

## IMPROVING STUDENTS' MENTAL MODELS OF THE RESEARCH PROCESS

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### AUDIENCE

This module is directed toward undergraduate students enrolled in English 105, *The Reading and Writing of Prose*. Most students enrolled in this course are in their first year of post-secondary study at University of the Fraser Valley, and are registered in degree or pre-degree programs (University of the Fraser Valley offers ladder programs, where students complete a 2-year diploma before being admitted to a degree program). English 105 is one of a handful of courses where library instruction is a customary part of the curriculum. More important, however, this course requires students to write three papers or essays, one of which involves integrating sources from the academic literature. For most of these students, this is one of their first experiences with academic research and writing.

### LEARNING GOALS

This learning design will enable students to successfully:

- describe one model of the research process;
- choose appropriate resources (e.g., databases) with which to conduct their research;
- find and select relevant, authoritative sources that meet the criteria for their assignment;
- explain their decisions and actions throughout the research process; and
- evaluate how efficiently and effectively they carried out their research.

### PROBLEM

Chi and Glaser (1985) observe that problems have three states – the initial state, the goal state, and a path that connects the two – and that “problem solving occurs when the current state of information is less than desired and there are barriers between the initial state and the goal state” (as cited in Tabatabai and Shore, 2005, p. 224). They continue by describing well-defined and ill-defined problems, noting that “in an ill-defined problem, any or all of the three components may be vague and unclear” (p. 224) (as opposed to a well-defined problem, in which the goal is clear and there is only one path to the goal).

When we conceptualize research as a problem solving process, we begin to understand why undergraduate students struggle so much with research-based assignments – why they find it difficult to apply what they learned from one research project to the next, a phenomenon that I’ve observed time and again in the more than 14 years that I’ve been teaching post-secondary students. The initial state of the problem may be well-defined (if not fully understood), but the goal state is often vague and the path connecting the two full of obstacles, redirections, and gaps.

Few students begin their post-secondary studies having engaged in the kind of inquiry and with the kind of resources expected in academic writing. Kuhlthau (1988) found that students’ perceptions of library research shifted significantly over the course of their post-secondary education. After four years, post-secondary students expected their interest in a topic to deepen over the course of their research, and they came to appreciate that the research assignment was integral to their course work and led to deeper learning. Kuhlthau’s findings suggest that post-secondary students do not start out with an appreciation of the inquiry process, and that this lack of appreciation may hinder their progress beyond the initial stages of research when they are struggling to

find a focus and experience confusion, doubt, and frustration. She suggests that students who cannot move beyond the early stages of research are more likely to cling to preconceived notions and ideas about the topic, which will hinder deepening their understanding by exploring new ideas and perspectives.

But even while students are developing an appreciation for academic inquiry, they may still lack a sufficiently sophisticated or comprehensive mental model of the research process, which can hinder their effectiveness as researchers. Westbrook (2006) notes that “mental models among [web researchers] reflect varying levels of understanding of the systems or processes from which they are required to glean information.” She further suggests that people can function well enough with incomplete or inaccurate mental models of a system, and that they “are quite likely to use a model without regard to its efficacy simply because it is emotionally comfortable and deeply familiar” (p. 565). But, she cautions, such models, which limit a user’s expectations of success, may also limit information access.

When students function with inadequate mental models of the research process, they sacrifice both effectiveness and efficiency. In an ethnographic study of student researchers, Law and Markel (2007) found that students tend to stumble most in choosing where to start their library research, a choice that can be strongly influenced by librarians, course instructors, and brand awareness. The researchers offer several examples:

- a third year biology student chooses to use the JSTOR database because “it’s great, it’s all full text, and the articles are all scholarly”; further prompting reveals that she learned about JSTOR from her first-year English instructor and had been using it ever since, without regard for its appropriateness to her current context;
- another student, when asked why he selected a ProQuest database, responds that he is familiar with various database “brands”; he has not used ProQuest in a while, so he decides to give it a try; and
- yet another student, a senior, has no difficulty selecting appropriate databases for his research, but when asked how long he has been using the library’s databases, he responds that he learned about them six weeks earlier when his class met with a librarian.

Researchers in this study also observed that students are most likely to use Google as a primary research tool when quality is not a concern (a third-year marketing student, for example, uses a white paper from a computer manufacturer, even though it is essentially a product advertisement masquerading as an academic paper); when they are insufficiently aware of library resources; or when they have had a bad experience using the library’s resources – “errors” such as searching the library catalogue for articles, difficulty navigating the library’s web site or discerning which databases will meet their need, and authentication issues can all lead students to “disconnect” from the library. This revelation suggests that both librarians and instructors have work to do in influencing students’ choices.

