

Methods for revealing the metacognitive knowledge of adolescent information seekers during the information search process

Abstract: This paper describes the methods used to investigate the metacognitive knowledge of adolescents, aged 16 to 19, as they searched for, selected and used information for a school-based inquiry project. The study has implications for information literacy instruction and contributes to the understanding of adolescent information-seeking behavior.

Résumé : Cette communication décrit les méthodes utilisées pour explorer les connaissances métacognitives d'adolescents, âgés de 16 à 19 ans, lors de la recherche, la sélection et l'utilisation d'information pour un projet de recherche scolaire. Cette étude a des répercussions sur l'enseignement de la culture informationnelle et contribue à la compréhension du comportement de recherche d'information des adolescents.

1. Introduction

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 (Flavell, 1979, Anderson & Krathwohl, 2001). Such knowledge, when used in information seeking, may help users to solve complex information problems. Land and Greene, in their study on 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 (2000).

There is perhaps no other user group who could benefit more from the development of metacognitive knowledge than adolescents, aged 16 to 19. 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. Metacognitive knowledge may be a particularly useful support for young people who are unraveling their first complex information problems.

There is a wide body of research that has looked at information seeking in relation to critical thinking, higher order thinking, mental models, reflection, self-monitoring and control processes - all constructs related to but not synonymous with, metacognitive knowledge. A small set of studies has investigated the metacognition of young people during the information search process. In her study of grade-six children in a New

Zealand school, Moore found that although all the students were guided by metacognitive knowledge during the research process, the nature of this knowledge was incomplete and flawed. (1991, 1995). McGregor explored the higher order thinking skills of grade-eleven students in a gifted program in a Canadian high school and found that the students' thinking was carried out at an intuitive level, without awareness of their own thinking or the ways they could modify their thinking to advance their learning. (1994a; 1994b). Wolf tested methods for scaffolding specific metacognitive strategies in aid of information problem-solving on grade-eight students but the study did not set out to expand understanding of metacognitive knowledge further (2000). On a broader level, research on adolescents and information-seeking behavior in general is strangely lacking. Large, 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 (2004, 357).

This paper describes a study that is attempting to contribute further to this body of research. The paper begins by explaining (in broad terms) what metacognitive knowledge is and why adolescents may find it particularly useful in their information seeking. It then describes the methods used to capture the metacognitive knowledge of adolescents during the information search process.

2. What exactly is metacognitive knowledge?

Metacognitive knowledge, as its name suggests, is a form of knowledge. Anderson and Krathwohl 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 (2001). 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.

Metacognition is a term that has at times defied definition. Hacker, 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" (1998, 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, Garner, 1987; Paris, Wasik, & Turner, 1991; Scardamalia & Bereiter, 1985; Baker & Cerro, 1996).

The literature on metacognition reflects a general agreement that there are two distinct, albeit interrelated, aspects to metacognition; *knowledge* and *control processes*. (Flavell, 1979; Garner, 1987; Moore, 1991, 1995; Baker & Cerro, 1996; Anderson & Krathwohl, 2001). The first half of the equation, 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: awareness of one’s own cognition; knowledge about different cognitive demands; and procedural knowledge of strategies to employ when unsuccessful. (Garner & Alexander, 1987; Pintrich, Wolters & Baxter, 1996). Anderson and Krathwohl, mirroring Flavell’s framework of 1979, limit metacognitive knowledge to knowledge about cognition and, like Garner and Alexander, subdivide metacognitive knowledge into three types: strategic knowledge (knowing what strategies to use); knowledge about cognitive tasks (knowledge about when and why to apply strategies) and; self-knowledge (knowing one’s strengths and weaknesses, awareness of motivational beliefs) (2000, p. 55-60).

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.

