

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.

**Approaches to Learning: The Selection and Use of Learning  
Strategies**

A thesis presented in partial fulfilment of the requirements  
for the degree

of PhD.

in Human Resource Management

at Massey University

Lynn Maud Hunt

1995

370-1523

Hun

DC20

## Abstract

This study examines two relationships. First, the influence of study management skills, forms of task representation and learner characteristics on learning strategy selection. Secondly, the subsequent effect of those learning strategies, in conjunction with prior knowledge and study management skills, on learning outcome in the context of specific learning tasks.

The approach students use to learning is measured by a self report questionnaire which also obtains biographical information (N=479). Principal component analysis, standard multiple regression and logistical regression were used on the data.

The results indicated that the main influence on learning strategy selection was the form of task representation the student used. Other influences included: the nature of the task, planning, a deep motive, age and gender. Learning strategy selection suggested that students exhibit complex patterns of strategy use in response to perceived task demands. This finding challenges the underlying assumption of other studies which submit that student learning can be characterised simply as either deep or surface.

When learning outcome is examined in a generic context, prior knowledge has the strongest effect. Prior knowledge seems to be most important at more advanced stages of learning. Smaller contributions are made by study management skills. When the same outcome is examined in a specific task context, other variables also emerge as making important contributions. Learning strategies which may be beneficial in one task context may be detrimental in another. In some contexts planning can be important to a successful learning outcome. Procrastination and an obsession with neat, organised study notes may translate into a poor learning outcome.

Several recommendations for the practical application of the findings are suggested and avenues for further research are proposed.

## Acknowledgements

I would like to thank a number of people who have helped me throughout the duration of this study. First, Prof. P.J. Dewe and Prof. T. Vitalis for their guidance, encouragement and patience, which have been deeply appreciated. I am also grateful to Prof. N. Long for the constructive advice he gave me on a number of occasions. I would like to thank Dr. T. Drawnek for helping me to unravel the mysteries of factor analysis and Mr Stuart McIntyre for his invaluable help with editing. Special thanks are due to the staff and students of the School of Aviation at Massey for their encouragement and support.

Most of all I would like to thank my family: My husband Graham, for always believing in me, even when I didn't believe in myself. Without him none of this would have been possible; my children, Noel and Kelly, who, despite the disruption of their home life for a large part of their childhood, never failed to be totally supportive; Cynthia, Clynton, Vaughan and Becky for their encouragement and never once suggesting I was too old to be at School still; my Mother-in-law, Doreen for her prayers; my sisters, Carol and Jane for their love and support; my brothers, Paul and Arvin, for always being on the sidelines cheering me on; and finally my Dad (John Lawler) for whom I will never be able to find words adequate to express the importance of his love and encouragement through all of this.

### Dedication

I would like to dedicate this project to my mother, Margret Winifred Lawler, who is not here to witness the triumph of its completion, but shares in it anyway.

# CONTENTS

	<b>Page</b>
<b>Abstract</b> .....	iii
<b>Acknowledgements</b> .....	v
<b>List of Figures</b> .....	ix
<b>List of Tables</b> .....	x
<b>Section 1: Literature Review</b>	
<i>Chapter</i>	
1. The Study Context .....	1
2. Diagnostic Tools for Measuring Learning Behaviour .....	9
3. Student Interpretation of the Learning Task.....	27
4. Study Management Skills and Learning Strategies .....	45
5. Learner Characteristics .....	61
<b>Section 2: Methodology</b>	
6. Methodology.....	67
<b>Section 3: Outcomes</b>	
7. Results .....	117
8. Discussion.....	169
9. Conclusions.....	221
References.....	227

**Appendices**

A: Learning Strategies from LASSI .....	255
B: Learning Strategies from the SPQ .....	257
C: Learning Strategies from SASI.....	259
D: Learning Strategies from Spring.....	261
E: Strategies from Instrument Study 1 .....	262
F: Strategies from Instrument Study 2.....	264
G: Content Areas from Instrument Study 3 .....	265
H: Questionnaire.....	276

## List of Figures

2.1	Biggs General Model of Study Processes .....	21
3.1	Y-Shaped Structure of Bloom's Taxonomy .....	35
3.2	Gagné's Five Categories of Human Capability .....	36
3.3	Merrill's CDT Matrix .....	38
6.1	Gender Distribution Across Classes .....	71
6.2	Age Distribution Across Classes .....	72
6.3	Ethnicity .....	72
8.1	Relationships Examined in this Study .....	169

## List of Tables

2.1	Six Factors of the SBQ and a Sample Item of Each .....	17
2.2	Relationship between the Six Factor and Ten Factor Interpretation of the SBQ. ....	20
2.3	Loading of Ten Dimensions into the 3-Factor Solution.....	22
2.4	Motive and Strategy Components of Approaches to Study.....	23
3.1	The Six Major Categories of Bloom's Taxonomy .....	34
3.2	Equivalent Levels of Task Performance .....	40
4. 1	Scales and Sample Items from LASSI .....	56
6.1	Distribution of Students across Classes .....	70
6.2	Items Measuring Time Management .....	76
6.3	Items Measuring Organising Study Materials .....	76
6.4	Sources from Which Items were Derived .....	77
6.5	Motive Scales from SPQ with Definitions .....	78
6.6	Number of Strategies Identified by Individual Students for Remembering and Understanding.....	82
6.7	Questions for Instrument Study Two .....	84
6.8	Questions for Instrument Study Three.....	87
6.9	Strategy Classes and Definitions .....	91
6.10	Items and Sub-scales of Learning Strategies Questionnaire.....	94
6.11	Sources which Confirmed Items Also Identified by Students .....	96
6.12	Items Measuring Cognitive Processing Levels.....	100
6.13	Items Measuring Answer Format .....	103
6.14	Items Measuring Interrelatedness.....	104
6.15	Items Measuring Conciseness (Workload).....	107
6.16	Grades.....	108
7.1	Principal Components Analyses of the Learning Strategy Inventory	120
7.2	Comparison of Suggested Function Classification and Actual Components .....	123

