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Making the Invisible Visible: Metacognition and the Research Process

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Introduction—Metacognition and Learning

The term *metacognition* refers to one's thinking or being self-conscious about one's thinking. Philosophers consider it when discussing human epistemology. Psychologists examine metacognition in relation to how we remember things. Flavell (1979) pointed out the educational implications of certain aspects of the way in which metacognition can influence learning, classifying metacognition into metacognitive knowledge and metacognitive experience. Metacognitive knowledge relates to one's knowledge about task demands or goals. (1979, p. 906). When teachers ask students to plan, reflect, and set goals, they are asking them to engage in this type of metacognition. Flavell also points out that when students and teachers use metacognitive strategies, learners begin to *monitor* their own learning process. (p.909). In contrast to metacognitive knowledge, metacognitive experiences occur when people feel dissonance because they don't understand something (Flavell, 1979).

Davidson, Deuser and Sternberg(1994) linked metacognition to problem-solving activities, indicating that metacognition assists those skills. They described problem-solving as the process in which users "(1) recognize that there is a problem to be solved (2) figure out what exactly the problem is, and (3) understand how to reach a solution." (p.208). The metacognitive aspects of problem-solving activities include "(1) identifying and defining the problem (2) mentally representing the problem (3) planning how to proceed and (4) evaluating what you know about your performance." (p. 208). These researchers also pointed out that "changes can occur as people gain a more complete understanding of the givens, goals, and restrictions in a problem or as they find some information that has been previously overlooked." (p. 211).

Metacognition and Information Literacy

Given Davidson, Deuser and Sternberg's description, one can see how information literacy also fits the model of problem-solving as it relates to metacognition. After all, one could describe an information need as a problem to be solved, the process of managing a topic and setting up a clear search plan as the way in which users can further define the problem, and then the search process, evaluation, analysis and integration of sources as the "solution." Librarians and instructors also know that changes occur as their students gain more understanding of the complexity of their research topics and questions and as they interact with the scholarly literature. The goals and restrictions placed on students doing research projects also play a part in the problem-solving process.

Metacognition has recently become part of the conversation in recent developments in the library community which is evident in the final draft of the *ACRL Framework* under "Searching as Strategic Exploration" one finds several "Knowledge Practices" that involve planning and self-monitoring in which the student must:

- determine the scope of the task required to meet their information needs;
- match information needs and search strategies to appropriate search tools;
- design and refine needs and search strategies as necessary, based on search results; (p. 9)

Interestingly, early drafts of the *ACRL Framework* included explicit discussion of metacognition, but much of it was taken out before the final draft. Here are some key passages regarding metacognition from Draft # 1 and 2 of the *Framework*: "Greater need for sense-making and metacognition in a fragmented, complex information environment requires the ability to understand and navigate this environment holistically, focusing upon intersections" (p. 2). In the section under "Dispositions, Self-Assessments," the authors of the Draft 1 Part 1 *Framework* stated, "The self-assessment activities suggested for each of the threshold concepts provide a starting point for students to examine their learning process." And "Learners will need to be adept in determining the strengths, the weaknesses, and the gaps in their knowledge and abilities. Promoting self-assessment is a critical element in accomplishing this goal." (p.7)

One self-assessment included in the first draft version of the *Framework* describes keeping research logs, "in which [students] note changes in particular research directions as they identify resources, read, and incorporate new learning." And "Review their research logs to identify strengths and/or problems that appear more than once and use this knowledge to change future research directions" (*Framework*, Draft 1 Part 1, 2014, p. 14). Another example of how the Framework encouraged metacognition through self-assessment can be found in this passage: "[Students]

reflect on their preferred method of finding information, both for academic and daily information needs. For each category be able to assess whether the information is produced in an appropriate manner for a particular need” (*Framework*, Draft 1, Part 1, 2014, p. 16) In these cases, the first draft of the Framework is treating reflection as a metacognitive self-monitoring strategy that enhances learning.