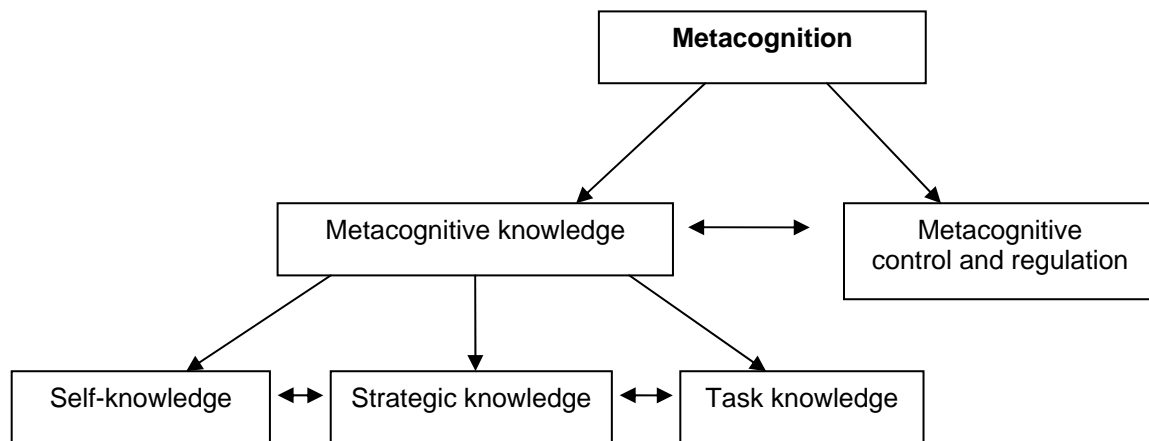


Figure 1. The structure of metacognition

3. Adolescents as information seekers

Information seeking can be a messy, ill-structured process at the best of times but labels such as the “Net Generation” (Tapscott, 1998, p. 3), the “wired generation” or “Gentech” (McNamara, 2007) suggest that young people are technologically savvy, experts in the area of information seeking, and therefore not in need of closer attention. The statistics, at least for Canada, do tell us that young people are active users of information technologies: 94% of young people in grades 4 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. (Enviro-nics Research Group, 2004).

But are young people effective information seekers? Studies indicate that, although technologically adept, adolescents still find information seeking to be a difficult task (Fidel et al, 1999; Agosto, 2002; Branch, J., 2003, Todd, R., 2003; Neilsen, J., 2005; Dresang, 2005). 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”, with little life experience and the ability to reflect upon their own thinking a new skill lately learned or even in development. 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. Metacognitive knowledge might provide the cognitive support needed when knowledge in other domains is weak. 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. 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.

4. Theoretical orientation

The methodological approach of this study is inductive and qualitative research methods have been used to uncover the patterns underlying metacognitive knowledge during the information-search process. The study investigates metacognitive knowledge within the framework of Kuhlthau’s Information Search Process (ISP) model, a six-stage, multidimensional model of information problem solving (1991). The six stages - *task initiation*, *topic selection*, *prefocus exploration*, *focus formulation*, *information collection* and *search closure (presentation)* – are actually tasks that the information seeker must carry out in order to successfully conclude the search. In later writings, a seventh stage called *reflection and self-assessment* was added (Kuhlthau, 1994). The ISP model is multidimensional in the sense that each stage is associated with three phenomenological domains - *thoughts* (cognitive domain), *feelings* (affective domain) and *actions* (behavioral domain). The use of this model implies, therefore, that metacognitive knowledge should be investigated through three lenses and, in fact, the three domains are reflected in the design of the study.

5. Challenges facing the study

Several factors constrained and 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 incident of information retrieval) meant that the study was necessarily longitudinal and therefore methods had to be devised that would capture change over time. Furthermore, in keeping with the purpose of this study, data 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. Since it was not known *when* the students would choose to conduct their information-search (as soon as the assignment is given by the teacher or the night before it is due) nor *where* they would choose to search (in the school library or at home, from their computer), direct observation was not possible. Finally, the participants in this study were active and busy young people, many with conflicting demands on their time. The problem of how to encourage their long-term engagement in the study (almost

four months) was a 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, 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 they want 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 of all, four types of data collection instruments were designed and used. Secondly, the instruments were applied 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) (Anders Ericsson & Simon, 1980; Branch, 2000). In addition, data collection questions were crafted in such a way as to ensure that the participants' thoughts were juxtaposed next to their actions. This was done to highlight patterns or produce 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.

6. Setting

The study was conducted with in two Montreal-area, English-language, junior colleges, commonly called CEGEP, hereafter referred to as Collage A and College B. The term CEGEP stands for “Collège d'enseignement général et professionnel” or, “College of General and Professional Education.” Although CEGEP is considered to be post-secondary education, the first year is roughly equivalent to grade 12 because high school in Quebec ends at Grade 11.

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 generally new to them. As well, the position of teacher-librarian does not exist in Quebec public high schools nor in most private high schools, 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.

7. The participants

Twelve adolescents, between the ages of 16 to 19 and all students in CEGEP, participated in the study. This sample size allowed for the gathering of an ample and rich set of data while providing a cushion of security should participants elect to withdraw from the study. Ten of the participants were from the same humanities class in College A, and the two remaining were in a social studies program in College B. (However one of the two participants from College B was in the pilot study which had been conducted six months prior to the formal study). The classes were selected on the basis of the nature and duration of the school assignment (it had to be full-term project that required a literature review). In the case of one college, the students were known to be highly able students, having been accepted to a program with limited enrollment. The academic abilities of the students at the second college were not known due to the comprehensive nature of the school program. All participants were compensated with a gift certificate at the end of the study because their involvement was in addition to their regular school assignments and responsibilities.