7.3	Principal Components Analysis of Study Management Skills Inventory.....	129
7.4	Principal Components Analysis of Task Representation Inventory...	132
7.5	Standard Multiple Regression of Task Representation, Study Management Skills, Age, Gender, Motive and Task on the Selection of Practice Strategies.....	143
7.6	Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Key Idea Strategies .....	144
7.7	Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Relating Strategies .....	145
7.8	Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Remember Strategies .....	146
7.9	Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Background Strategies .....	147
7.10	Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Project/Predicting Strategies.....	148
7.11	Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Grouping Strategies .....	149
7.12	Standard Multiple Regression of Learning Strategies, Study Management Skills and Grade Point Average on Learning Outcome for Whole Sample.....	156
7.13	Standard Multiple Regression of Learning Strategies, Planning and Grade Point Average on Learning Outcome for the Essay Task .....	157

7.14	Standard Multiple Regression of Learning Strategies, Planning and Grade Point Average on Learning Outcome for the Project Task .....	158
7.15	Standard Multiple Regression of Learning Strategies, Planning and Grade Point Average on Learning Outcome for the Case Study 1 Task .....	159
7.16	Standard Multiple Regression of Learning Strategies, Planning and Grade Point Average on Learning Outcome for the Case Study 2 Task .....	160
7.17	Influence of Surface, Achieving and Deep Strategies on Learning Outcome for Total Group .....	163
7.18	Influence of Surface, Achieving and Deep Strategies on Learning Outcome for Essay Task .....	163
7.19	Influence of Surface, Achieving and Deep Strategies on Learning Outcome for Project Task .....	164
7.20	Influence of Surface, Achieving and Deep Strategies on Learning Outcome for Case Study 1 .....	164
7.21	Influence of Surface, Achieving and Deep Strategies on Learning Outcome for Case Study 2 .....	165
7.22	Logistic Regression for Characteristics of Most and Least Successful Students .....	167
8.1	A Comparison of Processing, Learning and Knowledge Levels .....	192

## Chapter One

### The Study Context

#### Introduction

As we approach the twenty-first century the term "learning for life" has come to have a new significance. Whereas it once meant a one-time preparation of children and adolescents for adulthood, it must now take account of the need for adults to engage in on-going learning exercises to keep pace with rapidly changing technologies and social structures.

Traditional educational practice is based on a number of assumptions which define the role of the learner and the types of skills and knowledges he or she takes away from the learning experience. The teacher is perceived to be the fountain of knowledge and the decision-maker; the student is dependent on the teacher for information about what to know and how to learn it. Instruction is the process of equipping the student with subject-matter that becomes increasingly abstract as the student moves from primary school to university. It is concerned with learning "about" concepts and principles that will have some value and application in the distant future rather than immediate relevance (Knowles, 1983).

As long as knowledge learnt at school remained valid and stable for a life-time this model of education was perfectly adequate. However, for the first time in history the rate of social and technological change is so rapid that knowledge can be outdated within ten years and obsolete in twenty (Knowles, 1983). In a person's lifetime most of his or her learning will take place outside traditional, formal educational institutions. The adult who is dependent on a teacher to direct and facilitate learning is severely disadvantaged in this environment. Without the props of a formal education system such an adult may have difficulty defining problems, seeking resources, selecting and processing information.

The challenge for the nineteen nineties and into the twenty-first century is to develop educational practices and procedures that seek to pass the responsibility for learning from teacher to learner. The focus should move from merely transmitting knowledge, to fostering the management and development of cognitive skills that enable the learner to build, modify and manipulate his or her own knowledge bases in informal learning environments. The purpose of this study is a tentative first step in the development of diagnostic measures that may help to identify complete and consistent patterns of learning behaviour. If such a development is successful, it may lead to a clearer understanding of the process of learning, thereby enabling educators to better equip students with lifetime learning-to-learn skills.

### 1.1 Influences on Learning

In any given learning context, some students will learn more effectively than others. This may be due to some innate ability such as intelligence, or to contextual factors that favour some students more than others. More likely it is the result of an interaction between the two. If performance could be solely attributed to one or more learner characteristics, then we would expect consistent performances from students, whatever the instructional paradigm. For example, if we believed that intelligence was the determining factor, then we would expect that intelligent students would always do well whatever the teaching method or learning environment. However, under some learning conditions, such as programmed learning, some intelligent students perform far less well than expected (Hunt, 1976). Conversely, if performance was influenced only by contextual factors then all students should respond identically when exposed to the same learning environment. The inescapable conclusion is that the influence of learner characteristics is modified by the kind of learning environment or context in which the learning takes place.

Much of mainstream educational research has focussed on discovering general principles of learning or instruction such as using objectives as an instructional strategy. The underlying motive for this research has been to improve learning for all. However, these general principles interact with learner characteristics to

produce varying degrees of successful performance. Very often the students who need the most help are least able to benefit from them. For example using objectives improves learning because it helps the learner focus on the important information presented in the lesson. More able students can often make better use of the cues in an objective to direct their attention during instruction than less able students. Therefore, the most able are more likely to derive greater benefit from this strategy than other students. While learning overall has been improved, the gap between the best and the poorest learner has increased.

The social, economic and moral arguments for the desirability of reducing the size of this gap are self-evident. If macro solutions applied en masse exaggerated differences in student ability then a change in approach might be justified. Such a change in approach might raise the question as to how to identify differences in students, rather than to focus on macro characteristics which might respond to macro interventions.

In the 1960's educationalists began to look at the notion that differences in performance resulted from individual differences in learners themselves (Gagné, 1967; Glaser, 1970). This was later refined to an *aptitude-treatment interaction* approach (ATI). The ATI model assumes that different treatments or interventions will be differentially beneficial to students on the basis of particular learner aptitudes. Despite the intuitive appeal of this model the results were disappointing (Bracht & Glass, 1968).

Rather than trying to improve learning by matching learner characteristics directly with an appropriate instructional method, in the late 1960's and early 1970's researchers examined more closely the relationship between personality traits such as neuroticism and extroversion, and success in learning (Entwistle & Entwistle, 1970, Biggs, 1969). These researchers found that correlations between personality variables and academic success were low, but statistically significant. More importantly, they discovered that the kind of learning strategies used by students, often influenced by personality variables, were much more strongly related to

learning outcomes (Biggs, 1970a; 1970b). The significance of this finding is that the strategies a student uses to learn can be changed; personality variables cannot. Here at last was the start of an answer to the question "*How do we improve learning for individual students?*" that also satisfied the moral constraints of social equity.

