1999

Using a cognitive tool to support learning in interactive multimedia environments

Julie Gordon
University of Wollongong
NOTE

This online version of the thesis may have different page formatting and pagination from the paper copy held in the University of Wollongong Library.

UNIVERSITY OF WOLLONGONG

COPYRIGHT WARNING

You may print or download ONE copy of this document for the purpose of your own research or study. The University does not authorise you to copy, communicate or otherwise make available electronically to any other person any copyright material contained on this site. You are reminded of the following:

Copyright owners are entitled to take legal action against persons who infringe their copyright. A reproduction of material that is protected by copyright may be a copyright infringement. A court may impose penalties and award damages in relation to offences and infringements relating to copyright material. Higher penalties may apply, and higher damages may be awarded, for offences and infringements involving the conversion of material into digital or electronic form.
University of Wollongong

Faculty of Education

EdD Research Candidate:

Julie Gordon

Using

A Cognitive Tool

to Support Learning in

Interactive Multimedia Environments

A Dissertation

Presented in Partial Fulfillment of the Requirements for the Degree of Doctor of Education in the Faculty of Education in the University of Wollongong

1999
Using
A Cognitive Tool
to Support Learning in
Interactive Multimedia Environments

ABSTRACT

For learners, the organizing and planning process for structuring information is sometimes more important than developing knowledge itself. This idea, although not new, is continually gaining popularity as one of the basic principles of a social constructivist paradigm.

This research reports on an investigation into how learners can use genre templates as cognitive tools for the writing process. These technology-based tools helped learners produce more organized and structured texts, especially when the information was represented in multiple modes (video, audio, text and data). This study was based upon the contention that technology-based templates can enhance learning outcomes, especially for learners with poor metacognitive strategies. Using the technology tools provided as support in a complex information landscape, learners were more able to synthesise the data into meaningful knowledge and concepts. If learners are aware of their metacognitive processes when using interactive multimedia products they further understand the relevance of developing and refining metacognitive skills and strategies for learning.
ACKNOWLEDGMENTS

This project could never have been completed without the help and support from many different people. Heartfelt thanks go to my supervisors Associate Professor Barry Harper and Professor John Hedberg who have throughout my candidature offered unconditional supervision, leadership and support in the development and refinement of the education process.

To Barry Harper thank you for your hours of time, integrity, expertise, emotional, moral and professional development during this “tenacious” journey. “Reality Checking” and the ability to ground, yet empower the knowledge I have attained over the last five years, can only be attributed to your skills as an educator.

Thanks to John Hedberg for continued encouragement, the setting of high standards, before and during the study. Your suggestion to keep a journal at the beginning of this thesis helped to sustain a balance in the development of my cognitive and affective domains. Your words of wisdom will be with me forever as will the following quote from T. S. Eliot, that was instilled in me by you throughout the thesis,

We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time

(Little Gidding: Four Quartets, p.43).

If you think in seasons, plant cereals
If you think in decades, plant trees
If you think in centuries, educate your children
(Source Unknown).

I am also grateful to peers and colleagues at the University of Wollongong for their guidance in this study, thanks go to;

Dr Christine Brown for her tremendous in depth knowledge and perspective, as an adviser and reflective friend in this study. For her patience, integrity, genuine concern and willingness to discuss theories and issues at a moments notice. It is not often that you find someone who thinks along the same lines as you and has the ability to extend your horizons, thank you for your empowering professionalism, exemplary teaching style and pleasant nature.

Professor Tom Reeves for his time in reading and challenging this research as well as sending over resources from the United States. Mrs Deirdre Armstrong for her foresight and experience in teaching that I have drawn upon many times before and during this study and for her capacity as a mentor. Her comments have been a source of guidance throughout my academic career. This quote below from Deirdre represents only but one of many that I value,

Value others in order to value yourself

To Professor John Patterson thank you for your genuine concern and guidance with statistical methods, “Variance”. To Anne Porter for her valuable time and experience in helping me with the data analysis for the pilot research.
Dr Brian Ferry who throughout my whole Diploma in Education, Masters in Education and Doctoral candidature has always been there to express appropriate words of wisdom from the University of Life. For his having allowed myself to review his Master of Education thesis and Philosophy of Education thesis and in using these as a guide, one can only consider this an honor. I thank him for being a wise and trusted adviser.

