

# The Research Study

"I'm not really a natural teacher," a teacher-librarian<sup>1</sup> divulged in her pre-interview. Furthermore, she added that she had thankfully left the classroom to take on the more enjoyable responsibilities of planning, administrating, and integrating computerized technologies in the school library program. A few minutes later, she told us that she was an innovator with information technologies in the wider school system, and had worked with them and practiced enough that she instinctively knew how to teach the use of computer information literacy and technologies. It was this type of contradiction that had prompted our research. Undeniably intrigued, we utilized a Spencer Foundation grant to discover the what, how, and why of teacher-librarians' thinking, beliefs, and images; that is, their mental models, as delineated through their verbalizations and actions before, during, and after each of two lessons. The grant funded a study of six United States and four Australian teacher-librarians' espoused (before), in-action (during), and reflective (after) mental models while they were teaching two students individually how to use a computer information database resource.

The first task of the book is to detail our research study and the second task is to contextualize the book within the wider research study. As we elaborate further in this chapter, the purpose for this book is to demonstrate the ways and extent to which stimulated recall methods can inform our understandings of teaching with electronic computer databases and thereby prove a useful tool, not just for researchers, but also for teachers who want to discover more about their teaching and what their students were thinking. This would allow them to individualize further their teaching strategies and to troubleshoot problems with student misunderstandings. Our study occurred before we conceptualized this book.

The rationale for our research study was prudent on three major counts.

One substantial motive was the opportunity to weld our teaching and research strengths (see About the Authors) in order to examine the role mental models played in teacher-librarians' pedagogy, practice, and self-reflections when teaching computer database information literacy skills.

A second rationale was an analysis of the teaching of critical thinking skills for identifying information needs, locating information, and accessing, evaluating, synthesizing, and applying information to a problem that is a primary responsibility of the teacher-librarian in today's education environment. It has become an even more important role with the explosion of electronic computer resource tools as well as the incalculable quantity and dubious quality of much electronically accessed information. This responsibility is only beginning to receive the emphasis that it needs in teacher-librarian preparation programs in the United States because of previous dependency on the requirement in many states that teacher-librarians already had classroom teacher certification. Most programs assumed that teacher-librarians had acquired the skills to teach through their pre-service teacher education and classroom experiences. However, the elimination of the classroom teaching certification requirement in some states in the United States and an increasing diversity and availability of electronic information tools prompted the question of how prepared United States teacher-librarians were to teach students these skills. In Australia, to become a teacher-librarian involves a minimum of one year's further study beyond the baccalaureate<sup>2</sup> with an entry requirement of some years as a classroom teacher. Most are then employed for half their week as teacher-librarian and half as classroom teacher. Nevertheless, the same question of information literacy preparedness applied to Australian teacher-librarians.

Teacher-librarians benefit from the creation and maintenance of appropriate procedural and conceptual mental models for a range of information resources. Because mental models form as a result of the teachers' own learning and teaching experiences, they cannot simply transplant or transfer these to their students. Teacher-librarians ideally share their mental models to help students form their own conceptual mental models about the information tool, how it works, what information it contains, and how to apply their knowledge to troubleshoot technical problems. With a print resource, students could reasonably understand what it contained by visual inspection. With computer information resources, students depend on abstracts, help menus, and preliminary information plus their experiences with the resources to inform them about the content and how to search the tool. They cannot physically see the resource as a whole. Thus, it is much harder for them to grasp a conceptual under-

standing about the nature of the computer information tools and what skills they need to use it effectively.

Teacher-librarians often teach the process of using these information tools without helping students gain a conceptual understanding of the tool. Because of their press for time and the students' impatient "find the resource for me now" stance, teacher-librarians concentrate on providing the steps to retrieve a specific information product without explaining how or what is happening that enables the tool to retrieve that information (Rogers, 1992). Frequently, teacher-librarians do not think about the need to prepare the students conceptually (Dimitroff, 1992; Pitts, 1995). Some teacher-librarians assume that students will automatically learn how to search for information by watching their teachers demonstrate the steps to take in a once-off exercise. Although this strategy is sometimes appropriate, without accompanying and ongoing explanations about what is happening and why the steps are necessary, students will find they are not able to replicate or transfer their new skills to other searches (Duff, 1992; Seel, 1995). Knowing when, how, and why to provide conceptual understandings to help students gain independence in using the tool is critical for their troubleshooting abilities and future success. If the teacher-librarian stays satisfied with the procedural approach, the student's ability to transfer that brief learning to all but expressly similar situations is reasonably negated.