At the same time as researchers such as Biggs (1976), Entwistle (1977) and Marton and his colleagues (1976a) were establishing the role of learning strategies in the learning process, two significant shifts in the focus of learning research were taking place. First, there was a move away from experiments based on meaningless or trivial content in laboratory-based experiments to the more complex, real life learning context of actual classroom content. When it is remembered that meaningful learning is the basis of education, the importance of this shift becomes apparent.

The second trend was to view learning from the student's perspective (Entwistle, 1982). In spite of the claim of many behavioural theorists that they were studying individual differences in learning, in fact their work focussed on teacher and organisational control of learning rather than student learning processes. It was held that improvements would come from better teaching methods, instructional design or more media resources. To the behaviourist, students were regarded as relatively passive participants to be influenced or manipulated by the primary educative agent, the teacher. The new approach turned this perspective on its head. The student was now viewed as a principal agent in the learning process. Their behaviour, attitudes and decisions were recognised as having a strong influence on their learning outcomes.

## **1.2 Applying Research to the Classroom**

This focus on student processes in learning was useful because it provided new insight into the learning process and in doing so presented fresh opportunities for discovering alternative ways of improving learning. Students, no longer regarded as the passive recipients but active agents, could be recruited into taking more responsibility for their learning effectiveness, and teachers now with a clearer idea of

how students approach learning could design instruction that better accommodated these processes (Beckwith, 1991). Educationalists responded with enthusiasm. In the 1980's a multitude of books on student learning (Entwistle, 1982), along with study skill courses, came into being (Martin & Ramsden, 1987). Despite all of this effort there was little evidence for across-the-board improvement in learning (Ramsden, 1988). While there may be no definitive conclusions to account for this failure, an examination of the research and research tools suggest some possible reasons.

As Hounsell (1984) points out, recognising that students need to improve their learning is not the same as knowing how to help them. There have been suggestions that instruments such as Biggs' Study Process Questionnaire (1985b) and Entwistle and Ramsden's Approaches to Studying Inventory (1983) might be appropriately used as diagnostic tools for changing students' approaches to learning (Newstead, 1992). While these instruments were helpful in describing the normative characteristics of the different approaches a student might take to learning, they provide no prescriptive advice on how to alter that approach. Educationalists, too often, have made large and largely intuitive leaps from research findings to solution. Very often programmes and books have provided advice and remedies for learning not clearly defined nor fully understood (Martin & Ramsden, 1987). Sometimes these efforts to improve learning have been harmful and counter-productive (Marton & Säljö, 1976b; Ramsden, Beswick & Bowden, 1987; Martin & Ramsden, 1987).

The approach to learning research of the 1970's provided stereotypical profiles of students who adopted a particular approach to learning. Much of the research effort since has been to assign students to one of these stereotypes and treat them accordingly; not as individuals, but as a class. As early as 1982 Entwistle, one of the foremost researchers in this area, warned of the dangers of an uncritical, simplistic application of research to classroom contexts. He points out that students are individuals and respond differently to given situations. They may not behave consistently in their approach to learning, therefore generalisations are probably unjustified. While the typical characteristics of students who use a particular

approach to learning can be described, students themselves do not easily fit into a single category that can be used for diagnosing their learning problems.

### 1.3 The Research Problem

The purpose of this study is to extend the outcomes of Marton & Säljö (1976a; 1976b), Biggs (1987) and Entwistle & Ramsden (1983) and others who established the foundations for understanding how students learn and who have taken significant steps in developing strategies for improving student learning. Their efforts have triggered renewed enthusiasm amongst educators for developing interventions, techniques and programmes designed to help students maximise their potential. However the results of their work have not always achieved the clarification desired. Clearly, their shortcomings call for further refinement of their ideas and a greater understanding of the learning process.

Part of the deficiency in these investigations may lie with the instruments being used to measure and diagnose learning behaviour. For example, the *Study Process Questionnaire* (Biggs, 1985) was unable to provide specific diagnostic information for many individual students. Some students were found to have both high *surface* and high *deep* approaches. In many cases it was not possible to distinguish whether the two approaches were being used sequentially on the same material or concurrently on different material. Just as confusing is an opposite profile; a student who scores very low on both *surface* and *deep* approaches. Does such an outcome imply the student makes less effort overall, or could it be that they were using strategies or approaches not measured by the SPQ (*Study Process Questionnaire*)?

To address these weaknesses it was proposed that the study should focus on the factors which influence the choice of learning strategies, and the effects on learning that these strategies might have. To achieve this outcome an instrument would be constructed to measure the specific learning behaviours which contributed to a student's learning performance. In contrast to other instruments, this device would not seek to measure how strongly a student matched with one predetermined

category such as *deep*, or *surface* learning. The advantage of this approach would be the production of profiles of detailed specific student behaviour. Other studies which have been based on the use of earlier instruments such as the SPQ, ignored behaviours which fell outside the boundaries of pre-specified stereotypical profiles.

The construct of the proposed instrument was that specific behaviours contribute to the learning of a task, such as a student's interpretation of the learning task, the student's learning management skills, and the student's learning strategies used to acquire meaning from a particular task context. Further, as there is substantial evidence to suggest that in different contexts student might use different approaches, differentiated tasks would be identified in which those learning strategies would be allowed to interact. Whereas in previous studies, by focussing only on a macro view of student learning many micro behaviours have been ignored, in this study both macro and micro behaviours would be analysed to determine the degree to which they contributed to the learning of a particular task.

The remaining chapters in this section examine the development of the SPQ and identify its weaknesses as an instrument for measuring learning behaviour. From this analysis criteria will be posited for a new instrument which can measure student learning strategies. The literature on task analysis will be reviewed in order to identify a methodology for measuring a student's interpretation of a learning task. Finally, differentiations will be made between study management skills and learning strategies to clarify the effect of the relationship between these factors and the quality of learning.