In order to assure the teachers that their students would have equal opportunities to benefit from the study (a concern expressed by one of the teachers), it was decided that the study would be open to any student in their class who wished to participate. 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 (in that participants in this study were compensated, this would have indeed been the case). So, rather than hand-select participants in each class (purposeful sampling), a random approach had to be adopted.

Operating the study in two schools meant working through several layers of ethics approval in order to gain access to participants. The process involved McGill University, two college administrations and three teachers, and took six months for the pilot study and nearly a year for the formal study. Informed consent was received from each participant, as well as the parents of participants under the age of 18.

8. Task (Unit of analysis)

The study looked at the information search process of adolescents, ages 16 -19, as they searched for, evaluated and used information to complete a semi-imposed, inquiry-based research paper, using any variety of information sources. With the exception of the one student in the pilot study, all the participants were told about the research paper in late August – the first week of the fall term - and submitted the paper just before the exam period in early December. The subject area of the research paper was determined by the teacher, but the specific topics were selected by the participants. As a result, the twelve participants investigated a wide array of topics – from Greek architecture to classical music.

9. Data Collection Instruments

Data was collected in the spring of 2006 (in a pilot study) and throughout fall 2006. Four data collection instruments were used, resulting in a total of 75 documents. The instruments included: (1) written or audio-taped journals completed throughout the term; (2) telephone interviews conducted three times throughout the term; (3) a visualizing exercise (a timeline) and; (4) a final interview. The last two instruments were applied at the end of the term. Each instrument tried to capture three conceptual categories: the actions taken during the search process, the thinking underlying these, and the feelings experienced at each stage in the process. Metacognitive knowledge was specifically targeted with questions related to *why* and *self-prompting questions*.

9.1 Written or audio-taped journals

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 a kit that included a notebook, a small, handheld tape-recorder, and a card with question prompts. 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 of 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.

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 twelve participants, seven chose to keep a written journal, three kept both a written and 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, those who did use the recorder said it was more convenient when they were pressed for time.

9.2 Telephone interviews

At the beginning of the study, each participant was asked if they knew the topic of their research paper (only one did). Following the initial meeting with the participants, three telephone interviews were then conducted throughout the fall term. Interviewing by telephone, rather than in person, was preferable because it could happen 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 living in the participants’ homes.

9.3 Final interview and visualizing exercise

At the end of the term, after the research paper had been submitted to the teacher, the researcher met with each participant at the college. During the meeting a semi-structured interview and a visualizing exercise were conducted. The interview questions emerged from the telephone interviews and were framed by the three conceptual categories of thoughts, feelings and actions and the six stages of the ISP model. For the visualizing exercise participants were asked to draw a timeline and along this line describe four elements of their search process: their *actions*, the reasons *why* they took these actions, the *questions* they asked themselves and, 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, at what point did they know what they were looking for.

10. Preliminary thoughts about the methodology

The purpose of this paper is to present the methods used to uncover the metacognitive knowledge of adolescents during the information search process. Results of the study will be reported in subsequent papers. At this point, some general thoughts about the methodology can be offered.

There were serious access issues throughout this study. Researchers wishing to work with this user group should be aware of the additional time needed to gain ethics approval. In the case of this study, the process took several months and many telephone calls before the doors were open to the schools. Added to this are the particular characteristics of teenage life – school, socializing, and part-time jobs – elements that at times conflicted with the smooth running of the study. One solution to the access problem may be to reach young people by cellular telephone and computer - and incorporate text- and instant messaging into the data collection methodology.

Notwithstanding the access issues, the retention rate was higher than expected: Of the 15 participants who began the study, only three dropped out, resulting in 75 documents from the study. The researcher is now faced with the issue of data-overload, a problem that could have been avoided had a smaller sample size been used.

The young people who participated in the study were active partners in research and the majority of those who committed to the study, completed it. Many of the participants were intrigued by the study and hoped to read about it one day. The fact that few withdrew from the study suggests that the methods did not threaten or intrude on the participants' busy lives. The participants were generally open about their thoughts and feelings about information seeking and had strong opinions about the accessibility of information (or lack thereof) as well as their own abilities to find it. The notion of actually stopping to think about how to find, choose and use information was a novelty for most and many found the idea interesting. Despite the methodological challenges faced by this study, the research design allowed for triangulation, provided a framework for the expression of the participants' thoughts, feelings and actions, and resulted in a rich and varied data set.

11. Acknowledgements

I gratefully acknowledge the vital contribution of the twelve young people who participated in this study, as well as the assistance provided by Dr. Andrew Large, my supervisor, and the Graduate School of Library and Information Studies, McGill University.

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