The third rationale or motivation for the research continues to be a steadfast commitment to our theoretical construct. Mental models are "representations of part of a real or imaginary world," created and utilized in short term memory and stored and retrieved from long-term memory (Garnham, 1987, p. 150; Garnham, 1992). From our literature review (see chapter 2), we understand that when we teach, we activate mental models of planning, teaching, and evaluating a lesson. Mental models therefore allow us to plan, conduct, critique, and troubleshoot past, current, and future situations. We use our mental models of the students' needs and skills as we prepare our lessons and choose the teaching strategies and activities. Our teaching methods are a combination of how we have been taught, what we have learned about teaching, and our actual teaching experiences. Thus, they are those that are most comfortable for us. Our mental models of our teaching methods would more likely define our pedagogy as a combination of those events rather than following a particular teaching pedagogy described in the curriculum texts.

The literature emphasizes the complexity of mental models and their many uses in various disciplines to identify how people think and respond to the situations presented to them. Mental models serve as belief systems that guide the actions of teachers and learners. In a sense, a men-

tal model has its own philosophy and rules that describe its features. The holder of the mental model chooses either to let the mental model control the situation or to manipulate the mental model to respond to the situation (Jih and Reeves, 1992; Senge, 1992; van der Henst, 1999). If the mental model is based on procedural understandings, its holder will not easily transfer it to new situations. If the mental model is based on conceptual understandings, the mental model is more difficult to manipulate but has more transferability to new and complex situations as conceptual understandings change and develop. If the mental model is based on both conceptual and procedural understandings, the holder has the opportunity to control, manipulate, and transfer the mental model to fit new and potentially unpredictable situations, making it a powerful tool for teachers and learners.

Unfortunately, mental models are frequently difficult to ascertain, especially during the actual teaching. To ask teacher-librarians to remember what they were thinking during a lesson will usually result in an explanation of what they intended to do or were trying to do, not what they were actually thinking. Explanations of an intention do not allow researchers to discern or understand the actual mental models underlying the intentions. Without that understanding, the teacher-librarian and researchers would have difficulty identifying the mental models with a high degree of accuracy and analyzing the role the mental models play in governing the teacher-librarians' responses to the teaching situation. That identification and analysis contribute to critical reflective evaluation about teaching. The benefits hopefully extend to a real change in the practice of teachers who typically revert to the ways they themselves were taught and behavior-managed. If teacher-librarians understand the role that their identified mental models play in why and how they teach the way they do, their ability to alter or adapt their strategies to various teaching situations should improve.

We had four major research objectives.

1. To identify and categorize the teacher-librarians' espoused (pre-lesson), in-action (lesson), and reflective (post-lesson) mental models from their interviews and lesson transcripts.
2. To analyze how the in-action mental models matched their espoused mental models and influenced their teaching methods and critical self-reflective mental models during and after each lesson.
3. To identify and analyze either if and how the teacher-librarians controlled and managed their mental models by letting their mental models evolve to fit the needs of the lesson or if and how their mental models controlled the way the lesson proceeded.
4. To ascertain if the teacher-librarians' voiced a commitment to change

strategies based on their critical self-reflection mental models and examine whether this did, or did not, occur in the next lesson and, if so, in what ways.

Based on these research objectives and our literature review, we theorized that our research would confirm mental model theory and some of its various functions and characteristics. We additionally theorized that our research would reveal more clearly than other published studies the multitude of mental models or fragments of mental models being utilized in parallel or in hypermedia mode during segments in the lessons. Another conjecture was that our research would reveal a new twist from examining the teacher-librarians over two lessons, in terms of the compatibility between (a) their espoused mental models and their in-action mental models and, particularly, (b) their critical self-reflection mental models and their in-action mental models in the second lesson.

Because critical self-reflection is lauded as a key for changing teacher practices (cf. Brookfield, 1995; Mezirow, 1990; Valli, 1992; Wear and Harris, 1994; Zeichner and Liston, 1996), we thought that the teacher-librarians' reflective mental models would have an impact on their espoused and in-action mental models in terms of their actions and practices before and during the second lesson. Conversely, the research that highlighted the difficulty people can have in changing their mental models led us to speculate as to whether the teacher-librarian's critical self-reflection about their lesson's performance and beliefs would be adequate to change self-identified inadequate mental models for the second lesson. We therefore hypothesized that our findings would offer important insights pertinent to the critical self-reflective research.