Professor David Jonassen for his tremendous insight, honesty, time spent in reviewing this research through discussion and his application of academic skills in general. This research would not be as complete if it had not been for the previous work of David Jonassen which this study continually refers to.

Miss Lori Lockyer, thank you for your work on this research project as a research assistant and colleague. Lori always had time to offer her support not only as a technical assistant, but as a reviewer and as a fellow postgraduate. As a colleague with whom I could always depend on to discuss relevant issues that related closely to this research.

I would also like to thank my peers from the interactive multimedia Graduate Research and Input Location (GRAIL) research group for their ability to provide an environment that allowed questioning and an in depth discussion on current issues regarding research. Grant Farr, Matthew Fifield, Matthew Perry and Rob Wright for their technical assistance, programming advice and
communication skills. Thanks also to Peter Keeble for his time and effort in proofreading and editing this thesis.

To my family and friends thank you for always being there in times of need. To my parents Dawn and Terry Gordon for their continued support in providing a home to retreat to with many social, sporting and adventurous occasions that often led to a more balanced approach towards this dissertation. To my brother Greg Gordon for his respect, responsibility, financial assistance and good humor. To my sister Vicki Gordon for her patience, thoughtfulness and poems of encouragement. To my best friend Jackie Bawden for her lifelong friendship and many in depth discussions on issues regarding methodology.

To Tony Leeder-Smith for his devoted time and genuine concern in my health and well being. His words of wisdom throughout my candidature, continually became a source of inspiration,

Aim for the stars and you will land on the moon
You cannot improve if you remain in your comfort zone. If you remain in your comfort zone you will lose, this applies to anything in life that you do.

(Source Unknown).

Without his daily encouragement and objective viewpoint in maintaining a balance on life I would have been unhealthy, unfit and completely stressed at the end of this thesis. Finally thanks also to George Boulis for his unconditional love, support, patience, stamina and time spent editing and proof reading this research.
Declaration

This is to certify that the work presented in this thesis has not been submitted to any other University or Institution for the award of a degree

______________________________________________

Julie Gordon
TABLE OF CONTENTS

Table of Contents........................................................................................................1
List of Figures................................................................................................................5
List of Tables..................................................................................................................5
Chapter One – Learning with Technology-based Cognitive Tools........... 7
   Background to the Study................................................................. ................................9
      Multimedia and information.................................................................13
      Genre templates and cognitive tools....................................................14
      The experimental materials— Exploring the Nardoo........16
      Research questions...........................................................................20
Overview of the Methodology Used in this Study...................................21
   Variables and measures................................................................. ................................22
   Template use......................................................................................25
   Approaches to learning and cognition.........................................................27
   Definitions of terms and operational definitions........................36
Significance of the Study.........................................................................................38
   Limitations............................................................................................39
   Delimitations..........................................................................................39
Structure of the thesis...............................................................................................40
Chapter Two - Review of Literature.................................................................42
   Introduction.........................................................................................42
   A Review of the Research Context in the Literature..........................43
      Changes brought about by technology..................................................46
      Relevant theoretical models of learning and technology.....................49
      Jean Piaget.........................................................................................50
      Seymour Papert..................................................................................51
      Ausubel...............................................................................................52
Theories of Learning and Interactive Multimedia.................................54
   Principles and views currently held.........................................................56
   Environments......................................................................................62
   Summary of study support environments.............................................63
   Open ended learning environments.....................................................67
   Constructivist teaching and learning..................................................69
   Situated cognition..............................................................................77
   Context and situation.....................................................................78
   Scaffolding.........................................................................................79
   Metacognition...................................................................................84
Chapter Four - Data Analysis and Results

