University of Pretoria etd – Haupt, M M C (2006)

A KIRKPATRICK EVALUATION OF COMPUTER-INTEGRATED LEARNING SUPPORT MATERIAL FOR TECHNOLOGY EDUCATION

A dissertation of limited scope by
Maria M.C. Haupt

submitted as partial fulfilment for the requirements of the degree
MEd (CIE)

in the
Department of Curriculum Studies
of the
Faculty of Education
at the
University of Pretoria

Supervisor
Prof A.S. Blignaut

November 2005

Acknowledgements

I wish to specially thank:

- My family for unwavering support and understanding during the many hours I dedicated to achieving this milestone in my life and career.
- Prof Seugnet Blignaut for her commitment and dedication.
- Prof Johannes Cronjé for initiating this research.

I wish to thank my God for strength, drive and ability.

Abstract

A Kirkpatrick evaluation of computer-integrated learning support material for technology education

a dissertation of limited scope by
M.M.C. Haupt
Degree: MEd (CIE)
Department: Curriculum Studies
Supervisor: Prof A.S. Blignaut
November 2005

The aim of this research is to establish which aspects influence students' successful learning of design skills through contextually integrated learning support material for the design and technology education programme at the University of Pretoria. The purpose of the research is threefold:

- The first aim is to investigate the extent to which the electronic tutorial, *Design in Action*[1] (hereafter referred to as "the tutorial") contributes to students' (novice designers) design theory in a technological context i.e. to indicate whether the level of sophistication of the exemplary graphics and explanatory text is suited to the context.
- The second aim is to establish the levels of learning achieved by learners as a result of the intervention using *Design in Action* in order to indicate the adequacy of the learning support material in achieving the learning outcomes of the unit.
- The third aim is to establish possible improvements for the tutorial to increase its effectiveness in terms of curriculum, media & technology, learning & instruction and teacher education & didactics (Van den Akker, 1999).

The findings of this preliminary study will be used in broader studies focused on the design and development of contextually integrated learning support material for design and technology education students.

This research is a qualitative case study, including the evaluation of levels of learning of first year pre-service design and technology students, conducted in the interpretative paradigm, within the theoretical frame of socially responsible research (Reeves, 2000).
The evaluation of the levels of learning was based on a model designed by Kirkpatrick (Kirkpatrick, 1994). The model delineates four levels of instruction (training) outcomes: reaction, learning, behaviour, and results.

[1] *Design in Action* is an electronic self-study guide designed as contextually integrated learning support material for first year technology education students at the University of Pretoria.

Keywords

Aesthetics	One of the design aspects to be considered in the design of products, which is also considered as the universal visual language providing the necessary rules for synthesizing the basic carriers of meaning (Parr, 2004).
Design	The concept "design" was taken from the definition of the "act of designing" as part of the design process as prescribed for grade 9 in the RNCS (Department of Education, 2002, p.37)
Design aspects	It is generally accepted in design studies that the concept "design aspects" refers to the functionality, aesthetics, ergonomics and value of man-made products (Department of Education, 2002; Garratt, 1996; Press & Cooper, 2002).
Design elements	"Elements" refers to aesthetic design elements, e.g. shape, line, texture, colour/tonal value, illusion of movement (Lauer, 1985).
Design principles	"Principles" refers to aesthetic design principles, e.g. unity, emphasis, balance, proportion, rhythm, illusion of space (Lauer, 1985).
Design process	"Process" refers to the model prescribed by the RNCS (Department of Education, 2002) of which the steps are: investigating, designing, making, evaluating and communicating.
Drawing	The act of "drawing" is an important part of the "designing" and "communicating" steps of the design process (Department of Education, 2002) and seen as a tool to develop "designerly thought" in design and technology students (Garner, 1993).
Levels of learning	"Levels" refers to Kirkpatrick's (1994) model of four levels of learning that should be evaluated in order to establish the effectiveness of instruction, namely reaction, learning, transfer/behaviour and results.
Technology education	The learning area "Technology Education" is a relatively new one and was incorporated in the band of general education of schools in 1997, when it also became part of teacher training at the University of Pretoria.
Utility judgements	Students' individual and subjective perceptions of the usefulness of instruction and instructional material (Alliger, *et al*, 1997).