Our case studies (chapters 4 and 5) of two different teacher-librarians provide answers and explanations for these conjectures, as this was where mental model theory and application, theoretical methodological paradigms and tools, and data analysis interacted. Each chapter is a within-case study. Chapters 6 and 7 contain across-case analyses of the two teacher-librarians. Chapter 6 compares the role of stimulated recall across both cases for identifying the mental models and their changes from espoused to in-action and post-reflective mental models. Chapter 7 contains a cross-case comparison of the mental models themselves, resulting in an explanation of the mental model influences and how they affected the outcomes of the teaching-learning episodes.

## **METHODOLOGY**

We chose to use an empirical qualitative methodology to implement the research objectives of our study. We used a case study approach for ten

teacher-librarians, each with two students. The major theoretical construct is that of mental models (chapter 2), which we ascertained through utilizing information processing theory, the mediating processes paradigm, and introspective processing tools (chapter 3). Within this construct, our major research instrument was that of the stimulated recall interview, which provided the most useful and reliable tool to identify the teacher-librarians' and students' mental models at the time of the lesson. Chapter 3 clarifies how the study utilizes triangulation of data, interrater reliability checks, and other methods to strengthen the validity and reliability of the findings.

The ten teacher-librarians ranged in age from thirty to sixty. Their range of experience as classroom teachers and teacher-librarians was equally diverse. Some had years of experience in the classroom prior to taking up the responsibilities of the teacher-librarian. One had no experience or training as a classroom teacher, but was in her second year as a teacher-librarian. Others had several decades of experience as teacher-librarians. Some participants in Australia were half-time librarians with the other half of their school day spent teaching a content area subject, acting as lead teacher in their subject, or acting in a public relations role for the school. All were female and volunteers for the study. (Although one male teacher-librarian would have enjoyed participating, he was unavailable during the research period as he alternated his appointment between two rural schools, one of which he accessed via airplane.)

In the United States, there were seven male and five female students. In Australia, three male and five female students participated. The students ranged from Grade 4 to Grade 12. We ensured that we had a boy and girl in Grade 4 both in the United States and Australia. Except for one Grade 7 student in the United States, the other students were from Grade 8 through Grade 12. We obtained ethics clearance from both universities and from the schools, teachers, parents/guardians, and students. Appointments were made with each teacher-librarian to interview her and each of the two students prior to the teaching-learning sessions, at times convenient to them.

We chose the data collection tools carefully to accommodate our research objectives. For each participant, the data collection tools consisted of an audiotaped ten- to fifteen-minute pre-lesson open-ended structured interview, followed in sequence by (i) a videotaped fifteen- to thirty-minute lesson conducted in the library, (ii) an audiotaped twenty- to sixty-minute stimulated recall interview individually with the student and then the teacher-librarian, and (iii) an audiotaped ten- to forty-five-minute enhanced semi-structured open-ended post-interview (see chapter 3, particularly table 3.2). The longer times were with the teacher-librarians. At the end of the second lesson's sequence of interviews, the teacher-

librarians had the chance to report any final reflective comments about teaching computerized electronic database resources. This was an informal audiotaped interview of approximately ten minutes. The audiotapes and videotapes were transcribed as were our debriefing discussions after each day's data collection. The data collection tools and questionnaires were grounded in a pilot study with a teacher-librarian prior to the commencement of this study. The tools and questionnaires were also drawn from literature in the following areas: teacher-librarian professional literature, learning and teaching with computer databases and the cognitive science literature, as well as the information processing, mediating processes, stimulated recall literature, and mental model literature.

A major tenet for our research was the avoidance of the words or concept "mental model," during our research with the participants. In the consent forms and letters, our study referred to ascertaining what the participants were thinking or feeling before, during, and after the lessons. Cogently argued in the ethics applications, our rationale was influenced by two factors. The first rationale was the multitude of popular and academic definitions of a mental model (see chapter 2). Even if we had provided an example, the probability was high that the participants' conceptualization would have varied (see chapter 2) or not been the same as all other participants given the variance in age and experiences. The second rationale was commitment to minimize researcher bias and to maximize reliability of our data, particularly as stimulated recall is premised on these protocols. As demonstrated in the case study chapters, we accomplished this goal.

