knowledge used by 10 adolescents to complete an inquiry-based school assignment - *knowing your strengths and weaknesses, knowing what you don't know, scaffolding, building a base, parallel thinking, understanding curiosity, communicating, changing course, understanding time and effort, balancing, understanding memory, pulling back and reflecting and, connecting*. These categories, as well as the sub-categories that emerged from coding, together form the bones for an emerging a taxonomy of adolescent metacognitive knowledge during the information search process. With further research and development, the taxonomy may provide the framework for a rubric to be used in the teaching and assessment of metacognitive knowledge during the information search process.

The participants in this study were hindered in their searches by a lack of procedural knowledge related to information problem solving *and* a lack of conceptual knowledge in

the domain of history. These roadblocks were mediated by metacognitive knowledge, which was used as much as an emergency strategy as it was a deliberate line of attack. So while the young people in this study did show evidence of thinking ahead and planning (*parallel thinking, pulling back and reflecting*), their use of metacognitive knowledge was as often as not reactive, rather than predictive – a paradox perhaps for a knowledge that is associated with planning.

Uncertainty and its relationship to ISP metacognitive knowledge was explored. To varying degrees, the 13 types of ISP metacognitive knowledge uncovered were used throughout the search process as a way to bridge the chasm between uncertainty and certainty. Interestingly, the nature of uncertainty was less clear cut than expected, containing layers of meaning that depended upon where in the search process the students were at any given moment. The multi-faceted nature of uncertainty suggests an area for future research. In the context of the search process, what exactly is uncertainty?

The relationship of ISP metacognitive knowledge to affect was investigated. A complex, often conflicting, web of positive and negative feelings was revealed. One such conflict that arose was between the positive feelings associated with interest and curiosity, on the one hand, and the negative feelings related to the requirements of the school assignment on the other. This conflict was mediated by metacognitive knowledge. Curiosity being the lifeblood of learning, further investigation into the relationship between intellectual interest, positive and negative affect and the role of metacognitive knowledge in mediating between them is recommended. This study only peeled away the top layer of affect during the search process, looking at it through one particular lens – that of metacognitive knowledge. This is clearly an area rich in research possibilities

There was a strong social component attached to ISP metacognitive knowledge. The young people in this study actively sought humans to act as both information mediators and information sources. The natural way in which they to turned to the people around them for help suggests that social processes during information seeking, even information seeking for the purposes of completing school assignments, should play an important

role in the design of library and information systems and services for young people. More specifically, utilizing the social component of metacognitive knowledge to its maximum benefit is perhaps an important lesson that needs to be taught to young people.

As novice researchers and novice historians, the participants in this study looked for ways to support their own knowledge construction even as they searched for information, suggesting the need for library and information systems and services that enable open-ended discovery and interactive learning. Surprisingly, given the abundance of digital resources available to them, the students in this study tended to use the structure of books, rather than websites or e-texts, to help them understand the information environment.

An attempt was made to align the 13 categories in the taxonomy of ISP metacognitive knowledge to a broader model metacognitive knowledge. The 13 types of ISP metacognitive knowledge were found to relate to knowledge of cognitive strategies, the cognitive demands of task and to person variables (self). Further research into ISP metacognitive knowledge will help to draw clearer links between the taxonomy presented in this study and the broader picture of metacognition.

Evidence of metacognitive knowledge in this group of adolescents, albeit a small, rather exclusive group, is encouraging news for educators and designers of information systems for young people. First of all, it hints at the capabilities and potential of young people and secondly, it provides some benchmarks for understanding how metacognitive knowledge is actually used in service to information seeking by teens who like to think about their own thinking. The young people who participated in this study were able to handle the dissonance between what they did not know and what they needed to know through the application of metacognitive knowledge. This study concludes by asking the question, what happens when young people are *not* metacognitively-aware and cannot handle the dissonance? The taxonomy of ISP may provide a solution to this question by providing a roadmap for the development of a metacognitive tool kit that, if taught to young people, may help them search for information. The 10 young people who participated in this

study helped to lay out this map by showing how they were helped or hindered by the geography of their own metacognitive knowledge. It is hoped that the map they set out will be used to assist other adolescents who will be stepping into the adult world and navigating through new, uncharted territory.

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Appendix A: Ethics Certificate: 2005-2006

McGill

Faculty of Education – Ethics Review Board
McGill University
Faculty of Education
3700 McTavish; Room 230
Montreal H3A 1Y2

Tel: (514) 398-7039
Fax: (514) 398-1527
Ethics website: www.mcgill.ca/rgo/ethics/human

Faculty of Education – Review Ethics Board
Certificate of Ethical Acceptability of Research Involving Humans

REB File #: 608-1005

Project Title : The Role of Metacognitive Knowledge in the Information-Search Process: An Exploratory Study into Adolescent Information Behaviour

Applicant's Name: Leanne J. Bowler **Department**: GSLIS

Status: Ph.D student **Supervisor's Name: Andrew Large**

Granting Agency and Title (if applicable):

Type of Review: Expedited ✓___ Full _____

This project was reviewed by: Doreen Starke-Meyerring/Jeff Derevensky

Approved by
R Bracewell Nov 5, 2005
Signature/Date
Robert Bracewell, Ph.D.
Chair, Education Ethics Review Board

Approval Period: Nov 5/05 **to** Nov 5/06

All research involving human subjects requires review on an annual basis. An Annual Report/Request for Renewal form should be submitted at least one month before the above expiry date. If a project has been completed or terminated for any reason before the expiry date, a Final Report form must be submitted. Should any modification or other unanticipated development occur before the next required review, the REB must be informed and any modification can't be initiated until approval is received. This project was reviewed and approved in accordance with the requirements of the McGill University Policy on the Ethical Conduct of Research Involving Human Subjects and with the Tri-Council Policy Statement on the Ethical Conduct for Research Involving Human Subjects.