## Chapter Two

### Diagnostic Tools for Measuring Learning

#### Introduction

Over the past two decades a number of research tools have been developed to measure approaches to learning. These tools have been used to demonstrate that there are at least three different approaches that a student may take to learning (Biggs, 1976; Entwistle and Ramsden, 1983), and that the particular approach chosen may affect the quality of the learning outcome. However, these tools have been used to address research questions rather than to provide methods of diagnosis. The information they provide is global, and lacking in the detail needed to provide accurate guidance to individual students who want to improve their learning performance. This chapter is an attempt to explain why it is important to focus on improving student learning, to describe the role diagnostic tools might play in helping students and teachers to achieve such an improvement, to set out the limitations of some existing tools and the specifications for a new diagnostic instrument.

#### 2.1 Improving Learning

In 1988 Paul Ramsden made a plea for teachers to improve the standard of learning by understanding the process of learning. He criticised the American educational system for producing students who, although able to demonstrate mastery of objectives, reproduce vast quantities of factual material, display complex skills in science, humanities and mathematics, were unable to show that they *understood* the learned material (Ramsden, 1988). If learning is defined as problem solving and being able to apply theoretical concepts to the real world then, Ramsden argued, these students hadn't really learned at all. Similarly, Entwistle (1977) viewed the tendency of many university students (about half of first year students in Sweden, and reportedly about the same in Britain) to adopt surface processing styles as an

obstacle to the attainment of true academic achievement of “*relativistic reasoning*” (Perry, 1970).

Advances in educational techniques seem to have improved the planning and delivery of teaching but done almost nothing for the quality of learning (Dansereau, 1978). Education at all levels is based on the assumption that students will learn simply because they are directed to. Students are told *what to learn*, but not *how to learn*. Research has contributed little to the enlightenment of teachers as to how they can help their students to build an effective and efficient armoury of learning strategies. In spite of this, students do develop learning skills as a result of their experiences. Some of these may be highly effective, others are dysfunctional, and the acquisition often haphazard. Educational institutions have rarely defined their educative role as one of developing these essential skills for learning. Until students are given the opportunity to build such skills in a systematic way, the quality of learning is unlikely to improve.

In the past 30 to 40 years educational psychologists have hypothesised a variety of factors which might influence learning. In the 1950's and 1960's the Skinnerian operant conditioning ideas were regarded as the key to learning (Skinner, 1953). It was thought that by manipulating situational variables such as reinforcement and error free responses, learning would be enhanced. Work by Gagné (1962) shifted the attention to analysing the *psychological structure* of learning tasks and viewing learning as a process of moving up a carefully elaborated hierarchy of increasingly complex tasks.

About this time educationalists began to consider the effect of individual differences in learners themselves on learning outcome (Gagné, 1967; Glaser, 1970). Individualised learning and learner-centred education became the new panacea. In 1967 Cronbach, building on the concept of individual differences, proposed an alternative approach; aptitude-treatment interactions (ATI). This model assumed that different treatments would differentially affect students depending on the quality of the match between student aptitudes and teaching methods. The enthusiasm

generated by this new direction in the 1960's and 1970's gradually faded as study after study failed to show generalisable differences between treatments and aptitudes (Bracht & Glass, 1968; Cronbach & Snow, 1969).

## 2.2 Approaches to Learning

Emerging from this increased focus on the learner's role in the learning process has been a heightened awareness and interest in the *constructivist* view of learning. Seeing learners as central to the learning process is not new (Piaget, 1950), however since the 1970's it has taken on additional perspectives. More recent constructivists conceive the learner as an *active* agent in the construction of his or her knowledge (Reese and Overton, 1970; Pines and West, 1986). As Shuell (1986) says; "*It is helpful to remember that what the student does is actually more important in determining what is learned than what the teacher does*" (p. 429). If the constructivist theory is to have any impact on student learning, then the roles of the teacher and student must change. The teacher's primary function must no longer be concerned with transmitting knowledge according to some all-encompassing educational theory, but to help students become aware of, and use alternative strategies for constructing their own realities, defining their own goals and monitoring and correcting their own performance. Before teachers or students can begin this process they need to be able to measure what it is students do when they are learning. Until a clearer picture emerges of what students do *now*, it is less easy to prescribe what teachers *should do* to improve their students' learning, nor how students can be helped to improve their own learning.

### 2.2.1 The Göteborg Approach

Two main approaches have evolved from this challenge, the intensive small group studies typified by Ference Marton and his co-workers at Göteborg University (Marton & Säljö, 1976a; 1976b; Svensson, 1977; Fransson, 1977), and the more traditional large scale psychometric approach used by Biggs (1976) and Entwistle & Ramsden (1983). The Göteborg studies used interview and case study techniques to examine learning behaviour. Small sample sizes of between 20-40 students were asked to read a prose extract. Each student would read the extract in the presence

of a researcher, and then answer a series of questions to test their understanding of the text. Students were then asked to respond to a series of open-ended questions in order to provide an introspective account of how they approached the reading task. The conversation with the researcher was recorded so as to allow a complete analysis of the whole pattern of the students' responses. The two outcomes, level of understanding and the *approach* used, were classified by the researcher and another colleague.

The Göteborg studies have consistently demonstrated that the processing level, or type of learning strategies, used by students qualitatively affects learning outcomes. From these studies they concluded that there were two major approaches to learning; *deep* and *surface*. Surface level processors focussed on the surface features of the content, that is, specific facts or disconnected pieces of information that they learned by rote. On the other hand, deep processors were more concerned with the underlying meaning or significance of the content. The depth of processing used by students while studying was reflected in the quality of post study responses to questions. Whereas deep processors were more able to give an analysis of the intent of the content, surface processors were more concerned with regurgitating a reproductive conception of the content (Marton & Säljö, 1976a).

Further, Marton and Säljö (1976a; 1976b) argued for understanding learning in the context of the content being learned. The same learning task was seen to be understood differently by different students and this difference in perception influenced what and how students learned. The findings of these studies were much less equivocal than the traditional psychometric studies of the same phenomena in that they produced a clear demonstration of the link between *depth* of processing and the *quality* of learning outcomes. For example, all students who used a *deep-level* of processing were classified as achieving learning at the highest levels of complexity, whereas the surface processors could only achieve the lowest levels (Marton & Säljö, 1976a; 1976b).