Abbreviations

CAL	Computer assisted learning
CIL	Computer integrated learning
DoE	Department of Education
ICT	Information and communications technologies
OBE	Outcomes based education
RNCS	Revised National Curriculum Statement
WWW	World Wide Web

Table of Contents

Acknowledgements ii
Abstract iii
Keywords iv
Abbreviations v
List of tables vii
List of figures viii
List of chapters x

List of tables

2.1	Standard visual language ……..	29
3.1	Adaptation of Alliger's augmented version of Kirkpatrick's model for evaluation …….	45
3.2	Questions in the questionnaire evaluating reaction …….....	47
3.3	Questions in the semi-structured interviews generating data about reaction ...……	49
3.4	The exercise: learning assessed immediately after training in questions relating to visual analysis …….....	50
3.5	The test: learning assessed after a period of time revealed in questions relating to visual analysis as well as in drawings …….....	51
3.6	Problem statements posed to students in the project ……...	52
3.7	Problem statements posed to students in the end-of-year examination …….....	53
3.8	Checklist for procedure followed in measuring reaction ……...	54
3.9	Checklist for procedure followed in measuring learning ……...	56
3.10	Checklist for procedure followed in measuring transfer/behaviour …….	57
3.11	Data generating strategies implemented in the levels of evaluation of the tutorial ….	62
3.12	Coding system for analysing reaction, content of questionnaire and semi-structured interview …….....	63
3.13	Coding system for analysing learning after a period of time in questions relating to drawing …….....	66
3.14	Coding system for analysing immediate retention in the questions relating to visual analysis …….	67
4.1	Summary of participants' conceptual understanding of all the constructs in the exercise ……	87
5.1	Interpretation of the data …….....	123
5.2	Role of the tutorial in the realisation of the module's outcomes ……..	125
5.3	Useful solutions for improving the tutorial suggested by the data …….....	126

List of figures

1.1	A model of the design process as prescribed by the Revised National Curriculum Statement Grades R-9	2
1.2	Structure for the module JOT120	7
1.3	Kirkpatrick's model of the levels of learning	8
1.4	Structure and sequence of the tutorial *Design in Action*	13
1.5	Screen shot of the style of presentation in the tutorial	14
1.6	Screen shot of the style of presentation in the tutorial	14
1.7	Example of the definition screens	15
1.8	Example of an instructional screen	15
1.9	Example of a question screen in the exercise	16
1.10	Example of a screen with a link to the Internet	17
3.1	The research plan	41
3.2	Theoretical framework of the research	43
3.3	Data capturing for research question 1 (evaluating level 1 – reaction)	59
3.4	Data capturing for research question 2 (evaluating level 2 – learning)	60
3.5	Data capturing for research question 3 (evaluating level 3 – behaviour)	61
3.6	Analysing data for Research Question 1 (evaluating Level 1 – Reaction)	65
3.7	Analysing data for research question 2 (evaluating level 2 – knowledge)	68
3.8	Analysing data for research question 3 (evaluating level 3– behaviour)	69
4.1	Participant 9's schema the design principle "unity"	95
4.2	Image in tutorial illustrating the design principle "unity without variation"	95
4.3	Participant 14's schema of the design principle "unity"	95
4.4	Image in the tutorial depicting the design principle "unity" (with emphasis on unity)	95
4.5	Participant 21's schema of the design principle "unity with variation"	96
4.6	Image in tutorial illustrating the design principle "unity without variation"	96
4.7	Participant 9's schema of the design principle "asymmetrical balance"	96
4.8	Image on the tutorial of the tutorial illustrating asymmetrical balance	96
4.9	Participant 14's schema of the design principle "asymmetrical balance"	96
4.10	Participant 21's schema of the design principle "asymmetrical balance"	97
4.11	Participant 9's schema of the design element "visual texture"	98
4.12	Image on the tutorial depicting the design element "visual texture"	98
4.13	Participant 21's schema of the design element "visual texture"	99
4.14	Participant 14's schema of the design element "visual texture"	99
4.15	Image on the tutorial illustrating the design element "tactile texture"	99
4.16	Participant 9's representational drawing in the design phase of the project	102
4.17	Participant 14's representational drawing in the design phase of the project	103