10/31/05

Appendix B: Ethics Certificate: 2006-2007

McGill University – Faculty of Education
ETHICS REVIEW
RENEWAL REQUEST/FINAL REPORT

Continuing review of human subjects research requires, at a minimum, the submission of an annual status report to the REB. This form must be completed to request renewal of ethics approval. If a renewal is not received before the expiry date, the project is considered no longer approved and no further research activity may be conducted. When a project has been completed, this form can also be used as a Final Report, which is required to properly close a file. To avoid expired approvals and, in the case of funded projects, the freezing of funds, this form should be returned 3-4 weeks before the current approval expires.

REB File #: 608-1005

Project Title: The Role of Metacognitive Knowledge during the ISP.

Principal Investigator: Leanne Bowler

Department/Phone/Email: GSLIS 398-4204 leanne.bowler@mail.mcgill.ca

Faculty Supervisor (for student PI): Andrew Large

1. Were there any significant changes made to this research project that have any ethical implications? ___Yes X No
   If yes, describe these changes and append any relevant documents that have been revised.

2. Are there any ethical concerns that arose during the course of this research? ___ Yes X No. If yes, please describe.

3. Have any subjects experienced any adverse events in connection with this research project? ___ Yes X No
   If yes, please describe.

4. ✓ This is a request for renewal of ethics approval. YES

5. ___ This project is no longer active and ethics approval is no longer required.

6. List all current funding sources for this project and the corresponding project titles **if not exactly the same** as the project title above. Indicate the Principal Investigator of the award if not yourself.

Principal Investigator Signature: Leanne Bowler Date: September 1, 2006

Faculty Supervisor Signature: _____ Date: 5 September 2006
(for student PI)

___ The closing report of this terminated project has been reviewed and accepted

✓ The continuing review for this project has been reviewed and approved

___ Expedited Review ___ Full Review

Signature of REB Chair or designate: _____ Date: Sept 13, 2006

Approval Period: Nov 5, 06 to Nov 5 '07

Submit to Carole Grossman, Education Ethics Coordinator, Education Bldg., rm 230, fax: 398-1527 tel:398-7039

8/31/07

Appendix C: Assignment

Guidelines for the Research Paper
History of Western Civilization

Fall 2006

ALL DOCUMENTS CONCERNING YOUR RESEARCH PAPER MUST BE

- Typed
- 1.5 space
- 12 pts
- Times New Roman
- Word Default Margins
- Justified
- Number your pages (Excluding the Cover Page)
- Submitted with a Cover Page
- Sumbitted in Hard Copy format (**NO VERSION SENT BY E-MAIL WILL BE MARKED. A DOCUMENT SENT ON TIME BY E-MAIL ONLY WILL BE CONSIDERED LATE.**)
- Referenced
- Presented with a Bibliography (Final Paper only)
- Presented with pictures or tables in Appendix (The appendixes go before the bibliography – For the Final Paper Only)
- Submitted on time. A penalty of 5% a day (including weekends) apply.

1. **Selection of topic : September 1st**

What topic would you like to research?
Identify the geographical location and time frame.

Identify a research question.
What is your hypothesis?

What elements of continuity and change do you plan to explore?

Identify 2 or 3 books/articles/websites that you will possibly use.

Why do you want to research this topic?

2. **Critical Bibliography : September 15**

The final bibliography must include at least 8 documents. Only 3 of these documents can be websites.
The ***critical bibliography*** must include at least 5 documents.
In the critical bibliography, you must

- Explain why the documents chosen will help you in your research
- Target the chapters or sections that will be the most helpful
- Assess the credibility of the author
- Identify the type of document you will be using (primary, secondary source? Scholarly?)
- Identify the date of production of the document and how it might influence the content.
- Any other comment that justify your choice of document.

3. **Critical evaluation of a website : October 6**

You are allowed to use 3 websites in your final paper. However these websites must be reliable.

For the Critical Evaluation of a Western Civilization Web site, you must

- Print out the Home Page of the chosen website.
- Identify the website's address clearly
- Assess the credibility of the author. Where is he/she from? Where does he/she work?
- Look at the quality of the website : writing, presentation
- Indicate clearly the sections that will be helpful in your research
- Be able to identify the origin of the documents used by the authors of the website
- If possible identify the date of the last update