In response to the pre-lesson question probes, the teacher-librarians explained their role as teacher-librarians, their preferred ways of teaching and learning with electronic computer technologies, their in-service and conference participation, and their conceptual understanding of, and experience with, the computer database resources. The teacher-librarians were not asked for information about their knowledge of the two students they would be teaching and their students' information needs. The students were invited to tell us about their experiences with computers and databases, their understanding of a database, their computer skill level, and the availability of a computer in their home. Students were also asked if they liked learning computer skills by themselves, with the teacher, a friend, or a peer who knew more than they did.

Immediately following each of the open-ended, structured pre-lesson interviews, the teacher-librarian taught a lesson with one of the students individually. The researchers videotaped the session using two cameras feeding into a recording deck that combined the two signals into a split screen format. One camera aimed at the computer screen and hands on the keyboard while the other camera focused on the participants' faces.

The deck also recorded sound synchronized with the video. The researchers used additional audiotape recorders as backup.

All participants, although teaching and learning in their normal library environment and with their normal technologies, had cameras focused on their actions and conversation in addition to what was happening on the computer screen. The researchers also stayed behind them in the room as observers in order to monitor the equipment's operation but did not otherwise participate in the sessions. Three teacher-librarians professed nervousness about the research. The others, plus two of the previous three, claimed that they quickly focused on the student and the database and ignored the research paraphernalia and extra people. Interestingly, the students did not seem fazed by the equipment, possibly because we allowed them to play with the cameras beforehand.

The videotaped lessons differed in five ways from the normal one-on-one teaching-learning episodes that teacher-librarians experience in their daily teaching responsibilities.

1. For our study, the teacher-librarians asked teachers to suggest students who might want to participate in this research and learn about a technology information resource that would help with a current assignment. We wanted the research to have an authentic purpose. As it happened, one of the teacher-librarians whose case study is described in chapter 5 chose one student and asked the class teacher to choose another to participate in different authentic activities that the teacher-librarian identified as beneficial to each of them.
2. The teacher-librarians also had a better-than-usual opportunity to get to know the students in the time preceding the lessons and what the students thought their information needs were. A few took advantage of this opportunity. Others used the beginning of the interview to ask the student about his or her information needs and prior technology skills. In their jobs, most one-on-one lessons for teacher-librarians occurred spontaneously when a student asked for help in finding information.
3. The teacher-librarians also had a better-than-usual opportunity to refresh themselves with the electronic information tool(s) that they chose to teach. Because some of the teacher-librarians were novice users of the electronic resources they selected, some of them spent considerable time preparing for their teaching. Others allowed only a small amount of time, regardless of their experience with the resource.
4. Some of the teacher-librarians did not take advantage of the opportunity to talk with the classroom teachers about the students' authentic assignments. In the course of everyday events, teacher-

librarians, if they were not part of the classroom teachers' curriculum team, would not necessarily know about assignments that required students to search for information using computer resources.

5. Most of the teacher-librarians did not question the students to find out the students' information-seeking skills or technology strengths, or their interpretation of their information needs. Most of the time, it would be normal for teacher-librarians to find out about the student's skills at the start of lessons, if that were part of their teaching strategies.

Other unusual factors influencing each lesson included interviews with the researchers and students before the lessons, longer-than-normal periods of time allotted for each lesson, and, although some did occur (see chapter 3), fewer interruptions from other students or teachers who wanted help with immediate information needs. Additionally, there was the presence of the camera and recording equipment with the researchers observing out of direct sight of the participants, except for occasionally checking equipment operation.

So that the students could return to their normal class, the students were interviewed immediately after each lesson, followed by the teacher-librarian. Prompted by the replay of the video and the researcher's questions, the stimulated recall interview followed strict protocols (see chapter 3). The researchers' prompts invited the participants to tell us what they had actually been thinking during the course of the lesson. Through non-directive questions, such as "Can you tell us what you were thinking then?," we sought to have the teacher-librarian and student remember and relate their actual thoughts during the session, rather provide us with a justification or a rationale for their actions and comments.

This book is part of a series that examines how particular research methods and methodologies can inform our understandings. Therefore, chapter 3 details stimulated recall methodology's theoretical underpinnings, its strengths and weaknesses, its characteristics and protocols, and its particular usefulness for our study in comparison with other research methods of data collection, such as think-alouds and observations. We also outline in more depth the enhanced post-stimulated recall interview, which we define briefly in the following paragraph.