Valuable as these findings appeared to be, the studies suffered from some weaknesses. Firstly, the sample sizes were very small and the homogeneity of the samples (mainly volunteer female Swedish social science students) raised the question of generalisability (Entwistle, 1981). Secondly, the method of data collection and the interpretation were highly subjective.

As a tool for diagnosing learning behaviour, the Göteborg method's complexity of administration and subjectivity in interpretation is unlikely to make it useful for teachers and students. Its dependence on elaborate interviewing techniques is time consuming and requires special training to analyse student responses. It is unlikely that over-worked teachers would be willing to expend the necessary time and training needed to make such an approach work. The method obviously doesn't lend itself to student self-analysis.

### 2.2.2 The Psychometric Approach

The approach used by Biggs (1978) and Entwistle, Hanley & Hounsell (1979) overcame many of the problems of the *qualitative* method described above. These studies were large scale and conducted over a variety of faculties and subject areas. The instruments used were self-report questionnaires that were easily administered and scored.

Despite the differences in methodology the psychometric approach produced remarkably similar results to the Göteborg studies. Using second order factor analysis, Biggs (1978) and Entwistle, Hanley and Hounsell (1979) discovered a similar dichotomy to that of Marton & Säljö (1976a; 1976b), namely *surface* and *deep* approaches to learning. In addition, all three research groups identify 'motive', (Marton's 'intent') as a dimension of each learning approach. Further, the psychometric studies found a third learning approach: *achieving*. This achieving approach was found to be qualitatively different to either deep or surface approaches, and was characterised by high achievement motivation and organisational strategies. In a sense, students classified as achieving could also be seen as being *strategic* in that their primary strategy was to discover the rules of the

game, and play to win. They would use either deep or surface learning strategies depending on which one they believed would earn them their best marks. They would read all of the set readings, know when assignments were due and always have them completed on time. While they were often characterised as 'model' students they often had something of a ruthless streak in them.

### 2.3 The Biggs' Model

Biggs and Entwistle used similar approaches to develop their inventories. In fact Entwistle & Ramsden (1983) recognising this similarity in approach between the two projects, incorporated many features and items of Biggs' SPQ into the Lancaster Inventory. Because of this similarity it is proposed that only Biggs' work will be examined in detail.

Biggs' studies as to how people learn dates back to the 1960's. In common with other researchers of the time he strove to establish the link between learning behaviour and personality (Biggs, 1969; Entwistle and Welsh, 1969; Entwistle, 1971; Fishman, 1962). He built a model of information processing (Biggs, 1969) and concluded that differences in performance were largely a result of personality variables. Of particular interest to him was the issue of motivation which he sought to demonstrate from a cognitive frame of reference.

Biggs' information processing model incorporated a receptivity program whose function it was to maintain the system in an input-receiving mode. The receptivity program determined the level of arousal operating at any given time with high arousal levels causing input to be kept flowing. Biggs used Welford's (1965) argument that the arousal function (Biggs' receptivity programme) has two orthogonal dimensions: a rate of change; and a basic resting level. The rate of change had a neuroticism-stability dimension, while the basic resting level had an introversion-extroversion dimension. The neuroticism-stability dimension affected the individual's initial responsiveness to stimuli. The introversion-extroversion dimension operated on the level of uncodable 'noise' experienced as a result of

over-arousal. Extrinsic motivation (thought to be a characteristic of extroverts) created the need for information about extrinsic rewards to be maintained in the short-term memory. This information was not directly relevant to the information being processed and thus was classified as "noise". The effect of high noise levels was to reduce processing capacity. Reduced capacity resulted in the use of surface or rote strategies which processed information as isolated fragments. Intrinsic motivation was believed to be more characteristic of students who were highly sensitive to changes in arousal (neurotics) and/or who had high resting levels of arousal (introverts).

When input accepted by the receptivity programme was classified as 'relevant' it was matched with stored codes. When there is an optimal mismatch with existing schemata, intrinsic motivation and positive hedonic tone resulted, feeding the arousal state and thus maintaining on-task behaviour. Input that closely matched existing schemata caused boredom and a reduction in on-task behaviour, unless external rewards were used. Highly discrepant mismatching caused a break-down in processing because the system lacked the appropriate codes, or codes sufficiently close they could be adapted. However, in this mismatch mode the model stated that the receptivity programme would still be triggered causing input to continue. This backlog of unprocessed information would cause the cognitive equivalent of 'microphone howl'. One highly likely method of dealing with this information overload was to 'snap' code, using available, but inappropriate codes. Biggs noted that this snap coding might explain the stereotyping of behaviour observed by others (Maier, 1949) in conditions of extreme stress.

In this line of reasoning a link can be seen between deep strategies and intrinsic motivation, and surface strategies and instrumental (extrinsic) motivation. Intrinsic motivation, frequently associated with the personality characteristics of neuroticism and introversion, requires an optimal match between the task and the level of knowledge or coding strategies that the student already has. Movement either side of this optimality creates conditions which mitigate against the use of deep strategies. On the one side is boredom, in which deep strategies are redundant

because the task is too simple, and on the other, a difficulty level which defeats the coding strategies at the student's disposal.

In any condition other than an optimal mismatch of input and schemata, students require external reinforcers to sustain learning behaviour. Biggs argued that the need to maintain information about the external reinforcers occupied valuable space in the limited capacity of the IMS (immediate memory store or working memory), thereby decreasing the likelihood of the space-consuming deep strategies being used. The use of simple associative (surface) processing, as opposed to the extensive recoding found in intrinsically motivated behaviour, reduced the complexity of the learning task. This hypothesis was consistent with the minimal effort normally associated with task boredom, and the 'snap' coding discussed before with regard to overly difficult tasks.

### **2.3.1 The Study Behaviour Questionnaire**

By 1967 Biggs had begun to incorporate his beliefs about the relationship between personality (cognitive style) and study behaviour into the first version of his learning strategy inventory, which he called *The Study Behaviour Questionnaire* (SBQ). The nature of this relationship involved the translation of personality characteristics into study relevant operations. Thus students with certain personality characteristics were likely to be predisposed to adopt some strategies or behaviours rather than others. One of the motivating forces behind Biggs' work was a belief that different tasks (for example, Science) were better suited to particular study behaviours. Students with a preferred study behaviour would tend to choose a subject which matched that predisposition.