But the study also reveals good news; when librarians have the opportunity to engage with students, especially in the classroom, they can wield substantial influence over students’ choices. At University of the Fraser Valley, librarians have such an opportunity for intervention when they meet with each section of English 105 for thirty minutes early in the semester to orient students to library policies, services, and facilities, then follow up a few weeks later with an 80-minute seminar. In between the two sessions, students complete an online assignment (see web site) that introduces them to the library catalogue and one of the library’s research databases. In the seminar, librarians may also assign students a worksheet – asking students to identify two or three relevant sources related to their topic – to complete, which they review and return to the students within two weeks; this provides a measure of formative assessment, although it is unclear whether this has an impact on the students’ final product or research process.

It seems, however, that librarians frequently squander this opportunity. If there is such a thing as a traditional or common model of library instruction, it would be a lecture on research strategies combined with a demonstration of relevant library resources and followed by hands on practice where students can work with their own research topic. This model favours efficiency over effectiveness; because librarians have limited opportunities with the students, the temptation to load the lecture with everything they may need to know – rather than presenting a useful model for solving problems of this nature – is great, and demonstrations are often little more than tours of a database's features. Students often leave feeling overwhelmed and ill-prepared to apply the strategies to their own research problem, which limits the overall effectiveness of the intervention.

**DESIGN CONCEPT**

In order to increase the effectiveness of the librarian-led intervention, we need to increase the learners' ability to transfer what they already know and what they can already do to novel settings (for example, from school to work) or novel problems in different or similar domains in the same setting (for example, when researching topics in English and biology). One way to do this may be to help students develop an effective mental model of the research process, one that is flexible enough to adapt to differing contexts – disciplines, requirements, or environments – while providing learners with a structure or framework to help them work through the complex and often frustrating research process.

Formed and validated over more than two decades of research, Kuhlthau's (2007) model of the Information Search Process (ISP) (see Figure 1) is a

holistic view of information seeking from the user's perspective in six stages: initiation, selection, exploration, formulation, collection and presentation. The six-stage model of the ISP incorporates three realms of experience: the affective (feelings), the cognitive (thoughts) and the physical (actions) common to each stage. (p. 34)

Figure 1. Model of the Information Search Process (Kuhlthau, 2007)

| Tasks                       | Initiation                   | Selection | Exploration                       | Formulation                   | Collection               | Presentation                   | Assessment               |
|-----------------------------|------------------------------|-----------|-----------------------------------|-------------------------------|--------------------------|--------------------------------|--------------------------|
| <b>Feelings (Affective)</b> | Uncertainty                  | Optimism  | Confusion<br>Frustration<br>Doubt | Clarity                       | Sense of direction/focus | Satisfaction or Disappointment | Sense of accomplishment  |
| <b>Thoughts (Cognitive)</b> | Vague                        |           |                                   | Focused                       | Increased interest       |                                | Increased self-awareness |
| <b>Actions (Physical)</b>   | Seeking relevant information |           |                                   | Seeking pertinent information | Documenting              |                                |                          |

Kuhlthau asserts that the formulation stage – the point at which the researcher achieves focus or a personal perspective on their topic – is a pivotal point in the research process. It is here that feelings of anxiety and doubt give way to clarity and direction, that thoughts become focused and interest in the topic increases, and that the researcher moves from seeking relevant information (exploring) to seeking pertinent information (documenting). But in my experience, this is the stage where most novice researchers end the process (or perhaps begin the process), which is one reason why the result of their efforts often falls far short of the instructor's expectations.

Research has established that for novice learners in domains with well-defined problems – such as mathematics, physics, and computer science – worked examples are effective in improving students' ability to transfer knowledge and skills to similar problems or settings (Atkinson, Derry, Renkl, and Wortham, 2000). Worked

examples begin with a problem statement, then show the steps necessary to solve the problem. They model an expert problem-solving process.

It is less clear that worked examples are equally effective in situations where there are many paths to a solution, or where learning is more process-oriented, although Van Gog, Pass, and Van Merriënboer (2004) postulate that supplementing the worked example with additional information that explains “how” and “why” can enhance understanding and improve transfer, as can having students “think aloud” or self-explain as they progress through the worked example.

The instructional design of worked examples can have a profound effect on transfer performance (Atkinson et al., 2000). Using multiple examples of the same problem, for example, can facilitate student learning (two examples are better than one), as can pairing worked examples with practice problems. Integrating aural explanations and using visual cues (such as a flashing icon) to direct learners' attention can encourage the learner to focus cognitive resources on understanding the problem.