4. **Final Paper : November 17**

Length : 7 to 8 pages

Please refer to top of page 1 for instructions on format

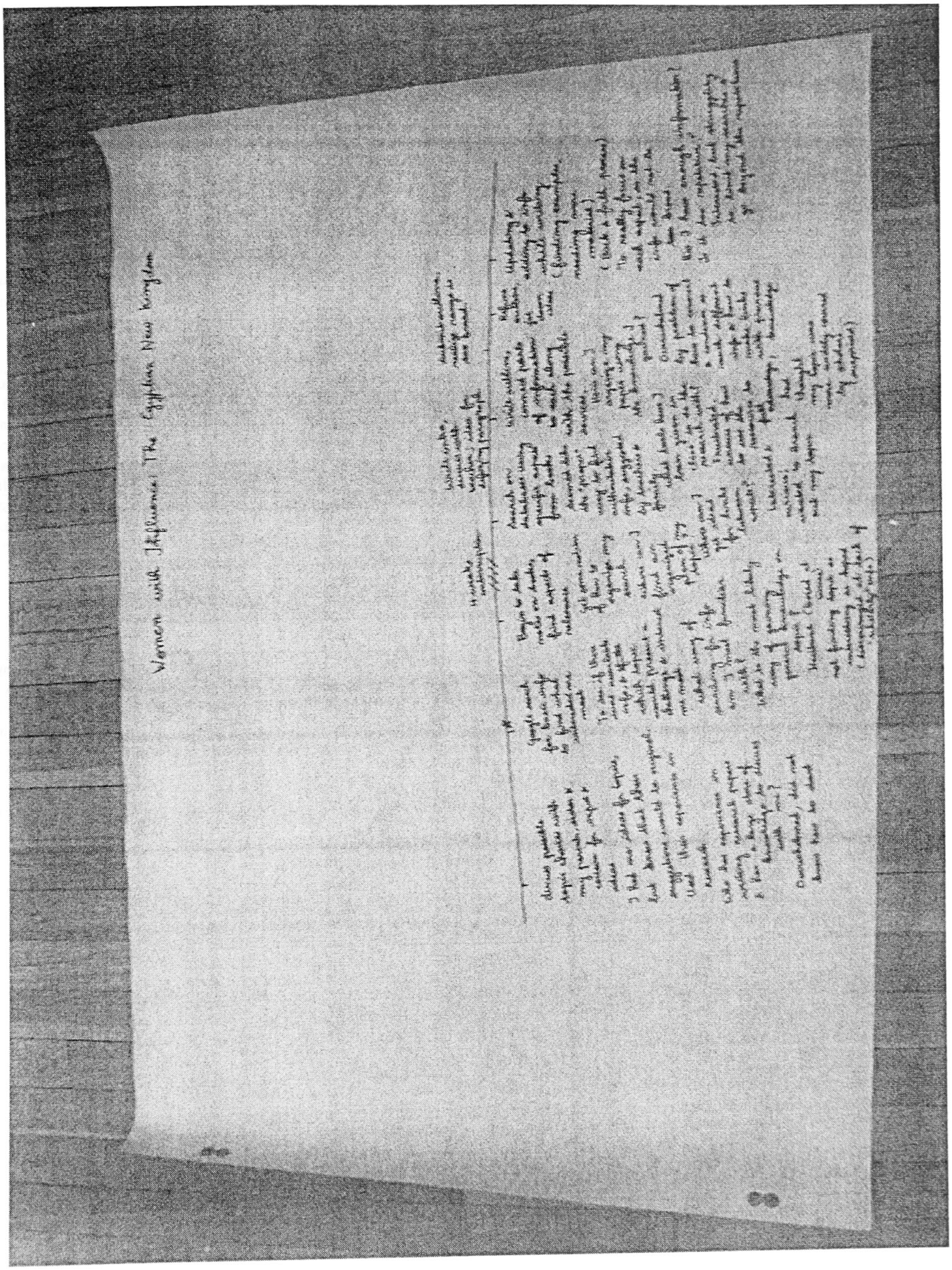
The final paper must include

- An introduction
- A development divided in sections of arguments
- A conclusion in which the arguments are summarized
- Appendixes (if relevant)
- A bibliography

Appendix D: Kit provided to participants

Includes: binder, notebook, handheld tape-recorder, pencils, mini-cassettes, and letter with schedule for telephone interviews

Appendix E: Timeline exercise



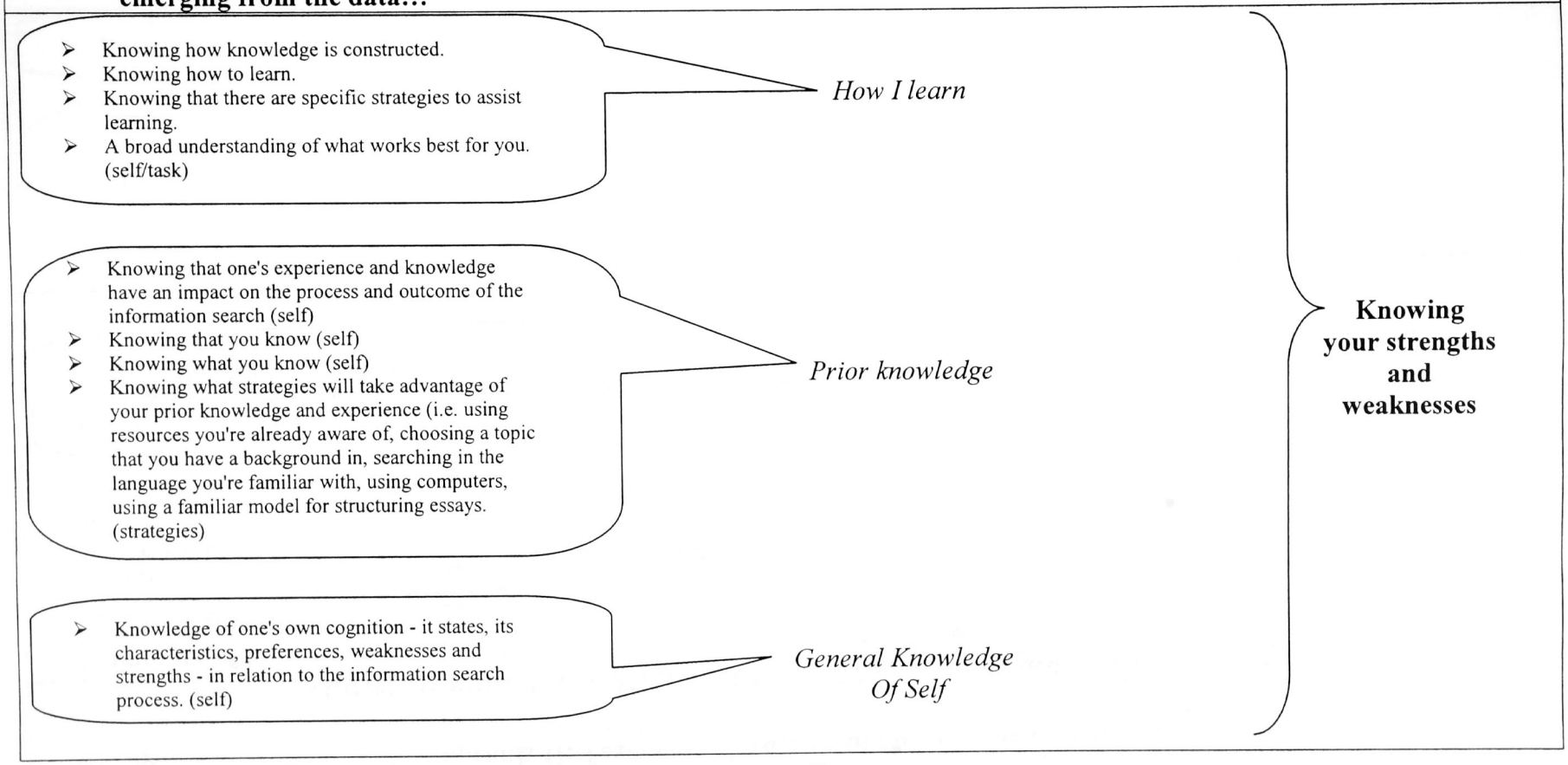
Appendix F: Timeline exercise: transcribed text

