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Mental models of teaching, learning, and assessment: A longitudinal study.

Thesis submitted by

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ABSTRACT

This doctoral thesis is a significant research project that contributes to complete gaps in the literature on mental models of middle years school students and their teachers. The research aimed to determine how a study of a teacher's and students' mental models can inform the educational community about effective pedagogy. The research questions included the identification of the participants' mental models before, during, and immediately after applied problem-solving in a robotics program. A more in-depth investigation exposed the teacher's and four of her students' mental models of teaching, learning, and assessment. Once these mental models had been established, the matches, mismatches, and/or changes over time of such mental models and the effect, if any, on teaching, learning, and assessment were examined. The investigation was designed to understand how the mental models of multiple participants were managed over an extended period of time.

This empirical qualitative study was centred within information processing theory and linked with the introspection mediating process tracing paradigm. The study involved close contact with the participants over an extended period of time. The methodology focussed on learner centredness and how the participants integrated new experiences with existing conceptual, declarative, and procedural knowledge in the areas of teaching, learning, and assessment. This was not a simple "input-output" focus, but rather an investigation that ascertained the mental models of the teacher and learners as they carried out pedagogical tasks. It made no fundamental assumptions about links between input, for example, the lesson, and action but utilised mental model theory to understand the participants' mental models.

The study used a technology-based learning context, robotics, although the findings could be applied across curriculum areas. It was situated in a suburban Australian school and involved one Year Six teacher and a group of 24 volunteer students from her shared class of 54 students. Four of these 24 students were selected anonymously from face-down piles of names and participated in the in-depth aspects of the study. Rigorous adherence to ethical procedures was maintained throughout the study.

Data collection tools used to identify the participants' mental models included Likert Scale Questionnaires, Semi-Structured Interviews (individual and shared), Stimulated Recall Interviews, Participants' Journals, a Teach-Back episode, a Focus

Group Interview, and the Researcher's Journal. The study's pre-experience investigations commenced in March 2005 and the post-experience phase occurred six months later in September, 2005.

The study found that specific teaching strategies are required to identify and redress ineffective mental models that inhibit the students' active participation in problem-based learning activities. Significant remediation was apparent for two of the participant students: one who failed to manage her mental models of problem-solving; one whose mental models of working with others inhibited her capacity to engage effectively in a social constructivist environment. Implications from these findings include a recommendation that teachers avoid making assumptions about students' ability to engage effectively either with discovery-based learning activities or with their peers without the relevant scaffolded instruction.

The study also determined that mental models are, in the main, stable over time. This finding is significant and has implications for remediation if the established mental model is inaccurate or incorrect and, therefore, limits application or communication of effective problem-solving efforts. The implication is for teachers to ensure that students are engaged in challenging learning experiences that enable the development, application, and communication of accurate and effective conceptual, declarative, and procedural knowledge. The reflective application of such knowledge enables students to create processes for and products of learning: robust, rich, and useful mental models.

This unique longitudinal study of mental models offers significant data to the educational community's constant quest for relevant information about productive pedagogical practice in the middle years of schooling.