Information Literacy Teaching Strategies and Metacognitive Strategies

Librarians have long recognized that learning about information literacy goes beyond developing isolated skills related to finding information in selected databases. Information literacy instruction includes teaching students about the research process itself and how one moves from the inception of a project to its completion. Yet, one of the main problems with information literacy/library instruction is that students are not always aware of how labor-intensive and time-consuming the research process is. This is where librarians’ attention to the previously mentioned metacognitive knowledge about an undertaking’s degree of demand or difficulty may be useful. Explicitly discussing the entire research process increases students’ awareness about how they can plan their research projects. At the outset of a project, librarians can help students develop metacognitive knowledge by working with them to outline the steps in a process that include selecting topics, creating research questions, setting up a search plan, matching questions and search terms to resources, identifying and evaluating relevant sources, and then citing sources appropriately. Direct attention to fostering metacognitive knowledge will help students start to think about planning, task difficulty, and problem-solving issues related to their research. Pointing out why these steps are neither linear nor simple and asking learners to reflect on their strengths and weaknesses related to the process also raises metacognitive awareness. Later, if librarians and teachers scaffold the processes for students, particularly at crucial stages in their research, learners can monitor their own strategies for accomplishing their goals.

What Happens When Students and/or Their Teachers Underestimate the Complexity of the Research Process?

When a complex, problem-solving activity is not well understood or well-constructed for students, one finds several unintended consequences. Some research projects or assignments are not well-constructed simply because instructors do not allow enough time for students to work their way through the process or because of their expectations that students can be taught everything they need to know in a one-shot library instruction session. If instructors underestimate what is needed for students to be successful, students, in turn, may develop false expectations. If students are under the impression that the research process consists of simple, linear steps to be performed in a short period time, they may procrastinate on working on a project. As a result, they neither have enough time to complete it successfully nor are they able to engage in self-assessment or reflection. Another unintended consequence of misunderstanding the labor-intensive nature of research and rushing through the process, is that learners are more likely not to be connected to what they are researching. This, in turn, also leads to poorer performance.

Integrating Metacognitive Strategies into Information Literacy Instruction--Making Thinking Visible

When librarians and academic faculty collaborate in teaching information literacy, they can work together to create a message that emphasizes the research process over the final product. An “embedded librarian” who can communicate with students throughout the semester can accomplish more than someone who sees students only once. Being able to communicate with students before, during, and after instruction imparts a different message to students about what can be learned over time. Moreover, the ability to “flip” instruction of the basics into course management systems allows valuable class time to be devoted more to the research process.

Another simple metacognitive teaching strategy that can be used in library instruction to reveal the “invisible” process is to think aloud while teaching problem solving. Think-aloud strategies are helpful in modeling to students what their thinking process could be when tackling complex tasks. For example, finding just the right article for one’s topic is a problem-solving exercise; if the librarian demonstrates a challenging database search by narrating aloud the way in which he/she thinks about solving problems such as tweaking the right search terms, evaluating the results, and revising strategies in the process, students begin to understand that such a task is anything but simple.

Later, when students are searching for information in a workshop environment, teachers and librarians can also ask students to think aloud about their search. Thus, the focus is not only on results, but on thinking about the process and how it works or not.

Cognitive apprenticeship is another teaching technique that identifies the process of a task and makes that process more visible to students. By modeling problem-solving strategies and then having students try out the same strategies in a reciprocal teaching context (Collins Brown Holum, 1991) cognitive apprenticeship can make the invisible part of a process, thinking and mental strategies, visible.

One example of this strategy in the library instruction classroom is to use role-playing exercises to teach students how to identify topics that are too narrow, too broad or “just right” for their assignment. Being able to determine one’s information need does require some metacognitive awareness. To illustrate the role-playing exercise, the course instructor and librarian simulate a reference interview about how to manage some topic related to the assignment. The “librarian” asks questions and helps the “student” with specifics about the topic. After this demonstration, students are paired up to brainstorm possible topics and practice the cognitive process of creating a research guiding question in a similar role-play exercise in which one student is the “librarian” and the other is the “student.” The research questions generated from the role-plays are later critiqued by the librarian and instructor in the context of a whole class discussion. This activity allows students to begin to determine and articulate their “information need” and to launch the research process. Furthermore, this type of cognitive apprenticeship ties into the *Framework’s* Knowledge Practice where students “determine the initial scope of the task required to meet their information needs.” (p. 12, January 2015).