07: Title: Women with influence: the Egyptian New Kingdom

Focus	Timing	What I did (actions)	Why	Questions I asked myself	Feelings
		Discuss possible topic choices with my parents, sister & cousin for input & ideas	I had no ideas for topics, but knew that their suggestions would be original. Used their experience in research.	Who has experience in writing research paper & has a large store of knowledge to discuss with me?	Overwhelmed, did not know how to start
X		Google search for basic info to find what interested me most	To see if there was available info, & which topic would present a challenge & interest me most	What way of searching for info am I most familiar with? What is the most likely way of gaining general knowledge on topic?	Hesitant (bored at times) not finding topic as interesting as hoped (discouraged at lack of "scholarly" info)
		Begin to take notes on books, find aspects of relevance	Get some notion of how to organize my search	Where can I find an organized plan of my topic? Where can I get ideas for links between aspects?	Interested & curious; wanted to branch out my topic
	4 weeks interruption				
		Search on databases using specific aspects from books	Seemed like the "proper" way to find authoritative info, suggested by teachers & family.	What book have I been given in class to do the research with?	Frustrated, unsure of how to use the resources to full advantage; had though my topic was more widely covered by scholars (surprised)
		Write intro Discuss with teacher; Idea for defining paragraph			
		Write outline, connect parts of information to each along with the possible sources		How can I organize my paper using the knowledge I gained?	Overwhelmed by problem of how to connect & condense so much different info & how to make links with previous knowledge
		Submit outline. Realize range is too broad			
		Refine outline, jot down ideas			
		Updating & adding to info while writing (finding examples, needing more material) (back & forth process)	To really focus on each aspect, so the info should not be too broad	Do I have enough information? Is it too repetitive?	Interested, but struggling to limit my searches & go beyond the repetitions.

Appendix G: Taxonomy of Adolescent Metacognitive Knowledge

Knowing your strengths and weaknesses (continued on next page...)



Appendix G: Taxonomy of Adolescent Metacognitive Knowledge

Knowing your strengths and weaknesses (continued from previous page)

Definitions of the types of knowledge emerging from the data…	Attributes	Category
➢ The participants' knowledge of their own strengths. (Self)	*My Strengths*	**Knowing your strengths and weaknesses**
➢ The participants' knowledge of their own weaknesses, their self-awareness. A weakness could include a gap in knowledge (self)	*My Weaknesses*	

Appendix H: Taxonomy of Adolescent Metacognitive Knowledge

Knowing that you don't know

Definitions of the types of knowledge emerging from the data...	Attributes	Category
➢ Knowing there is a gap in knowledge. (self)	*Knowing that you don't know*	**Knowing that you don't know**
➢ Knowing that one's experience and knowledge have an impact on the process and outcome of the information search (self) ➢ Knowing that you know (self) ➢ Knowing what you know (self) ➢ Knowing what strategies will take advantage of your prior knowledge and experience (i.e. using resources you're already aware of, choosing a topic that you have a background in, searching in the language you're familiar with, using computers, using a familiar model for structuring essays. (strategies)	*Prior knowledge*	
➢ The participants' knowledge of their own weaknesses, their self-awareness. A weakness could include a gap in knowledge (self)	*My Weaknesses*	
➢ Knowledge of one's own cognition - it states, its characteristics, preferences, weaknesses and strengths - in relation to the information search process. (self0	*General Knowledge Of Self*	

Appendix I: Taxonomy of Adolescent Metacognitive Knowledge

Communicating

Definitions of the types of knowledge emerging from the data…	Attributes	Category
➢ Knowing that talking to people is a useful cognitive strategy (strategy)	*Talk as a Metacognitive Strategy*	**Communication**

Who do I talk to?

Social dimension: Identifies the person the participants talked to about their information search. (Does not necessarily reflect metacognitive thinking).

Associated with these code(s) in Atlas.ti:

- (soc) adult
- (soc) cousin
- (soc) expert
- (soc) friend
- (soc) grandparents
- (soc) librarian
- (soc) neighbour
- (soc) parent
- (soc) sister
- (soc) teacher
- (sos)talk = Anytime participant talked to someone about their project.