TABLE OF CONTENTS

ABSTRACT.....	2
TABLE OF CONTENTS	4
LIST OF TABLES	9
LIST OF FIGURES	12
CHAPTER ONE: <i>Introduction</i>	14
Introduction	14
The Research Aims	14
Methology, Scope, and Limitations	15
<i>Methodology</i>	15
<i>Scope</i>	16
<i>Limitations</i>	15
Thesis Format	14
<i>Voice and Literacy Aspects</i>	15
<i>Document Format and Pseudonyms</i>	16
Chapter Outline	16
<i>Chapter One: Introduction</i>	16
<i>Chapter Two: Literature Review</i>	17
<i>Chapter Three: Methodology</i>	17
<i>Chapter Four: Pre-Experience Mental Models</i>	17
<i>Chapter Five: In-Action Mental Models</i>	18
<i>Chapter Six: Post-Experience Mental Models</i>	18
<i>Chapter Seven: Teach-Back and Focus Group</i>	18
<i>Chapter Eight: Longitudinal Mental Models (March 2006)</i>	18
<i>Chapter Nine: Longitudinal Mental Models (October 2006)</i>	19
<i>Chapter Ten: Conclusion</i>	19
And so the story starts . . .	19
CHAPTER TWO: <i>Literature Review</i>	20
Introduction	20
Mental Models	21
<i>The Journey to Find a Definition</i>	21
<i>How Mental Models Compare with Other Cognitive Structures</i>	22
The Nature of Mental Models	27
<i>A Question of Process and Product</i>	28
The Multiple Functions of Mental Models	29
<i>A Question of Unravelling Problems</i>	29
<i>Explanatory Function</i>	30
<i>Predictive Function</i>	31
<i>Control Function</i>	32
<i>Diagnostic Function</i>	33
<i>Communication Function</i>	34
<i>Memory Mechanism Function</i>	36
<i>Memory load.</i>	37
<i>Patterning.</i>	38
<i>Summary of the Multiple Functions of Mental Models</i>	38
Robotics and Mental Models	39
<i>A Problem-Based Learning Environment</i>	39
Assessment and Mental Models.....	42
<i>A Question of What and How to Measure</i>	42
Distributed Mental Models	46

<i>A Question of Sharing</i>	46
Novices and Experts.....	47
<i>A Question of How We Undertake a Journey of Learning</i>	47
Finding a Path through the Trees	49
<i>Where to From Here?</i>	49
CHAPTER THREE: Methodology	52
Introduction	52
Nature of Mental Models Research.....	52
Research Aim and Questions	56
<i>Research Aim</i>	56
<i>Research Questions</i>	56
Context of the Study.....	56
Robotics Laboratory.....	57
<i>Robotics</i>	58
<i>Participants</i>	59
<i>Teacher Participant</i>	60
<i>Student Participants</i>	60
<i>Ethics</i>	64
Data Collection.....	62
<i>Timeline of Collection</i>	62
<i>Tools of Collection</i>	67
<i>Likert Scale Questionnaire</i>	67
<i>Interviews</i>	68
<i>Semi-structured interviews</i>	68
<i>Longitudinal interviews</i>	71
<i>Stimulated recall interviews</i>	73
<i>Value of protocol change</i>	75
<i>Teach-Back and Teach-Back Interviews</i>	77
<i>Participant Journals</i>	80
<i>Students' journal</i>	80
<i>Teacher's journal</i>	82
<i>Researcher's journal</i>	82
<i>Focus Groups or Distributed Cognition</i>	83
<i>Coding</i>	86
<i>Maximising Validity and Reliability</i>	87
<i>Conclusion</i>	88
Chapter Four: Pre-Experience Mental Models	90
Introduction	90
Espoused Mental Models	90
<i>Conceptual Knowledge</i>	90
<i>Robots and Robotics</i>	90
<i>Robots and What They Do</i>	91
<i>Robotics – Programming and Intelligence</i>	96
<i>Robots Summary</i>	98
<i>Social Construction</i>	99
<i>A Shared Learning Environment</i>	99
<i>Predictions of Success and Assessment</i>	104
<i>An Assessed Learning Environment</i>	104
<i>Making Mistakes and Problem-Solving</i>	110
<i>Trying a New Formula</i>	110
<i>In Summary</i>	114