We attached the "enhanced" label to this interview because we included the repetition of most of the pre-lesson interview questions (in order to assess any change) in addition to the standard post-interview, and we asked participants about their recalled thoughts prompted by the previous stimulated recall questions and video replay. The enhanced post-stimulated recall interview was the time and place for the interview-

ers to ask about anything that struck them during the observation of the lesson or during the stimulated recall answers, allowing the teacher-librarian and student an opportunity to reflect on the events of the lesson. Question examples included why the teacher-librarian had asked a particular question or responded in the way she had; why the teacher-librarian had taught the way she did; what thoughts the students had about the way the teacher-librarian taught them; what each thought about the session, the electronic tool, and what they had learned; what the teacher-librarian thought her student had learned; and if there was anything that she would change. The entire process, minus the pre-lesson interview with the teacher-librarian, was repeated with the second student. Generally, the second lesson occurred between one to seven days later, except for four teacher librarians for whom it occurred on the same day, with two hours intervening between the first and second lesson.

The objective of the second lesson was to gauge whether and how the teacher-librarian might have changed mental models after reflecting on them during (a) the enhanced post-stimulated recall interview at the end of the first lesson and (b) the intervening period before the second lesson. We hoped to ascertain how the teacher-librarian responded to different students through planning, student learning needs, and tool use. Because the teacher-librarian had control over what computer database resource was to be used, the tool could be changed for the second student if she wished. Further, it was crucial to ascertain whether teacher-librarian reflections had prompted changes in mental models of the databases, students, assignments, and teaching strategies that would motivate her to modify plans for the second lesson, and whether an evaluation suggested improvements for the student for a certain item.

The computer tools used ranged from encyclopedia CD-ROM databases to automated university or public library catalog databases online to searching the Internet for particular resources. Five teacher-librarians used the same electronic database for both lessons, but two of these did not do anything different with that database, regardless of the students' prior experiences, use of the electronic resource, or the student's perceived need for the particular resource. In addition, three of these teacher-librarians did not inquire before, at the beginning of, or during the lesson if the student had previously used the resource. Another five teacher-librarians inquired of one student but not the other. Only two teacher-librarians inquired of both students. If they did and they discovered that the student already knew how to use the resource, three teacher-librarians still did not adjust their planned teaching agenda. For four teacher-librarians, the constraints of the videotaping equipment and the type of technology setups available constrained their ability to change to another resource because they had not pre-planned for such a possibility.

Two teacher-librarians were very inexperienced using electronic resources, much less teaching their use to students, although their libraries had computerized access points to electronic computer resources for student use. These two teacher-librarians practiced extensively with the resources for this research project. They voluntarily used the research project as a stimulus for learning a new computer resource and bravely taught one of their first lessons with the resource. Seven teacher-librarians knew their electronic resources quite well and the tenth teacher-librarian was considered an expert by her peers. With respect to the twenty student participants, seventeen students had not used the resource chosen by the teachers, although seven were knowledgeable computer users. Three students had used the resources before, with the teacher-librarian successfully extending the skills of one of the students. Unfortunately, the teacher-librarians did not expand the skills of two of these students, according to the students, nor did these students either have or take the opportunity to suggest the teacher-librarian change to a more useful resource.

There were a total of 140 transcripts involving the participants; eight for each teacher-librarian and three for each student (the video transcript played a dual role for teacher-librarian and student). Each set of teacher-librarian data files produced an average of 100 typed pages of transcripts. The transcripts included the participants' non-verbal and relevant computer sounds to align with each participant's voiced comments. The transcriber also noted pauses. This helped our memories and our decision-making about the significance of certain statements. When in doubt, we re-ran the video.

We began with the teacher-librarians' transcripts, specifically the eight files for each teacher-librarian. We coded one teacher-librarian's set of eight files together, identifying the mental models based on the literature and what emerged from the data. We discussed any differences of opinion until we reached a compromise. If a compromise proved impossible, we excluded that data. This was particularly important in the stimulated recall interview coding. We also excluded any recalled thoughts where we believed we had led the participant. For instance, instead of the neutral, "Can you remember what you had been thinking then, at that point in the lesson?" we asked, "What were you thinking? Was it to do with the student's comment?" We could not designate the teacher-librarian's answer to that type of question as an "in-action stimulated recall mental model" because we had inadvertently skewed the participant to think about the student's comment, which may not have been in their mind at that time. After coding the first set together, we coded and categorized the next ones individually, meeting regularly to compare results with the time span between meetings increasing as our inter-rater reliability

increased. We kept a percentage count of our discrepancies. By the end, we were consistently obtaining 95.4 percent or more compatibility.