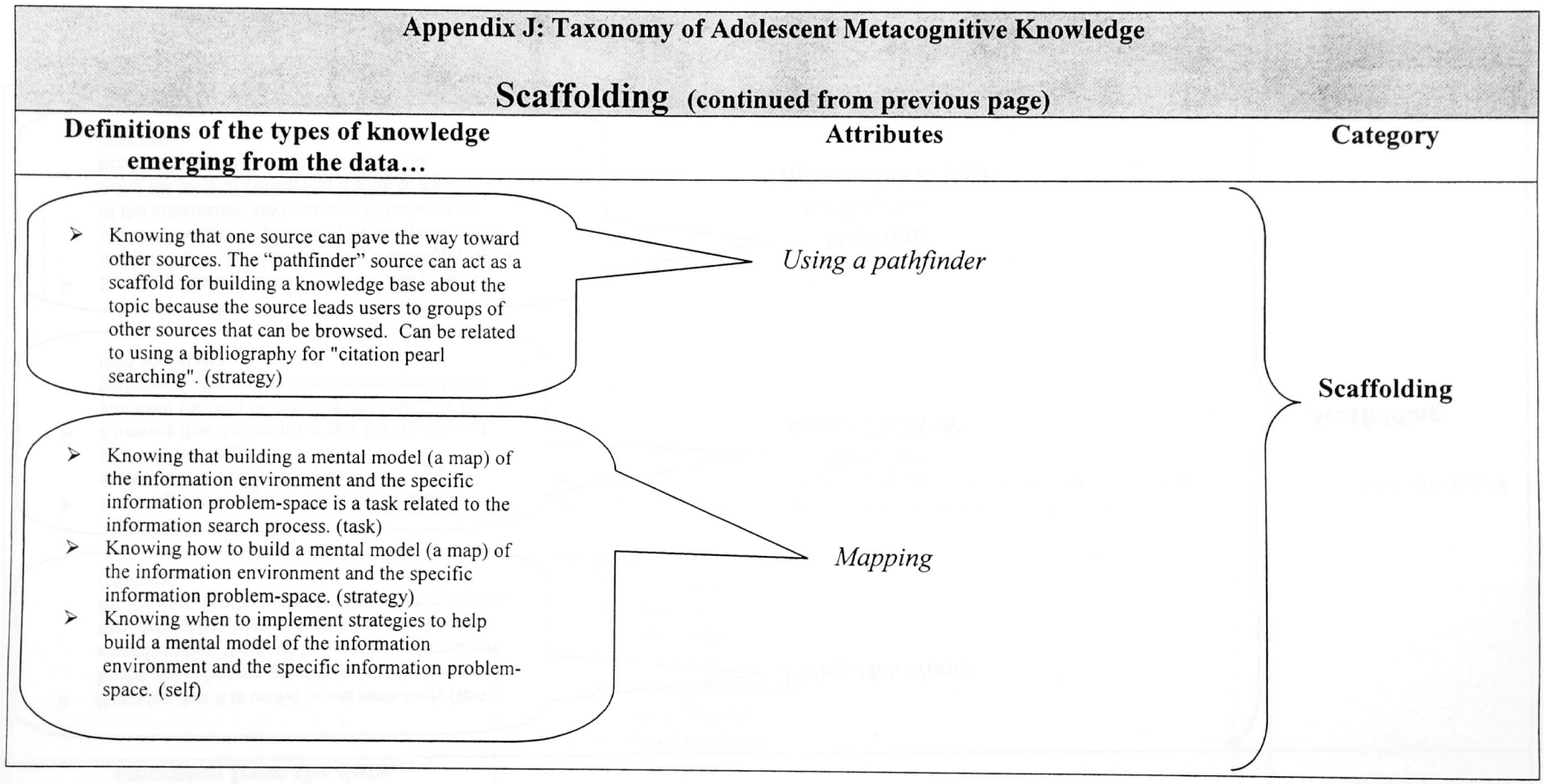
Appendix J: Taxonomy of Adolescent Metacognitive Knowledge

Scaffolding (continued on next page...)

Definitions of the types of knowledge emerging from the data...	Attributes	Category
➢ Knowing that it is useful to use meta-tools (text books and reference sources such as dictionaries, encyclopedias, thesauri) because the information they deliver has been simplified and synthesized for the user. Furthermore they are reliable sources (strategy).	*Using Meta-tools*	**Scaffolding**
➢ Knowing that using the expertise of others is a useful information-seeking strategy - a cognitive shortcut. (strategy) ➢ Knowing that the cognitive task is complex and you need the help of someone or something that understands the information environment better than you. (task)	*Modeling Expert Thinking*	
➢ Knowing that the structure and content of an information source can support the development of search strategies by providing a conceptual model of the information environment. Often involves using the table of contents in a book or the headings and sub-headings on a web site. (strategy)	*Modeling the Structure of Information Objects*	

Appendix J: Taxonomy of Adolescent Metacognitive Knowledge

Scaffolding (continued from previous page)