Chapter Five: <i>In-Action Mental Models</i>	116
Introduction	116
Stimulated Recall Methodology	117
Change of Protocol	120
<i>Quantity of Response</i>	121
<i>Quality of Response</i>	124
In-Action Mental Models	126
<i>Journals</i>	126
<i>Problem-Solving</i>	131
<i>Social Construction</i>	141
In Summary	147
Chapter Six: <i>Post-Experience Mental Models</i>	150
Introduction	150
Reflective Mental Models	150
<i>Conceptual Knowledge</i>	150
<i>Robots and Robotics</i>	150
<i>Teacher</i>	151
<i>Students</i>	153
<i>Robotics – Programming and Intelligence</i>	158
<i>Richness of the Robotic Environment</i>	161
Reflective Mental Models	162
Social Construction	162
<i>Assessment and Predictions of Success</i>	168
<i>Teacher</i>	169
<i>Students</i>	171
<i>Making Mistakes and Problem-Solving</i>	176
<i>Teacher</i>	177
<i>Students</i>	179
In Summary	185
Chapter Seven: <i>Teach-Back and Focus Group</i>	187
Introduction	187
Teach-Back	187
<i>Mental Models of Teaching and Learning</i>	188
<i>Preparation: Designing the Teaching Tasks</i>	188
<i>Teaching Robotics</i>	189
<i>Data Analysis</i>	191
<i>Teach-Back Episode</i>	191
<i>Mental Models of Teaching Strategies</i>	192
<i>Mental Models of Learning and Teaching Strategies</i>	195
Focus Group	197
<i>Mental Models of Assessment</i>	198
<i>Teacher’s Mental Models</i>	199
<i>Preparation: Designing the Assessment Tasks</i>	199
<i>Assessing Robotics</i>	200
<i>The Focus Group Interview: Another Journey into Unknown Territory!</i>	203
<i>Mental Models of Assessment Design</i>	206
<i>Types of assessment</i>	207
<i>How assessment results can be reported</i>	208
<i>How assessment can show what you have learned</i>	210
<i>Mental Models of Assessment Help</i>	213
<i>How much help is too much?</i>	214

<i>Is completing the whole task necessary?</i>	215
<i>Matches and Mismatches of Mental Models of Assessment</i>	217
Where To Now?	223
Chapter Eight: Longitudinal Mental Models (March 2006)	224
Introduction	224
A Longitudinal Study	224
<i>Mental Models of Teaching and Learning</i>	225
<i>Working in Groups of Two or More</i>	225
<i>Problem-Solving</i>	231
<i>Metacognition</i>	233
<i>Mental Models of Assessment</i>	236
<i>Types of Assessment</i>	237
<i>Timing of Assessment</i>	240
<i>Communication of Assessment</i>	243
<i>Mental Models: What Can We Learn?</i>	246
In Summary	250
Chapter Nine: Longitudinal Mental Models (October 2006)	252
Introduction	252
A Longitudinal Case Study.....	252
<i>Interview Methodology</i>	253
<i>Teaching and Learning with Robotics</i>	254
<i>Pedagogical practice. – teaching robotics.</i>	255
<i>Pedagogical practice – what can be learned?</i>	258
<i>Learning Through Problem-Solving</i>	261
<i>Assessment</i>	264
In Summary	269
Chapter Ten: Conclusion	271
Introduction	271
<i>Contribution to Research</i>	271
<i>Research Focus</i>	272
<i>Research Methodology</i>	273
<i>Limitations of the Research</i>	274
<i>Implications of Research</i>	275
<i>Pedagogical Implications: Teaching, Learning, and Assessment</i>	275
<i>Timeliness of intervention.</i>	275
<i>Intensity of intervention.</i>	276
<i>Intervention for social constructive collaboration.</i>	277
<i>Appraising mental models for problem-solving.</i>	277
<i>Communicating assessment strategies.</i>	278
<i>Multiple authors for multiple assessment strategies.</i>	278
<i>Proactive Strategies for Improved Learning and Problem-Solving</i>	279
In Closing	281
<i>And so the story goes</i>	282
REFERENCES	283
APPENDIX A	298
APPENDIX B	300
APPENDIX D	303
APPENDIX E	304
APPENDIX F	306
APPENDIX G	308
APPENDIX H	310

APPENDIX I	312
APPENDIX J	313
APPENDIX K	315
APPENDIX L	316
APPENDIX M	318
APPENDIX N	319
APPENDIX O	320
APPENDIX P	322
APPENDIX Q	324
APPENDIX R	326
APPENDIX S	327
APPENDIX T	328
APPENDIX U	329
APPENDIX V	330
APPENDIX W	332
APPENDIX X	334
APPENDIX Y	336
APPENDIX Z	337