4.18 Participant 21's representational drawing in the design phase of the project …….. 104
4.19 Participant 14's exploratory drawing in the end of year examination ……. 106
4.20 Participant 9's exploratory drawing in the end of year examination …….. 107
4.21 Participant 21's exploratory drawing in the end of year examination ……. 108
4.22 Segments of patterns, families and categories …….. 113

List of chapters

Chapter 1	**Introduction**	**1**
	.....	
1.1	Conceptualising the study	1
1.2	Deriving the research topic from preliminary reading	1
1.3	The module	4
1.3.1	The approach	4
1.3.2	Aim and focus of the module	5
1.3.3	The structure of the module	6
1.3.4	The learning outcomes	7
1.3.5	Evaluation and assessment	8
1.4	The tutorial	9
1.4.1	Introduction	9
1.4.2	Conceptualisation	9
1.4.3	Analysis	9
1.4.3.1	The target group	10
1.4.3.2	Content	10
1.4.3.3	Strategy for instruction	10
1.4.3.4	Delivery options	10
1.4.3.5	Timeline for completion of the tutorial	10
1.4.3.6	Constraints	11
1.4.4	Design	11
1.4.4.1	The platform	11
1.4.4.2	Access	12
1.4.4.3	Programming	12
1.4.4.4	Storyboarding	13
1.4.4.5	Screen layout	14
1.4.4.6	Organisation	14
1.4.4.7	User interface	16
1.4.4.8	User control	16
1.4.4.9	Collecting needed materials	17
1.4.5	Development	17
1.4.5.1	Selecting activities	17
1.4.5.2	Selecting the delivery system	18
1.4.5.3	Conducting individual trials	19
1.4.5.4	Revising instruction	19
1.4.5.5	Repeating individual trials	19
1.4.5.6	Synthesised into integrated learning programme	19

1.4.6 Implementation 19
1.4.6.1 Training of facilitators 20
1.4.6.2 Preparation of the students 20
1.4.6.3 Placing all tools 20
1.4.7 Evaluation 20
1.5 Articulating the research problem 21
1.6 Research design and methodology 21
1.7 Outline of the remainder of the dissertation 21

Chapter 2 Literature survey 23
2.1 Introduction 23
2.1.1 Category 1: Levels of learning 23
2.1.2 Category 2: Design studies 23
2.1.3 Category 3: CAL in design and technology education programmes 24
2.2 Discussion of the literature survey 24
2.2.1 Category 1: Levels of learning 24
2.2.1.1 Level 1: Reaction 25
2.2.1.2 Level 2: Learning 25
2.2.1.3 Level 3: Behaviour 26
2.2.1.4 Level 4: Results 26
2.2.2 Category 2: Design studies 26
2.2.2.1 The concept “design” 27
2.2.2.2 Aesthetics and drawing in design activities 27
2.2.2.3 Universal visual language 28
2.2.2.4 Drawing in design and technology education programmes 29
2.2.2.5 Drawing as a cognitive tool 30
2.2.3 Category 3: CAL in design and technology education 31
2.2.3.1 A strategy for teaching and learning drawing in technology education 32
2.2.3.2 The use of CAL in technology education 35
2.2.3.3 Suitability of Microsoft PowerPoint™ as platform for a tutorial 35
2.2.3.4 Tutorials 36
2.3 Overview of the literature relating to the theoretical underpinnings of this study 36

Chapter 3 Research methodology 38
3.1 Introduction 38
3.2 Methodology 39
3.3 Theoretical framework 41
3.4 Population and sampling methods 45
3.5 Data generating strategies 46