This design uses two worked examples to illustrate Kuhlthau's model as applied by an experienced researcher. The worked examples are presented as animated videos, created using Adobe's Captivate software, which allows the integration of visual cues (“click this link next”) to direct the students' attention, audio to illustrate the researcher's thought processes (“thinking aloud”), and prompts to focus students' reflections and observations.

Using the animated video offers the learner an authentic glimpse into the researcher's experience and demonstrates the mechanics of searching and features of the database, allowing the librarian to focus on the more complex aspects of research, such as evaluating sources for authority, objectivity, and relevance, or selecting an appropriate database. Captivate, and other software like it, makes the creation of animated videos quite easy, and requires little post-production editing. They can be designed as stand-alone, re-usable resources, or create as highly customized examples, depending on the context. And the resulting videos can be easily mounted on a web site or within a learning management system, and can then be used to provide instructional experiences for students at a distance using either synchronous or asynchronous communication.

This design also uses reflective writing to aid learners in making a connection between the concepts and strategies illustrated in the worked example and those discussed by the librarian, and in the application of these concepts and strategies to their own research problem. In a study of undergraduate psychology students, Berthold, Nückles, and Renkl (2007) confirmed that reflective writing (“writing learning protocols”) in response to carefully designed prompts “strongly fostered learning outcomes” (p. 573) and improved understanding and retention.

### DESIGN SPECIFICATION

In the English 105 library seminar, the lecture and demonstration are replaced by two worked examples, presented as animated videos; in each video, the researcher works through a research topic similar to ones the students are working on (students are asked to make an argument for change in a community). The researcher talks aloud through her research, revealing her engagement with the tools and resources and the reasoning behind her choices, and demonstrating the mechanics of searching the research databases. The focus in these examples is on journal articles, although books are also acceptable sources.

Prior to showing the videos, the librarian introduces Kuhlthau's Information Search Process and provides students with a handout showing the model; this gives students a mental model of the research process to help them follow the examples.

During the viewing of the first worked example (see web site) – the topic is “B.C. should increase the minimum wage to \$10/hour” – the librarian pauses the video at strategic points to highlight aspects of the researcher's decisions and actions, and to link the researcher's thoughts, actions and feelings to Kuhlthau's model. At the end of the example, students are asked to reflect (in writing) upon what they learned about research from this example; they then have an opportunity to share their observations with a neighbor before participating in a class discussion. An example of a writing prompt at this point is, “What steps did the researcher take, and why? What in the researcher's experience illustrates, confirms, or conflicts with your own prior research experience?”

The second worked example focuses on the topic, “The City of Abbotsford should promote social justice within its community.” The process for viewing and explaining the video is the same as the first time, with one addition: students are encouraged to take their own notes linking the researcher's process to Kuhlthau's model, and given the opportunity to share their observations before the librarian adds hers. Once again, at the conclusion of the video students engage in reflective writing, this time with a focus on linking their observations from the first and second examples to how their perceptions of the research process may have changed as a result of this experience. A prompt at this point might be, “Which aspects of the researcher's process do you find interesting, useful, convincing, and which not?”

Finally, students are directed to find and document five sources relevant to their own research topic, with guidance and support from the librarian. As they document their sources, students are prompted to explain their choices and to reflect briefly on the effectiveness of their process. The librarian gathers the worksheets and review them, providing formative feedback and returning them to students within two weeks.

### ASSESSMENT

Formative assessment – assessment *for* learning – is built into the seminar at several points. Following each reflective writing exercise, students are invited to share their observations and conclusions, allowing the librarian to check for understanding and learning. The reflective writing exercises encourage students to make connections between the model to which they're being introduced, the examples they're viewing, and their own experiences. The librarian reviews the students' source-gathering worksheet, providing an additional opportunity to check for student learning and respond individually to each student. One final assessment takes place following the completion of the students' research essay – students are asked to complete a final, brief reflective piece focusing on what they learned about research from their research assignment, what they wished they could do more effectively, and what kind of support (library or other) they sought during the project. This is reviewed by the librarian and shared with the course instructor.

### CONCLUSION

It is my expectation that the introduction of a model for the research process, the use of the two worked examples, and students' reflections on and self-explanations of the research process will enable these learners better understand how experts approach this type of academic inquiry, to recognize the variety of resources available to them, and to make appropriate choices and decisions in using these resources. The greater their ability to articulate their own choices and the reasons behind them, the more sophisticated their mental model will become.

## WEB SITE

View the artifacts or learning objects for this project on the web:  
<http://www.transplantedgoose.net/gradstudies/educ890.shtml>

## REFERENCES

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