LIST OF TABLES

Table 3.1: Synopsis of Activities from “Introducing Robotics” (QSA, 2003, p. 1)	61
Table 3.2: Detail of Data Collection Instruments Used in the Study	65
Table 3.3: Student Participants’ Involvement from March 2005 to October 2006	68
Table 3.4: Pre- and Post-Experience Likert Scale Questionnaire: Students (2005)	70
Table 3.5: Themes of Mental Models Addressed with Sample Questions in Semi- Structured Interviews with the Students	72
Table 3.6: Themes of Mental Models Addressed with Sample Questions in Semi- Structured Interviews with the Teacher	73
Table 3.7: Number and Percentage Change in Responses after Protocol Change	78
Table 3.8: Student Journal Entries	83
Table 4.1: Teacher’s mental models of students’ mental models of robots	94
Table 4.2: “What is a robot?”	95
Table 4.3: “What actions do robots do?”	95
Table 4.4: “How useful are robots?”	96
Table 4.5: Student responses to Pre-Experience Likert Scale question about robots	97
Table 4.6: Pre-experience semi-structured interview responses to questions about thinking and brain function of robots	100
Table 4.7: Student responses to the Likert Scale questions about social construction	103
Table 4.8: Semi-structured interview responses to group work	105
Table 4.9: Working with others	106
Table 4.10: Student responses to class journal sentence starter, “The things that I am most looking forward to in making my robot include. . .”	109
Table 4.11: Student responses to class journal sentence starter, “The things that I am most worried about when making my robot include. . .”	110
Table 4.12: Predictions of the forthcoming robotics activity	111
Table 4.13: Students’ general predictions of robotics	111
Table 4.14: Student responses about their forthcoming robotics activity	115
Table 4.15: Students’ strategies for correcting mistakes	115
Table 4.16: Students’ responses about where they would find help	117
Table 5.1: Segment of initial Stimulated Recall1 Interview with Pamela, 3 May 2005	121
Table 5.2: Segment of initial Stimulated Recall 2 Interview with Ellen, 15 July 2005	124

Table 5.3: Segments of Stimulated Recall Interviews with Sam, May and July 2005	128
Table 5.4: Pamela, Sam, and journal writing (14 July 2005)	132
Table 5.5: Ellen and Jayne and journal writing (15 July 2005)	133
Table 5.6: Ellen and Jayne predicting outcomes (15 July 2005)	134
Table 5.7: Ellen and Jayne problem-solving with sensors (15 July 2005)	136
Table 5.8: Ellen and Jayne refit the robot (15 July 2005)	137
Table 5.9: Pamela and Sam observe Sam's robot in a spin (14 July 2005)	139
Table 5.10: Pamela and Sam troubleshoot through the problem (14 July 2005)	142
Table 5.11: Ellen and Jayne at the computer (15 July 2005)	145
Table 5.12: Ellen and Jayne work together to program (15 July 2005)	146
Table 5.13: Ellen and Jayne share the computer (15 July 2005)	148
Table 6.1: Comparison of teacher's mental models of students' concepts of robots	155
Table 6.2: Student responses to question, "What is a robot?"	160
Table 6.3: Student responses about thinking ability and brain function of robots	163
Table 6.4: Student responses on the success of their experiences with robots	175
Table 6.5: Student responses about problem-solving effectiveness	184
Table 6.6: Student responses about solving problems	185
Table 6.7: Student responses about frustration felt when encountering problems	185
Table 6.8: Student responses about receiving guidance from the teacher	187
Table 7.1: Observed teaching methods. Students' reasons for selecting those methods and preferred learning style	196
Table 7.2: Assessment tasks designed by students and Pamela's predictions	204
Table 7.3: Thoughts and emotions during assessment	207
Table 7.4: Types of assessment	210
Table 7.5: Reporting on assessment	212
Table 7.6: Showing what you have learned (A)	214
Table 7.7: Showing what you have learned (B)	215
Table 7.8: How much help is too much?	217
Table 7.9: Is completion of the task essential for achievement?	219
Table 7.10: Student journal entries about assessment	220
Table 7.11: Participants' mental models of assessment from four data sources	222
Table 8.1: Student responses about working in groups	229
Table 8.2: Student responses about the quality of robots	232
Table 8.3: Student responses about the importance of problem-solving skills	235