3.5.1 Level 1: Reaction 47
3.5.1.1 The questionnaire 47
3.5.1.2 The semi-structured interviews 48
3.5.2 Level 2: Learning 49
3.5.2.1 The exercise 50
3.5.2.2 The sequential test 51
3.5.3 Level 3: Behaviour 51
3.5.3.1 The project 51
3.5.3.2 The examination 52
3.6 Implementation of data generating strategies 53
3.6.1 Level 1: Reaction 54
3.6.1.1 The questionnaire 54
3.6.1.2 The semi-structured interviews 55
3.6.2 Level 2: Learning 55
3.6.2.1 The exercise 56
3.6.2.2 The sequential test 56
3.6.3 Level 3: Behaviour 56
3.6.3.1 The project 57
3.6.3.2 The examination 58
3.7 Capturing the data 58
3.8 Data analysis 61
3.8.1 Level 1: Reaction 62
3.8.1.1 The questionnaire 62
3.8.1.2 The semi-structured interviews 63
3.8.2 Level 2: Learning 64
3.8.2.1 Drawing 64
3.8.2.2 Visual analysis 66
3.8.3 Level 3: Behaviour 69
3.9 Validity and reliability 69
3.10 Limitations of the methodology followed in this study 70

Chapter 4 Findings 74
4.1 Introduction 74
4.2 Research question 1: What are the implications of the participants' reaction to the tutorial with regard to the possible improvement thereof? 74
4.2.1 Data collection for research question 1 75
4.2.2 Level 1: Reaction 75
4.2.3 Discussion 76
4.2.3.1 Sub-question 1: Were the participants satisfied/dissatisfied with the tutorial? 76
4.2.3.2 Sub-question 2: What was the perceived usefulness of the tutorial? 78

4.2.3.3	Sub-question 3: About what in the tutorial were the participants dissatisfied?	80
4.2.4	Conclusion ……	82
4.3	Research question 2: What are the implications of the participants' retention of knowledge towards possible improvements of the tutorial?	83
4.3.1	Data collection for research question 2 …….....	83
4.3.2	Level 2: Learning ……	84
4.3.3	Discussion ……	84
4.3.3.1	Sub-question 1: What knowledge was retained immediately after exposure tot the tutorial? ……...	84
4.3.3.2	Sub-question 2: What knowledge was retained after a period of time? …….	88
4.3.4	Conclusion ……	100
4.4	Research question 3: What are the implications of participants' behaviour/transfer for possible improvement of the tutorial? ……...	100
4.4.1	Data collection for research question 3 ……	100
4.4.2	Level 3: Behaviour/transfer ……...	101
4.4.3	Discussion ……	101
4.4.3.1	Sub-question 1: How was knowledge transferred to participants/ projects? ….	101
4.4.3.2	Sub-question 2: Was the changed behaviour sustained? ……..……..	105
4.4.4	Conclusion ……..……	109
4.5	Conclusions and recommendations ……	109
4.5.1	Research question 1: What are the implications of the participants' reaction to the tutorial for the possible improvements thereof? ……...	109
4.5.2	Research question 2: What are the implications of participants' retention of knowledge for possible improvements of the tutorial? ……..….	110
4.5.3	Research question 3: What are the implications of participants' behaviour/transfer for possible improvement of the tutorial? ……..……..	111
Chapter 5	**Conclusions and recommendations ……..……**	**114**
5.1	Introduction ……..……..	114
5.1.1	The findings ……..……..	114
5.1.1.1	Level 1: Reactions ……..….	114
5.1.1.2	Level 2: Learning ……..….	114
5.1.1.3	Level 3: Transfer ……..……	115
5.1.2	Research methodology ……..….	115
5.1.2.1	Qualitative nature of the research ……..….	115
5.1.2.2	Development research …….....	115
5.1.2.3	Kirkpatrick's model for evaluating learning ……..	116
5.2	Relation of the findings to the literature and theory …….....	116
5.2.1	Computer assisted learning theories and the findings of the study ……..….	116
5.2.1.1	CAL in technology education ……..….	116

5.2.1.2 Suitability of Microsoft PowerPoint™ as platform 117
5.2.1.3 Tutorials 118
5.2.2 Levels of learning 118
5.2.2.1 Level 1: Reaction 118
5.2.2.2 Level 2: Learning 119
5.2.2.3 Level 3: Behaviour 119
5.2.3 Design studies 120
5.2.3.1 Drawing as a cognitive tool 120
5.3 The research methodology and its impact on the study 122
5.3.1 The nature of the study 122
5.3.2 The aims of social responsible development research 123
5.4 Limitations of the study 127
5.4.1 Disadvantages of qualitative research 127
5.4.2 Researchers effect 127
5.4.3 Difficulties in the research 128
5.4.4 Future research 128

References 129

Addenda 132