The original content of the SBQ was derived from three sources:

1. An analysis of personality variables associated with academic achievement as identified by researchers such as Frenkel, Brunswick (1949) Hudson (1966); Rokeach (1960) and Schroder, Driver & Streufert (1967).

2. Variables which matched Biggs' information processing model of complex learning such as the use of coding or rehearsal strategies, and the relationship between coding quality and arousal levels (Biggs, 1969).
3. Well established items from study skill inventories as developed by researchers such as Brown & Holtzman (1966).

The SBQ measured six scales of study behaviour that operationalised personality predispositions. Three of these were derived from previous research: *intolerance of ambiguity* (Frenkel-Brunswik, 1949), *dogmatism* (Rokeach, 1960) and *cognitive complexity* (Schroder, Driver & Streufert, 1967). To these Biggs added *study organisation*, *independence* and *intrinsic motivation*. These six factors formed the dimensions of the original SBQ (see table 2.1).

**Table 2.1: Six Factors of the SBQ and a Sample Item of Each.**

Intolerance of ambiguity	I find it confusing when lecturers emphasize that a particular theory is only tentative and must be understood as such
Dogmatism	I'm quite prepared to accept that I may find that my university study will raise more questions than it settles.
Cognitive complexity/simplicity	I try to question a new idea by thinking of exceptions to it, no matter how far-fetched they may be.
Independence of study behaviour	I much prefer to be given a specific assignment of work rather than a general direction that I can interpret myself
Study organisation	I work out in advance what my study schedule will be and then try and keep to it under all circumstances
Intrinsic motivation	Once I get going I find that virtually all my studies can be highly interesting.

This questionnaire was first administered, along with personality and reading performance tests, to 300 first year students at Monash University in 1967. The results of their first year at university and of their final year at high school were also

obtained. The data were factor analysed to produce the expected six factors described above.

Biggs (1970a) found a correlation between the SBQ measures and performance, though not a direct relationship between personality characteristics and performance. This pointed to a mediational role that study strategies played between personality and learning outcomes. For example, *tolerance of ambiguity* manifested itself in students who accepted that theories might be only tentative, would read widely so as to cover many different viewpoints and read general summaries to develop a framework before dealing with the detail of the task at hand. *Cognitive simplicity*, on the other hand characterised students who accepted information at face value with a minimum of analysis. Complex situations were dealt with using simplistic interpretations. These student tended to soak up information without actively processing it. Cognitively, they resembled pieces of blotting paper.

A major argument of the study was the effect of the task on the type of strategies used. Biggs expected that given the fundamental differences in the nature of Arts and Science, students would accommodate these differences by using different strategies. In the event, no simple picture arose. Successful Arts students coped with the unstructured material that characterised many Arts subjects through using one of two approaches. They either used a simplifying strategy (cognitive simplicity) in which they accepted information at face value and with a minimum of analysis or *opening out* strategies. Biggs called the first *reproductive* and the second approach *transformational*. This second approach was identified in students who were open to experiences of novelty and complexity (tolerance of ambiguity), preferred to make their own interpretations (independence of study) and were prepared to change viewpoints (dogmatism). No direct relationship between either of these approaches and successful performance was identified in Science students. Biggs explained that this finding may have been because the Science subjects at university were built on high school science and the primary factor in success was the amount of *prior knowledge* that the student had of the subject. This latter finding was

confirmed by Goldman and Warren (1973) who found no difference in study behaviours between students from different faculties.

Subsequent studies by Biggs (1972; 1976) suggested alternative interpretations of some of the dimensions, and the addition of others. The original six dimensions were now expanded to 10 (see fig. 2.2). In his research instrument each dimension was measured by six to ten items, most of which had come from previous versions of the SBQ. The ten dimensions were now:

1. **Academic aspiration:** pragmatic, grade-oriented, university as a means
2. **Academic interest:** intrinsically motivated, study as an end
3. **Academic neuroticism:** confused, overwhelmed by demands of course work
4. **Internality:** sees 'truth' coming from within not external authority
5. **Study skills and organisation:** works consistently, reviews regularly, schedules work
6. **Fact-rote strategy:** centres on facts details, rote learns
7. **Dependence:** rarely questions instructors, tests; needs support
8. **Meaning assimilation:** reads widely, relates to known, meaning oriented
9. **Test anxiety:** very concerned about tests, exams, fear of failure
10. **Openness:** university place where values are questioned.

Some of his work explaining the development of these ten scales remains unpublished. However, it would appear that the original six scales may have been used as the basis for elaborating four additional factors as shown in table 2.2.

**Table 2.2: Relationship between the Six Factor and Ten Factor Interpretation of the SBQ.**

Original Six Factor Solution	Modified 10 Factor Solution
1. Intrinsic motivation	1. Academic aspiration (Pragmatism)* 2. Academic interest (Academic motivation)*
2. Tolerance of ambiguity	3. Academic neuroticism
3. Extreme responders on Dogmatism scale	4. Internality
3. Dogmatism	5. Openness
4. Study organisation	6. Study skills and organisation
5. Cognitive simplicity (complexity)	7. Fact-rote strategy ( Rote learning)*
5. Cognitive complexity (simplicity)	8. Meaning assimilation (Meaningful learning)*
6. Independence of study	9. Dependence (Class dependence)*
	10. Test anxiety

\* Biggs later renamed some of the scales. The later name is given in brackets.

As an example of this elaboration the *Internality* scale resulted from an examination of extreme responders on an early administration of the SBQ and personality measures, who exhibited characteristics inconsistent with the usual description of such a group (Biggs & Das, 1973). Two types of extreme responders were found: *internals*, who were high on divergence, academic interest, introversion and used meaningful rather than rote learning strategies; and *externals*, who focussed outwards, rote learnt facts, were less responsive to change and sought to create favourable impressions on others. The distinction between the two groups is along similar lines to that made later by Biggs between major approaches to learning, deep (meaningful learning) and surface (rote, reproductive learning).

A study by Biggs in 1976 used an oblique multiple group method of factor analysis to substantiate the ten dimensions and found some interesting sex and faculty

differences. Both male and female Arts students who scored high on the *internality* scale had slightly higher performance levels than those with low scores. In Science, however, males who adopted an external stance (that is, low on *internality*) and females with an internal stance (high on *internality*) performed better.