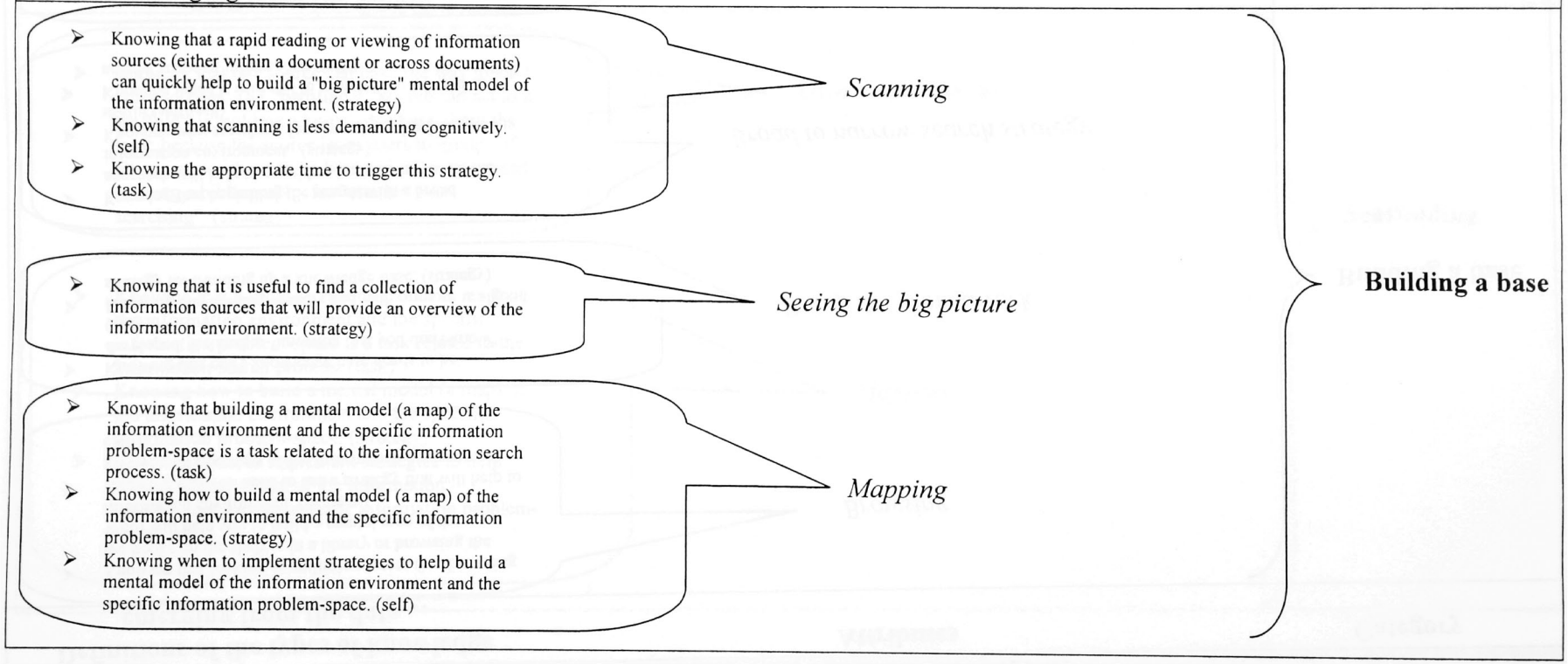
Appendix K: Taxonomy of Adolescent Metacognitive Knowledge

Building a base (continued on next page...)

Definitions of the types of knowledge emerging from the data...	Attributes	Category
➢ Knowing that looking at multiple sources (i.e. browsing the books on the shelves in a library or browsing the Web) will help you to build a mental map of the information environment. (strategy) ➢ Knowing that you need to use a strategy that will help to give you an overview of the information environment. (self)	*Browsing*	**Building a base**
➢ Knowing that one's knowledge base needs to be developed. Related to "knowing that you don't know". (self) ➢ Knowing that reading broadly and with purpose is a good strategy for building up a knowledge base. (strategy)	*Doing the groundwork*	
➢ Knowing that beginning the search with a broad approach will help to provide a basic overview of the information environment. (strategy) ➢ Knowing why searching for general level information is useful (self/task) ➢ Knowing when it is useful to switch from a broad to a narrow scope of information. (self)	*Broad to narrow search strategy*	
➢ Knowing that finding different ways to say the same thing is a useful cognitive strategy for broadening the search and thereby building a knowledge base. (strategy)	*Finding synonyms*	

Appendix K: Taxonomy of Adolescent Metacognitive Knowledge

Building a base (continued from previous page)



Appendix L: Taxonomy of Adolescent Metacognitive Knowledge

Connecting (continued on next page...)

Definitions of the types of knowledge emerging from the data...	Attributes	Category
➢ Knowing that you are confused about an aspect of the topic and you need to take steps to clarify it. (self) ➢ Knowing which steps will help you to clarify. (strategy).	*Clarifying*	**Connecting**
➢ Knowing that new information will have to connect to previously gathered information. (task) ➢ Knowing that the information to be used in the final product has to connect in a way that makes sense. (task) ➢ Knowing that you have to think of ways to relate information. (strategy)	*Connecting information*	
➢ Knowing how to construct meaning from multiple information objects (strategy). ➢ Knowing that it is necessary to synthesize the information in order for it to create a cohesive whole (task).	*Part to Whole Thinking*	
➢ Knowing that there are gaps in the information gathered. Either its not relevant, there's not enough, or its missing key pieces. (self) ➢ Knowing that there are strategies for filling in gaps in information and knowing when/how to use them (strategy).	*Fill in Gaps in Information*	

Appendix L: Taxonomy of Adolescent Metacognitive Knowledge

Connecting (continued from previous page)

Definitions of the types of knowledge emerging from the data…	Attributes	Category
➢ Knowing that the process of knowledge construction follows certain steps. (task) ➢ Knowing that its helpful to figure out the structure of the information environment (strategy) ➢ Knowing that one way to explore the information environment is to first break the topic into its components and then reconstruct it.(strategy) ➢ Knowing that breaking apart and rebuilding is a method for assuring authenticity - reduce plagiarism (strategy) ➢ Knowing that "breaking apart and rebuilding" is a a strategy that works for you (self) ➢ Knowing that focusing on smaller aspects of the topic will allow you to arrive at a deeper understanding of it.(strategy)	*Break Apart and Rebuild Strategy*	**Connecting**
➢ Knowing how to use the "narrow to broad" strategy. Using search tactics that will help one hone in on specific details within the information environment and thus fill in gaps. (strategy) ➢ Knowing why searching for specific information is useful (self/task)	*Narrow to Broad Search Strategy*	

Appendix M: Taxonomy of Adolescent Metacognitive Knowledge

Understanding Curiosity

Definitions of the types of knowledge emerging from the data…	Attributes	Category
➢ Knowing that an imbalance between curiosity and task performance can affect the search process (task). ➢ Knowing when to reign in curiosity in order to move forward in the search task (strategy).	*Conflict and curiosity* Super code created by combining "conflict" and "curiosity"	**Understanding Curiosity**
➢ Knowing what motivates you (self)	*Role of Motivation*	
➢ Knowing what interests you (self) ➢ Knowing the role of interest in information seeking. (task)	*Role of Interest*	

Appendix N: Taxonomy of Adolescent Metacognitive Knowledge

Understanding time and effort (continued on next page...)

