

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

LEARNING APPROACHES AND STUDY PATTERNS OF DISTANCE EDUCATION STUDENTS IN MATHEMATICS

**Glenda Joy Anthony
1991**

LEARNING APPROACHES AND STUDY PATTERNS
OF DISTANCE EDUCATION STUDENTS IN MATHEMATICS

A thesis presented in partial fulfilment
of the requirements

for the degree
of MPhil
in Mathematics Education at

MASSEY UNIVERSITY

Glenda Joy Anthony
1991

ABSTRACT

Teaching is an activity that assumes an understanding of learning: to teach in a way that encourages changes in conceptions and develops understanding, one must be aware of how students learn. This research examines and analyzes the learning processes used by extramural students studying mathematics. Findings indicate students exhibit learning approaches that can be classified into Surface, Deep and Achieving approaches. Each approach produces qualitatively different outcomes both in performance and in affective outcomes. The role of worked examples was found to be very important in the learning process: the purpose and manner in which the example was studied differed depending on the learning approach employed. Metacognitive behaviour is seen to be an important mediating factor in determining the individual effectiveness of an approach to a specific learning situation. In particular the monitoring of one's understanding is a significant factor in the value of self explanations and construction of understanding by the student. There is also evidence that students' perception of learning mathematics and assessment affects the approach to learning.

ACKNOWLEDGEMENTS

I wish to express my appreciation for the guidance and inspiration provided by Associate Professor Gordon Knight. His supportive comments and encouragement have been a great motivation to complete this research.

I also wish to acknowledge with gratitude the support and encouragement Dr Gillian Thornley has provided. Her example as a mathematician and her encouragement were instrumental in my furthering studies in mathematics education.

I also thank Dr Gillian Thornley and Dr Mike Hendy, in their role as course controllers for 60.102: their cooperation has enabled this research to be undertaken. A special thanks also to the many extramural students of 60.102 who took the time to complete questionnaires, provided helpful feedback and discussed at length their learning approaches and experiences as an extramural student. I hope by raising students' awareness of the "process of learning" in mathematics there is some mutual benefit to myself and the respondents.

CONTENTS

ABSTRACT	ii
ACKNOWLEDGEMENTS	iii
1 INTRODUCTION	
1.1 Background	1
1.2 The Specific Problem	2
1.3 The Research Objective	3
1.4 Relevance of the Objective to Education	4
2 LITERATURE REVIEW	
2.1 Introduction	6
2.2 Developments in Cognitive Psychology	7
Introduction	7
Constructivism	8
Knowledge Dependent Learning	10
Metacognition	11
2.3 Biggs' Model of Learning	13
2.4 Approaches to Learning	15
Types of Approaches	15
Approaches used by Tertiary Students	17
Factors Affecting Approaches	21
2.5 Use of Worked Examples and Exercises	25
2.6 Summary	32
3 THE RESEARCH PROCESS	
3.1 The Research Method	33
3.2 Justification for the choice of Methodology	37

4	STUDY PATTERNS - RESULTS Part 1	42
4.1	Introduction	42
4.2	Study Patterns Diary	43
4.3	Time Spent on Section 4	43
4.4	Study Patterns	46
4.5	Examples as a Source of Learning	48
4.6	Role of Assessment Material	56
4.7	Summary	59
5	LEARNING APPROACHES - RESULTS Part 2	61
5.1	Study Process Questionnaire	61
5.2	Scoring the Study Process Questionnaire	63
5.3	Interpreting the Study Process Questionnaire	64
	Distribution of Scores	
5.4	Approach Scores and Outcome	68
5.5	Presage Factors Affecting Learning Approaches	73
	Motivation	73
	Plans for further education	75
	Time	76
	Age	77
	Prior knowledge	79
	Student perception of course organization	80
	and assessment	
	Student perception of learning mathematics	84
5.6	Student Profiles of Approaches to Learning	90
	Surface Approach	90
	Deep Approach	93
	Achieving Approach	96
	Deep Achieving Approach	98
5.7	Metacognitive Behaviour	101
	Examples of metacognitive behaviour	102
	Levels of metacognitive behaviour	107
5.8	Summary	109

6	CONCLUSIONS	110
6.1	Approaches to Learning	110
6.2	Metacognitive Behaviour	112
6.3	Prior Knowledge	114
6.4	Student use of Textual Material	115
6.5	The Context of Learning	116
7	RECOMMENDATIONS FOR FURTHER RESEARCH	119
8	BIBLIOGRAPHY	122
9	APPENDICES	128
1	Study Patterns Diary (SPD)	128
2	Questionnaire	129
3	Study Patterns Questionnaire (SPQ)	130
4	Interview Questions	134
5	Raw SPQ Scores	135
6	Decile scaled SPQ Scores/Categories	136
7	Chi Square Analysis for Biggs' science versus respondents' Deep Approach scores.	137
8	Comparison of mean Approach Scores of Science and Mathematics.	138
9	Correlation of Strategy/Motive Scores	139

1 INTRODUCTION

1.1 BACKGROUND

Distance education in mathematics at Massey University was first established in the 1960's. Despite the rapid growth in the last 30 years, both in New Zealand and worldwide, relatively few publications or research projects relate to distance education in mathematics.