Role-Playing Strategy and Results in Creating Research Questions

After students create research-guiding questions, they can be asked to formulate a search plan using a concept map, which allows them to state the question and then map out major/minor concepts of their question. This prepares the students to plan for the next task of the process, making visible the *Framework* Knowledge Practice of having students “design and refine needs and search strategies as necessary.” The search plan can be the homework that students complete before the hands-on workshop with database searching in a computer classroom. Planning for upcoming tasks is a form of scaffolding that encourages metacognitive thinking in students. By spending a class session just on managing topics and setting up the search plan, students begin to practice their own assessment of “information need” and what it would take to find what they need.

After conducting a study about the effectiveness of cognitive apprenticeship through role playing activities, van Ingen and Ariew (2015) found that this technique was very effective in teaching students how to manage their research topics. The authors studied two groups of students in their efforts to create research-guiding questions, one in which the role-playing intervention was used and one in which it was not used. Results from the study showed that the intervention group had better, more focused research-guiding questions that were classified as manageable (71%) than did the comparison group (42%).

Fostering Metacognition and Self-Monitoring Through Student Research Logs

Metacognition can be also used to enhance student learning through student research logs. Van Ingen and Ariew (under review) asked students to self-assess their research strategies throughout the research process. Students recorded their initial “problem-statement,” what they already knew about their topics, their research-guiding questions, their search terms, their choice of databases, and then whether their research questions changed once they interacted with the scholarly literature. The authors also asked students to rate their confidence levels at each stage of the process. Students were to find three studies and discuss how ideas in the studies could be applied to their classroom student teaching (van Ingen & Ariew, under review). The instructor in the course also asked students to apply what they learned to their student teaching and then reflect on whether using research for their classroom practice was beneficial. Much of the data recorded in the research logs revealed processes that normally are “invisible” to librarians and teachers because they illustrated the dynamic nature of the research process as students reflected on it.

What Was Learned as a Result of Student Research Logs

- 1) Student confidence varies depending on where in the process they are. When asked about how confident they were in a rating scale from 1-5, student progress did not show a linear trajectory. Rather, there were peaks and valleys depending on where they encountered problems and what those problems were.
- 2) Students have difficulty articulating and managing research questions. Observations during the role-play exercises and research logs indicated that many students had trouble moving from a broad or narrow problem-based topic to a manageable research question. Some students struggled with their research questions so much that they changed their topics and questions several times rather than accomplishing some problem-solving to continue their inquiry. Some students became so frustrated that they “worked backwards,” on their projects, finding an article they liked and then changing their initial questions to match what they found.
- 3) Students have difficulty with compromising (modifying) their initial questions based on the information they find in the research literature. Many of their natural language questions needed to be “translated” into academic language once they engaged with information systems.
- 4) Students vary in their ability to reflect on their own research processes meaningfully. When asked if their research questions had changed by the end of the project, many students said “no” when clearly their focus had changed and morphed into a different question.

Looking to the Future

Finally, librarians and teachers who wish to incorporate metacognitive strategies into their teaching ought to stress process over outcomes in their approaches to teaching students about research. It helps students if instructors lay bare the metacognitive processes that are key components of the research process. This can occur through direct instruction and discussions, through modeling and cognitive apprenticeship techniques, such as role-playing, and through think-aloud techniques. Bringing attention to the importance of metacognition in information literacy also means offering students opportunities to reflect on various aspects of their journey, using research logs or through final reflections after a research project has been accomplished. Incorporating metacognition into teaching and learning provides opportunities for students to learn about themselves, and when that happens they become empowered to leverage research to meet their information needs.

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