Another strategy was the regular re-checking of previous categorizations of mental models to maximize reliability. The categorization of mental models was grounded in the literature (chapter 2); however, as clarified in chapters 4 and 5, we allowed the data for each transcript to establish the categorization for that transcript. Although we re-checked our categories among participants, it was never our intention that any new category or possible category would be made to fit previous categories.

The purpose of the pre-interview was to discover the participant's mental models that existed up to entry into the first lesson. The mental models identified from the pre-lesson interview transcripts we therefore categorized as the "espoused mental models" (cf. Strauss, 1993). They provided a comparative benchmark for the subsequent identification of mental models.

The videotaped lesson allowed identification of two types of in-action mental models. First, from the lesson's discourse we identified in-action (videoed) lesson mental models. We based these mental models on our interpretation of what participants said and did during the lesson. Second, the video replay and our question prompts were the triggers to stimulate the participants to recall what they had been actually thinking during a particular point in the lesson. Either the researcher or participant would stop the video to prompt or recall a thought, respectively. We also queried if the teacher-librarian or student had the thought during the lesson or only in hindsight, during the interview. We identified and categorized recalled introspective thoughts as particular "in-action stimulated recall mental models"; for instance, "self-concept" mental models (see chapter 5).

The purpose of the in-action (videoed) lesson mental models was to determine whether the espoused mental models were implemented in practice. The purpose of the in-action stimulated recall mental models was to ascertain if either or both the espoused and in-action (videoed) lesson mental models were those that the participants actually had in their heads as they progressed through the lesson or if there were a divergence. Indeed, we often found a discrepancy between the espoused and in-action (videoed) lesson mental models, and between both of these and the teacher-librarian's and student's actual thoughts at that point in the lesson; that is, their "real" or more accurate in-action mental models.

The purpose of the enhanced post-stimulated recall interview was to identify self-reflective mental models and to determine whether they referred to any other identified mental models or, instead, were new types. It allowed the participants the chance to reflect and, particularly for

the teacher-librarians, to self-evaluate their lesson and their thoughts. It provided the opportunity for the participants to ask questions and allowed the students and teacher-librarians to justify, elaborate, explain, and extend the thoughts they had recalled in the stimulated recall interview. A further and essential function was to establish, first, if the teacher-librarians committed themselves to changing their strategies or pedagogy that they had evaluated as needing to be changed and, second, if they actually made the changes in the second lesson. This last interview would help answer the question, "Did their mental models dominate their behavior or did they dominate their mental models to allow change to occur?" The enhanced post-interview allowed us to address our third and fourth research objectives.

The very last interview at the end of both lessons for the teacher-librarians permitted them the occasion to comment on the whole experience. We noted the areas and identified any mental models that they indicated as significant. Another function was to act as a culminating activity to provide a sense of closure to the research experience.

## RAISON D'ÊTRE AND STRUCTURE

A particular focus of this book is the identification of the teacher-librarians' mental models to help inform our understanding of the teaching role and espoused, in-action, and self-critical reflective practices of teacher-librarians (and other teachers). We acknowledge that the cause-effect combination of the teacher-student interactions would also offer insights to this goal. We, however, leave that to another book or articles. This book emphasizes the use of stimulated recall methodology to help researchers identify in-head mental models rather than resorting to the process-product paradigm that would have us using observable actions to conclude the participants' mental models. As we note in the case study chapters, in-head thoughts and observable actions conflicted often enough to throw doubt on the accuracy of the process-product paradigm as a useable research tool, particularly for the professional world of teaching.

In chapter 2, mental models provide the theoretical construct by which we developed questions to examine our data. There is a synergy between the use of stimulated recall as an introspection tool, which accesses and uncovers participants' mediating processes that occur in short-term memory (see figure 3.1), and mental models, which are created and manipulated in short-term memory and stored in long-term memory. We define mediating processes as the participants' thoughts about such things as their pedagogy, roles, beliefs, and attitudes—that is, their mental models.