Descriptive Statistics

Approaches to Learning

Investigation of Hypotheses

Learning Outcomes

   Main effect with template
   Main effect with LPQ
   Interaction effects with LPQ and group
   Main effect with GEFT
   Interaction effects with GEFT and group

Style

   Main effect with template
   Main effect with LPQ
   Interaction effects with LPQ and group
   Main effect with GEFT
   Interaction effects with GEFT and group

Information Sources

   Main effect with template
   Main effect with LPQ
   Interaction effects with LPQ and group
   Main effect with GEFT
   Interaction effects with GEFT and group

Presentation

   Main effect with template
   Main effect with LPQ
   Interaction effects with LPQ and group
   Main effect with GEFT
   Interaction effects with GEFT and group

Quality of Argument

   Main effect with template
   Main effect with LPQ
   Interaction effects with LPQ
   Main effect with GEFT
   Interaction effect with GEFT and group

Investigation of the Questionnaire Data

Questions to Both Groups

Open-Ended Questions to Both Groups from the Post Treatment Student Questionnaire

Questions to the Experimental Group
Open-Ended Questions from the Experimental Group .................. 247
Results and Summary of the Questionnaire Data .................. 250
Teacher and Student Interviews ........................................ 253
Results and Summary of the Observation Data .................. 256
Results and Discussion of the Research Questions .................. 258
Chapter Five - Findings and Conclusions ................................. 262
Students' Use of the Genre Templates .................................. 262
Students' Understanding of the Genre Template as a Cognitive Tool .................................................. 263
Facilitating metacognitive skills and strategies .................. 266
Development of dynamic tools ............................................ 270
Recommendations for further research and future directions .................................................................................. 271
Bibliography ........................................................................ 273
Appendix A ........................................................................... 331
Instructions on the Use of Nardoo Given to All Students ........ 331
Exploring the Nardoo an overview .......................................... 331
Exploring the Nardoo curriculum statement .................. 333
Discussion Template Given to All Students in the Experimental Group .......................................................... 337
LIST OF FIGURES
Figure 1.1: An example of a genre template from the CD-ROM Exploring the Nardoo .................................................. 19
Figure 2.1: Constructivist pedagogical theories .............................. 71

LIST OF TABLES
Table 2.1: A comparison of constructivist views .................................. 66
Table 2.2: Summarises the learning style inventories based upon information processing preferences ........................................... 104
Table 3.1: Research questions with template use and data sources consisting of post treatment questionnaire, interviews, observations and statistical analyses ................................................... 154
Table 3.2: Template use with data sources and statistical analysis used .................................................................................. 155
Table 3.3: Teaching decisions and some LPQ profiles ............................. 172
Table 3.4: LPQ categories devised from LPQ data sources in the main study ............................................................................. 173
Table 3.5: Assessment protocol ............................................................ 187
Note to markers only. for section 4. quality of argument marking criteria see below .............................................................. 188
Note to markers only continued .......................................................... 189
Table 3.6: Data collection ...................................................................... 190
Table 4.1: Descriptive statistics for the independent variables with the treatment and non-treatment groups .................................. 197
Table 4.2: Frequency distribution and cell size for LPQ ............................ 199
Table 4.3: Frequency distribution and cell size for LPQ/Modified ............... 199
Table 4.4: Frequency distribution and cell size for GEFT ......................... 199
Table 4.5: A two factor analysis of variance of learning outcomes and template use .............................................................. 201
Table 4.6: A two factor analysis of variance of learning outcomes and LPQ .............................................................................. 203
Table 4.8 Unpaired t-test of interaction effects with zlearn and group ......... 205
Table 4.10: A two factor analysis of variance of style ............................... 208
Table 4.11: A two factor analysis of variance of style and LPQ .................. 209
Table 4.12: A two factor analysis of variance of style, LPQ and group ......... 210
Table 4.13: A two factor analysis of variance of GEFT and group ............. 211
Table 4.14: A two factor analysis of variance of information sources ...... 213