In the past much of the research in higher education has used an input/output model. Input variables such as instructional design or teaching method have either been observed or systematically varied and have been linked to output variables such as grades or withdrawal rates.

Much less attention has been given to the intermediate step of process: of how the students learn, on ways in which students approach their study tasks, and also on the learning styles they commonly employ. (Kember and Harper, 1987)

Research needs to focus now not on general mechanisms of learning but on learning of specific subject matter in its natural context. (Ramsden, 1988) In particular research concerning the process of learning as an extramural student rather than the content of distance education courses is needed to ensure the provision of the best possible service to students. (Knight, et al. 1990)

Teaching is an activity that assumes an understanding of learning: to teach in a way that encourages changes in conceptions and develops understanding, one must be aware of how students learn.

1.2 THE SPECIFIC PROBLEM

Entwistle and Ramsden (1983) expressed the view that too little attention had been given to the process of learning and the effects of teaching on it.

"Lecturers tend to think that the context of student learning is not of great importance; they attribute success or failure to the characteristics of the student, not to their teaching. As a consequence we know remarkably little about the effects of lecturers' teaching, assessment, and course organization on student learning."

The context of mathematics distance education learning is quite different to that of the full time tertiary student. Teaching is done largely through textual material, consisting of purpose written material in the form of Study Guides, text-books and regular assignments.

For example the subjects of this research are studying 60.102 Linear Algebra and Geometry, which is based on a purpose written text Geometry and Linear Algebra (Thornley and Hendy, 1989). The text contains information of a primary nature such as definitions, theorems and proofs, expositions and illustrations of the application of the primary information. Exercises and quiz sections provide opportunities for students to explore and assimilate the concepts, and to develop problem-solving skills and strategies. Study guides provide supplementary explanations, worked examples and suggested exercises and hints. Regular assignments indicate to the tutor and student how well a student is grasping the information and developing mathematical techniques and concepts.

The problem arises in that written presentation of the assignment, often representing the result of several draft attempts, does not necessarily reflect the learning processes employed by the student. Specific learning strategies used by the student and difficulties the student encountered while completing the exercise may not be evident in the final presentation.

Thus, although tutors may have knowledge of content areas which prove to be difficult, mistakes which are likely to occur and a record of assignment grades, little is known about how the student studies the given material, what parts of the material are the most important to the student, how much time the student spends on each section and what activities are beneficial for the learning of mathematics.

This information, relating to the way students learn, pertains to the "process" stage of Biggs' Model of Learning. Biggs (1987b, 1989) has conceived of students learning in three stages: **Input**, **Process** and **Product**. The process can be seen as the way in which the student approaches the learning task of the input phase.

1.3 THE RESEARCH OBJECTIVE

The purpose of this research is to examine and analyze the learning processes used by extramural students studying 60.102 (Linear Algebra and Geometry).

An examination of the process phase of student learning will gather data on:

1. the study patterns: the way in which students approach their study tasks.
2. the learning styles they commonly employ.
3. the extent to which these reflect the effects of teaching and assessment demands.

1.4 RELEVANCE OF OBJECTIVE TO EDUCATION

The student approach to learning is a composite of a motive and an appropriate strategy, categorized by Biggs (1987a, 1987b) into three types:

- 1) Surface - students who are learning in order to get by with minimal effort, or pass their subject without aiming for high grades. Students are likely to focus on the core essentials and rote learn them.
- 2) Achieving - students who are motivated to achieve high grades and organize their work.
- 3) Deep - students who are intrinsically motivated tend to extract most meaning from their learning; they read widely, relating new content to what they already know.

Biggs (1989) urges for the further study of students' learning: what misconceptions they hold, what specific activities or processes are involved in carrying out key tasks and what constitutes deep or surface approaches to handling those tasks.

There is strong evidence (Biggs, 1987b; Marton and Saljo, 1976; Watkins, 1983) that different ways of approaching learning tasks will produce characteristically different outcomes:

- surface approach leads to the memorization of factual details, lack of structure and low involvement.
- achieving approach leads to outcomes structured in terms compatible with course requirements involving ego enhancement rather than personal commitment.
- deep approach leads to qualitatively structured outcomes involving personal commitment.

Analysis of study patterns and strategies to provide profiles of learning approaches may suggest ways to enhance teaching material to maximize deep and minimize surface approaches. If we had more knowledge of how distance education students study, what processes they used and which are related to successful outcomes, we would be able to provide appropriate course material and feedback on assignments.

"Until study patterns are better understood it is unwise to purport to know and advise students of the recommended way to study." (Roberts, 1986)

A specific area of importance is the students' use of textual materials. Design of textual materials in distance education has often reflected the view that learning from text is primarily a function of how well text-writers can influence or manipulate learners. In courses involving large amounts of written material devices such as objectives, advance organisers, in-text questions, headings and assessment items have become widely used. Evidence from distance learning research (cited Marland et al. 1990) has cast doubts on the alleged values of many of these common devices and led to a growing doubt of some commonly-held assumptions about what is helpful to students.

The uncertainty surrounding the value of the traditional approach to writing instructional text has prompted calls for studies of how distance learners actually use and learn from textual materials. Advocates of this research (Baird and White, 1982) recommend undertaking descriptive research in real-world learning contexts to provide a basis for the development of grounded theory. Such research, it has been suggested, should be directed at finding out how distance learners use and learn from the materials provided to them.