Definitions of the types of knowledge emerging from the data...	Attributes	Category
➢ Knowing that a sustained effort is required in order to remain focused.(task) ➢ Knowing how to sustain the effort and hold on to the "thread" of thought. (strategy) ➢ Conversely, knowing that concentrating for too long can become frustrating and can prevent you from focusing. (task)	*Concentration*	**Understanding time and effort**
➢ Knowing that self-control and determination is required, either by concentrating, filtering out "noise", setting restraints on the scope of the topic, keeping an eye on the target, establishing deadlines in order to progress (strategy)	*Control*	
➢ When a metacognitive strategy becomes a crutch. (strategy). Associated with use of information mediators (parents, teachers). Related to uncertainty and lack of confidence - the focus isn't "real" until the teacher says it is. Evidence of a lack of metacognitive knowledge?	*Crutch*	
➢ Knowing that investing time in an information-seeking task is a strategy that will pay off. Seeing the relationship between cognitive effort and results (strategy) ➢ Knowing that its not worth investing time in an information-seeking task (strategy) ➢ Knowing that certain tasks require an investment of time and certain tasks don't. Knowing when to invest time in a task and when not to (task)	*Investment in time and effort*	

Appendix N: Taxonomy of Adolescent Metacognitive Knowledge

Understanding time and effort (continued on next page...)

Definitions of the types of knowledge emerging from the data...	Attributes	Category
➢ Knowing that laziness is a personal characteristic that affects the information search process. Related to metacognitive knowledge of self.(self) ➢ Knowing the effects of laziness on one's ability to complete a cognitive task. (task)	*Laziness*	**Understanding time and effort**
➢ Knowing that certain strategies require less cognitive effort than others. (task) ➢ Knowing when and how to use strategies that require less effort (strategies)	*Principle of Least Effort*	
➢ Knowing that you're a patient learner - someone who is willing to take the time to explore, delve into, relate, etc. (self) ➢ Knowing that patience is sometimes required in order to find good information. (task) ➢ Knowing when patience is required in order to find good information. (task)	*Patience*	
➢ Knowing that you are a persistent searcher. In other words, knowing that you're the kind of person who is willing to invest time and cognitive effort in the search. (self) ➢ Knowing that persistence is a good cognitive strategy in certain situations. (strategy)	*Persistence*	

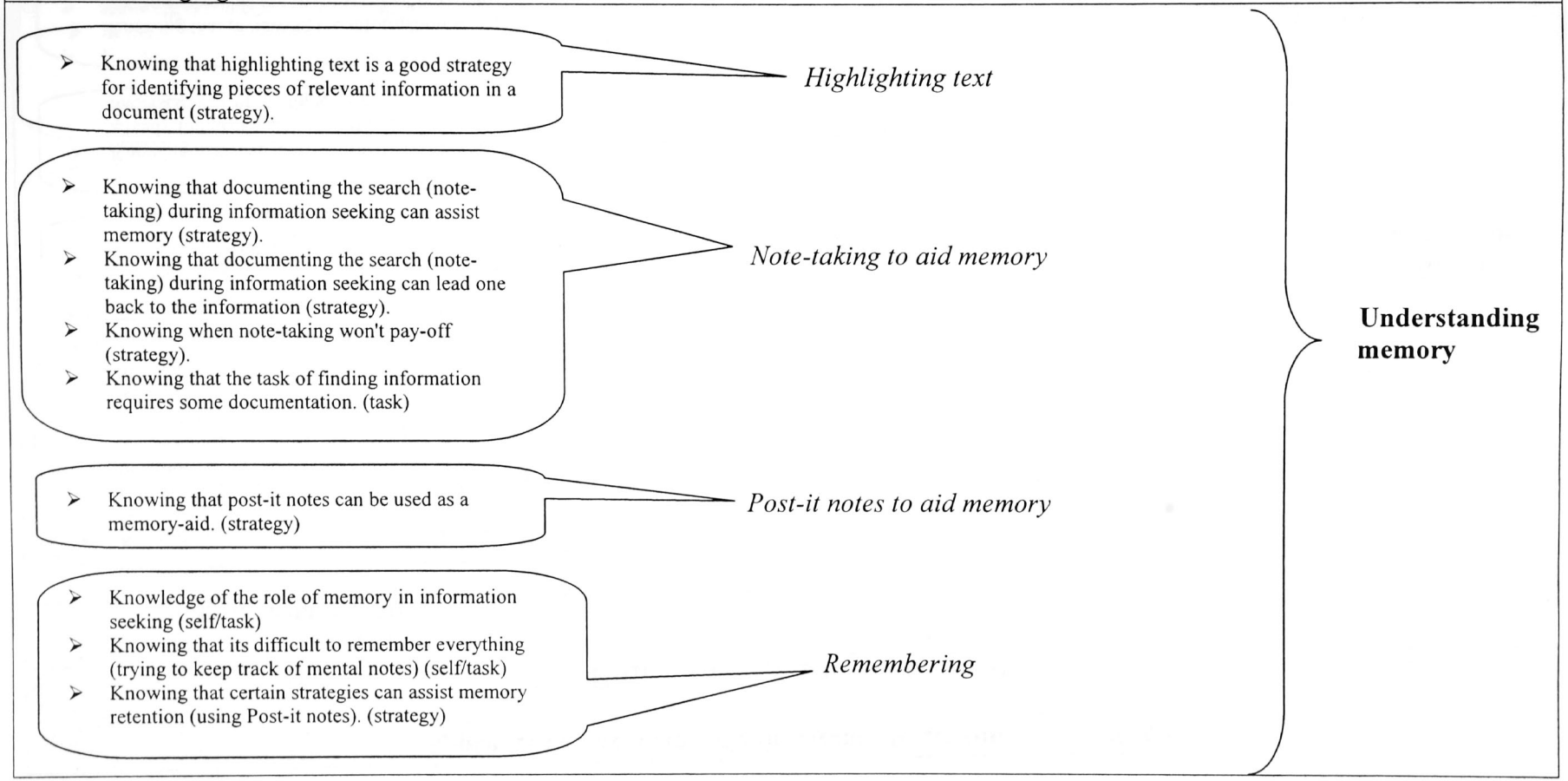
Appendix N: Taxonomy of Adolescent Metacognitive Knowledge