Two years later the SBQ evolved into the *Study Process Questionnaire* or SPQ (Biggs, 1978). Biggs adopted the term *study processes* as a more accurate descriptor than *study behaviour* of the complex of tactics, strategies and approaches that are determined by the students' values and attitudes. From his SBQ studies Biggs developed a *General Model of Study Processes* (see fig. 2.1) which expanded his original hypothesis of personality characteristics predisposing students to adopt particular strategies to include a variety of other factors. These additional factors, which he called *presage*, included personal factors (for example, cognitive style) and institutional factors (for example, subject area). The study processes that were manifestations of these presage factors were *values*, *motives* and *strategies*.

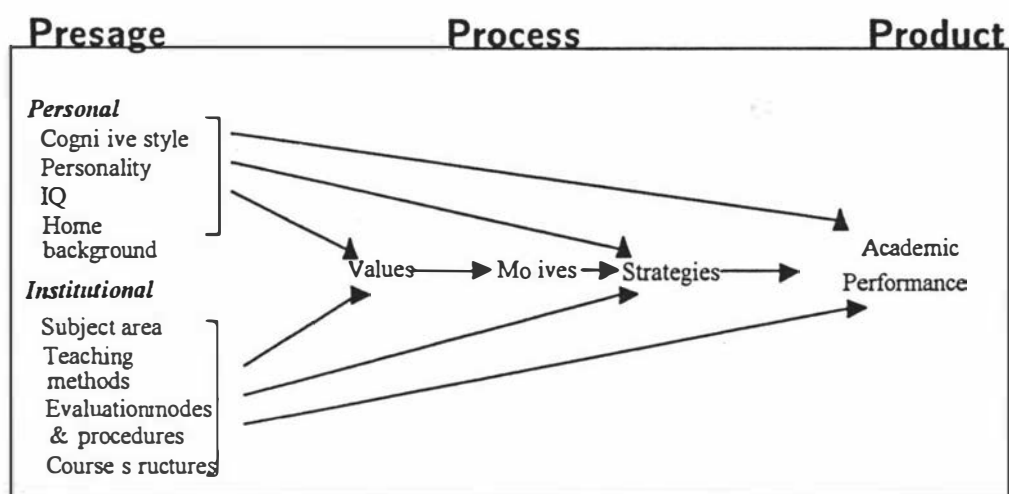


Figure 2.1: Biggs General Model of Study Processes

Presage factors, such as home background, shape values which in turn influence students' motives for studying. Motives determine the type of strategies students choose for learning and consequently the quality of academic performance. Strategy selection and academic performance are also likely to be directly affected by presage factors such as ability and cognitive style.

The study process variables are comprised of the ten dimensions described above. Biggs now sought to redefine these more economically to overcome practical difficulties with administration (Biggs, 1987). The 10 dimensions of the SBQ had a degree of intercorrelation which suggested scope for a second order factor analysis. Three separate analyses with three different samples were performed, producing three orthogonal dimensions. This three-factor solution was almost identical across the three samples. Each of these factors contained a complex of value, motive and strategy items (see table 2.3).

**Table 2.3: Loading of ten dimensions into the 3-factor solution**

	Factor 1	Factor 2	Factor 3
Study skills			positive
Neuroticism	positive		negative
Test anxiety	positive		negative
Internality		positive	
Academic motivation		positive	positive
Pragmatism	positive		
Class dependence	positive		
Meaningful learning		positive	positive
Rote learning	positive		
Openness		positive	

Biggs reduced these results into the following three multidimensional approaches.

1. **Reproductive** (factor 1): *Value*: study is seen as a means to an end (pragmatic). *Motive*: fear of failure (neurotic, test anxiety), dictating *surface strategies* (class dependence, rote learn) .

2. **Internalising** (factor 2): *Value*: self growth, actualisation, university seen as a place where growth can take place. *Motive*: intrinsic dictating *deep strategies*: study is a process of growing hence wide reading, interrelating, meaningful.
3. **Organising** (factor 3): *Value*: competing and winning, whether goals self set or not. *Motive*: n-achievement dictating a highly *organising strategy*: very cool, low anxiety, highly organised approach.

To avoid confusion and in order to be consistent with other researchers in the field, Biggs renamed his three approaches, *Surface*, *Deep* and *Achieving*. The *value* component of each factor was absorbed into the *motive* and *strategy* dimensions. Each approach now comprised a motive and a strategy component as shown in table 2.4.

**Table 2.4: Motive and Strategy Components of Approaches to Study**

Approach	Motive	Strategy
Surface	Instrumental: aim to meet, minimum passing requirements.	Reproductive: focus on bare essential and rote learn.
Deep	Intrinsic: to gain competence in specific subjects.	Meaningful: reads widely, interrelates material with prior knowledge.
Achieving	Competitive and ego-enhancing: to obtain highest grades whether or not interested in material.	Organising: time, resources, behave as model student.

Biggs' SPQ Inventory and Entwistle and Ramsden's Approaches to Studying Inventory (1983) were developed primarily as research instruments designed to understand how students approach learning. The easily administered Likert-type scale questionnaires were conducive to the large scale sampling needed to identify

the consistent patterns of learning behaviour in the general population. However, the loss of much of the micro behaviour in establishing normative generalisations reduced the value of these tools as diagnostic instruments for teachers and students. In the process of developing norms Biggs reduced his questionnaire from 102 to 42 questions by including only those which captured the typical characteristics of students within the domain groups.

### 2.3.2 Limitations of the SPQ

#### 1. Distinguishing between Learning Strategies, Values and Attitudes

One of the difficulties with using the SPQ as a diagnostic tool is the very broad definition it uses for the construct of *strategy*. Jonassen (1985) has defined learning strategies as representing "*complex mental operations that assist learners to perceive, store, retain, and recall different forms of knowledge or performance.*"(p.26). Many of the items in the SPQ measure much more than this. For example, this item from the surface strategy subscale "*I find it best to accept the statements and ideas of my lecturers and question them only under special circumstances*", indirectly measures the strategy of critically evaluating information (learning strategy), plus attitudes and values relating to the respective roles of teachers and students. When a student responds positively to this statement its hard to know whether its the strategy, the nature of the task content (that is, factual) or beliefs about student-teacher roles, that elicits the subject's response. This ambiguity is detrimental to the validity status of the item.