An in-depth exploration of the worth of stimulated recall interviews to

the act of teaching demanded that it be given center stage or, more accurately, joint center stage with mental models. Chapter 3 therefore examines this research tool's theoretical and methodological underpinnings, its implementation, and its strengths and weaknesses.

In chapters 4 and 5, two teacher-librarians' within-case studies rather than the whole ten or an amalgam of the ten teacher-librarians individual cases are presented to provide a comprehensive examination allowing teachers and other researchers to obtain a holistic view. For convenience, we refer to the two teacher librarians as Anne and Marie. We used examples from the other eight cases where applicable in all chapters, but particularly in the two case study chapters. We chose these particular case studies for their representation of two teaching styles and lesson goals, and how these impacted the teacher-librarian's mental models. Within each case study chapter, we presented an extensive analysis of the teacher-librarian's mediating processes, how this translated into observable performance in a lesson, and how she critically self-evaluated her thoughts and actions.

We have organized the within-case study chapters in sequence to emphasize the relevance of order; that is, when during our phases of data collection the participants constructed their mental models. Thus the major sections are espoused mental models, in-action (videoed) lesson mental models, in-action stimulated recall mental models, and enhanced post-reflective (stimulated recall) mental models. We maintained a fairly complex protocol, discussing our analysis of mental models in each of the major sections as if we had no prior knowledge of the mental models in the forthcoming sections for the first lesson. The exception was the discussion of various mental models and the causality and impact of those mental models for the second student's lesson. We then allowed comparison with the first lesson's data and analysis. (This is re-clarified at the beginning of each case study.) Also, in the second case study, chapter 5, we compared and contrasted with the previous teacher-librarian's mental models and actions where relevant.

Chapter 6 provides a discussion of the role of stimulated recall in disclosing unobservable thoughts that impacted mental models in the two case studies. We employed an across-case study methodology to compare the teacher-librarians' mental models for patterns that emerged from the data, allowing insights into the mental models that were common or conflicting across all our instruments. The stimulated recall interviews confirmed various consistencies and highlighted surprising discrepancies between Anne's and Marie's individual espoused and in-action mental models. One of the roles of across-case studies is to present data in various ways to substantiate interpretations. We did so in this chapter and found that the accepted analogies of running mental models or fragments

of mental models in parallel or in hypermedia mode are perhaps incorrect. A more appropriate and powerful analogy is that we weave distinguishable fragments and complete mental models when running our mental models and that this has implications for working memory overload.

Chapter 7 highlights the comparison of mental models between the two teacher-librarians with flowcharts of how each participant's mental models interact to contribute to the overall teaching-learning lesson outcomes. A major emphasis in the chapter is the teacher-librarian's ability to control and to change or maintain mental models, and the consequences of these actions. Additionally, we summarize the value of stimulated recall methodology for identifying mental models in-action and offer implications from our work for pre-service teacher and teacher-librarian preparation programs as well as for in-service teacher development.

## CONCLUSION

This Spencer Foundation-funded research study was undertaken to explore the mental models influencing and contributing to a teacher-librarian's teaching when using electronic databases. Because so little attention has been paid to the importance of the teaching role for the teacher-librarian, individual teacher-librarians can decide how much or how little teaching they want to emphasize as part of their responsibility. Originally, we desired to explore the mental models that were the most influential in how, why, and what the teacher-librarians taught their students about using electronic computer databases. The study focused on these tools mindful of the increasingly vital importance such resources play in students' information literacy.

What the study also uncovered was the importance of using stimulated recall methodology in revealing in-action thoughts that at times contradicted what the researchers observed and the video cameras, recorded as the teaching took place. Preliminary insights and understandings about a teacher-librarian's mental models that were running during the teaching episode were changed based on the new information about their actual thinking. We were therefore enabled to identify more accurate mental models that the teacher-librarian was running, resulting in a deeper understanding of how the teacher-librarian taught and why she focused on what she did.

## NOTES

1. The term "teacher-librarian" is inclusive of library media specialists and school, college, university, and public or government librarians. It also can encom-

pass classroom teachers because they, too, are involved in teaching procedural and conceptual information literacy skills. Sometimes we use “teachers” to encompass teacher-librarians, lecturers, and instructors.

2. In Australia this is referred to as an undergraduate degree; e.g., Bachelor of Education.