Table 8.4: Student responses about what they had learned about themselves as learners
237-238

Table 8.5: Student responses about why showing what has been learned is a suitable
assessment strategy during **240**

Table 8.6: Student responses about whether completing a task means you have or have
not learned **241**

Table 8.7: Student responses to questions: What if you needed more time to finish the
assessment? Is it fair that students have different time limits for assessment?
Should everyone be at the same stage at the same time? **244**

Table 8.8: Student responses to question: Do you understand what the teacher is looking
for in an assessment item? **246**

Table 8.9: Student responses about what can they learn about themselves when
completing assessment tasks **250**

Table 9.1: Student responses to general questions about planning for research **256**

Table 9.2: Student responses to questions about teaching robotics **258**

Table 9.3: Ellen's responses to questions about what she had learned about herself **261**

Table 9.4: Bree's responses to questions about what she had learned about herself **262**

Table 9.5: Students' mental models of the importance of problem-solving skills **265**

Table 9.6: Students' mental models of assessment issues **268**

Table 9.7: Students' mental models as to how assessment can help learning **270**

LIST OF FIGURES

- Figure 3.1 Robotics laboratory showing three of six stand-alone computers (left, centre and right) **59**
- Figure 3.2. Data collection points and instruments used with participants in the study **66**
- Figure 4.1. Screen capture of pilot program from RoboLab™ illustrating iconic language used to program robot. Image ©2010 The LEGO Group. Used with permission **108**
- Figure 5.1 Change in number of useable responses from first Stimulated Recall episode (SR1) in May 2005 to the second Stimulated Recall episode (SR2) in July 2005 **125**
- Figure 5.2 Decrease in “no responses” from the first Stimulated Recall episode (SR1) in May 2005 to the second Stimulated Recall episode (SR2) in July 2005 **127**
- Figure 5.3 Sam’s journal entries for the robotic lesson held on 5 May 2005 **130**
- Figure 5.4 Sam’s journal entries for the robotic lesson held on 14 July 2005 **131**
- Figure 6.1. Comparison of responses to Item 17 on Pre- and Post-Likert Scale Questionnaire on the usefulness of robots **156**
- Figure 6.2 Example of robot [RCX] used in the activities associated with the study where wheels form the foundation of movement. Image ©2010 The LEGO Group. Used with permission **157**
- Figure 6.3 Comparison of responses to Item 6 on Pre- and Post-Likert Scale Questionnaire on the ability of robots to do more than one thing **158**
- Figure 6.4 Comparison of responses to Item 19 on Pre- and Post-Likert Scale Questionnaire on the usefulness of robots who can talk **159**
- Figure 6.5 Comparison of responses to Item 24 on Pre- and Post-Likert Scale Questionnaire about robots having brains similar to those of humans **162**
- Figure 6.6 Comparison of responses to Item 12 on Pre- and Post-Likert Scale Questionnaire about learning more when working in a group **167**
- Figure 6.7 Comparison of responses to Item 13 on Pre- and Post-Likert Scale Questionnaire about learning more when working in a group **170**
- Figure 6.8 Comparison of responses to Item 2 on Pre- and Post-Likert Scale Questionnaire about having the skills to make a robot **175**
- Figure 6.9 Comparison of responses to Item 11 on Pre- and Post-Likert Scale Questionnaire about the challenge of creating robots **177**

Figure 6.10 Comparison of responses to Item 14 on Pre- and Post-Likert Scale
Questionnaire about changes in the way the students look at robots **178**

Figure 6.11 Comparison of responses to Item 29 on Pre- and Post-Likert Scale
Questionnaire about learning more when given the opportunity to fix their own
mistakes **183**

Figure 7.1 Students engaged in Teach-back episodes, 2005 **193**