Understanding time and effort (continued from previous page)

Definitions of the types of knowledge emerging from the data…	Attributes	Category
➢ Knowing that a specific approach/action/strategy/tactic is easier (less effort) than others. (strategy) ➢ Knowing that finding information requires effort. (task)	*Understanding the Role of Effort*	**Understanding time and effort**
➢ Knowing tactics that will help to move the search forward more quickly and efficiently: How to skip over some steps in the search - a shortcut. (strategy) ➢ Knowing when to apply a shortcut tactic. When it is it helpful; when is it not helpful. (self)	*Using a Short Cut*	
➢ Knowing that the cognitive effort required to summarize a lot of information into a short paper is quite high. (task)	*Understanding Effort Required to Summarize*	

Appendix O: Taxonomy of Adolescent Metacognitive Knowledge

Understanding memory



Appendix P: Taxonomy of Adolescent Metacognitive Knowledge

Pulling back and reflecting

Definitions of the types of knowledge emerging from the data…	Attributes	Category
➢ Knowing that reflection is a strategy that can help you clarify and construct meaning (strategy). ➢ Knowing that reflection is a useful activity during the information search process. (strategy) ➢ Knowing that reflecting is required in order to make sense of the process (task) ➢ Knowing that a lack of reflection can lead to frustration and the end of concentration (task)	*Reflecting*	**Pulling back and reflecting**
➢ Knowing that stepping away from the task is a useful strategy (strategy)	*Take a break from the task*	
➢ Knowing that revisiting information you have already found can help to improve your understanding of the topic. (strategy)	*Following-up a lead*	
➢ Knowing that reviewing the information will help you to evaluate it and make sense of it. (strategy) ➢ Knowing that consulting the teacher's instructions more than once (!) will help you to complete the assignment. This will keep you on track (strategy)	*Reviewing*	

Appendix Q: Taxonomy of Adolescent Metacognitive Knowledge

Changing course

Definitions of the types of knowledge emerging from the data…	Attributes	Category
➢ Knowing that adaptations to the topic will have to be made in order to move forward (task) ➢ Knowing that one's understanding of the topic doesn't match the information environment therefore steps should be made to adapt (self)	*Adapting the Topic*	**Changing course**
➢ Knowing that shifting from one tactic to another is a useful strategy to help one explore the information environment (strategy) ➢ Knowing when to shift from one tactic to another (strategy) ➢ Knowing when a tactic isn't working (self)	*Shifting the Search Strategy*	
➢ Knowing when to use a strategy that is less of a cognitive load (strategy) ➢ Knowing what strategies require less cognitive effort (strategy)	*Simplifying the Search Strategy*	
➢ Knowing when to stop wandering (exploring and browsing) through the information environment and focus on the task at hand (strategy).	*Ending Exploration*	

Appendix R: Taxonomy of Adolescent Metacognitive Knowledge

Balancing

Definitions of the types of knowledge emerging from the data…	Attributes	Category
➢ Knowing that sorting and choosing information is an important task related to searching for information (task) ➢ Knowing that choosing information necessarily means that some information must be eliminated (task) ➢ Knowing how to sort and choose information .(strategy) ➢ Knowing when to sort and choose information. (strategy/self)	Filtering information	Balancing
➢ Knowing that finding a balance between two desirable options may help one move forward in the search process. (strategy)	Finding an equilibrium	
➢ Knowing that a cognitive strategy can have a secondary effect that is counter-active. (strategy).	Awareness of the weakness of a strategy	
➢ Knowing that the benefits of two different strategies must be weighed in order to make a decision. (strategy). Often involves finding a compromise or balance between two options.	Weighing the options	

Appendix S: Taxonomy of Adolescent Metacognitive Knowledge

Parallel thinking

Definitions of the types of knowledge emerging from the data…	Attributes	Category
➢ Knowing that information seekers must continuously plan and evaluate - look forward, look backward – all the while thinking in the present. (task)	*Double Thinking*	**Parallel thinking**
➢ Knowing what the next step is (task) ➢ Knowing what the cognitive goal (or outcome) is (task) ➢ Envisioning the future. Envisioning the outcome. Related to planning, thinking ahead (strategy)	*Future Thinking*	
➢ Knowing that deliberate planning can improve outcomes. (task)	*Planning*	