#### 2. Narrow Range of Learning Strategies

A second limitation of the SPQ as a diagnostic tool is the narrow range of learning strategies it actually measures. Mnemonics, a significant class of strategy for learning *remember only* material may be a more powerful learning strategy than rote learning. However, the mnemonic strategy has been completely ignored. Other strategies, such as using examples for

learning (Zhu & Simon, 1987; Anthony, 1991), do not appear in the SPQ at all.

The deep strategy sub-scale is measured by a total of only seven items. While it is clear that these measure significant strategies, it is possible to identify over fifty other learning strategies (Hunt, 1992). If learning strategies are the focus of analysis, then a diagnostic tool must capture all of that information, not just some of the behaviours which might typify a learning profile.

### 3. **Learning Tasks**

A central issue in the Göteborg studies was the content of learning. Marton and his associates repeatedly stated that any analysis of learning must take into account the content of the learning task. Biggs (1970b), particularly in his early work, expected to find strategy differences between students studying Arts and Science which he regarded as two quite disparate tasks. Further, implicit in the SPQ model is the notion that deep strategies will more naturally be used for tasks in which we are interested, and surface for those that we are not. This implies that students will change the type of strategy used as they move from one subject to another. The SPQ as a macro measure doesn't identify the student's strategy orientation to any particular task type. This makes for confusing interpretation. Does the student respond in terms of their favourite subject, or think of different subjects in relation to different items? These confusions have the potential to reduce the validity of the constructs.

If it can be demonstrated that one student's selection of strategies is based on his or her inappropriate interpretation of the task, and another student's selection of the same strategy was based on their dislike of the subject, then a useful diagnosis must differentiate between these two situations. If the content of a learning task influences which strategies a student chooses, then

a useful diagnostic tool must identify the important task characteristics and measure the student's perception of such.

## 2.4 Summary

The SPQ summarises an individual's approach, and in the process loses important distinctions between differing responses to different circumstances. It is not enough to simply know that a student uses a surface approach. Of more importance is knowledge of the mix of strategies used, and the context in which they were applied. It is probable that students adopt different motives, strategies and interpretations of tasks in different situations and at different times. Any diagnostic tool must be capable of capturing a complete 'snapshot' of all the important variables, including the full range of strategies used, in the context of the students interpretation of the task.

## Chapter Three

### Student Interpretation of the Learning Task

#### Introduction

Studies which have focussed on learning processes as determinants of learning performance have tried to explain how or why students choose particular strategies for learning. These studies have sought to determine *why* students choose one strategy over another in order to develop effective treatments for enhancing strategy selection and use, and thereby improving learning. Many early attempts at strategy training failed because it was assumed that if students were taught to use a particular strategy, that strategy would become an habitual part of their learning behaviour (Peterson & Swing, 1983). More recent evidence suggests that students may have a range of strategies at their disposal but often deploy them inappropriately (Pressley, Levin & Ghatala, 1988). If students are to be taught to use strategies appropriately, then the decision-making process that students use to arrive at their final choices must be taken into account. Factors which have been identified as influencing strategy choice include: *motivation orientation* (Biggs, 1987; 1993; Entwistle & Waterston, 1988; Boekaerts, 1987; d'Ydewalle, 1984); *repertoire of strategies and/or ability levels* (Biggs, 1985); *anxiety levels* (Fransson, 1977); *accessibility of knowledge* (Naus & Ornstien, cited in Ornstien & Naus, 1985), and *prior knowledge* (Peeverly, 1991). A major omission from this list is an analysis of how student interpretation of the task influences strategy selection.

This chapter reviews that literature which offers insight into some aspects of a student's interpretation of a task, including *problem representation* and *test expectancy*. In addition, it examines the tools of task analysis that have long been used by instructional designers for structuring and sequencing instruction. As no suitable measures of task interpretation by students could be found in the literature, it is argued that the tools traditionally used by instructional designers may be

adapted for this purpose, that is understanding how students interpret or analyse a learning task.

### 3.1 Problem Representation

Work in two separate areas has contributed partial explanations for students' perceptions of learning tasks: investigations of the differences between expert and novice representation of problems (Glaser, 1987b); and studies of anticipated answer format in tests (Lundeberg & Fox, 1991). Early work by de Groot (1965) on the differences between chess experts and novices identified perceptual abilities as a significant distinguishing feature. Experts (which students are not by definition) identified the essential properties of the task which suggested possible solutions. Building on the work of de Groot, Newell & Simon (1972) wrote, "*Defining the situation is an important type of information processing to understand, ... There is clear evidence that this first act of definition differs substantially from all others.*" (p.761). When faced with a problem or task, the student must recognise or understand it in some way. Either its meaning must be constructed, or evoked if it already exists in memory.

Experts have available to them large stores of domain-specific knowledge that is highly organised and conceptually integrated. When faced with a problem, experts draw on these stores of knowledge to recognise implicit principles within the problem. They use these, rather than surface features, to solve the problem. Novices fail to recognise these fundamental principles and define the problem space in terms of explicit surface features (Chi, Feltovich & Glaser, 1981; (Chi, Glaser & Rees, 1982).

Siegler (1985) contends that at least part of the difficulty people have in accurately perceiving problems is the need to consider so many possible dimensions of the problem with limited cognitive resources. Experts view a new problem and recognise something that is familiar; the novice sees the same problem and is faced with a bewildering array of possible variables that may or may not be relevant. The

novice has no way of identifying those which are relevant. Relevant dimensions which have been missed out hinder task performance, as do irrelevant dimensions which have been included. These irrelevant dimensions serve to take up limited cognitive capacity and interfere with performance. Wier (1964) demonstrated this with an unusual study of probability learning in which preschoolers performed better than primary and secondary school children. As there was no determinate answer, the best strategy was to guess the answer each time, which is exactly what the preschoolers did. The older children tried to take into account numerous features such as spurious patterns that appeared in the series of trials that were actually irrelevant to the solution, and as a result they were less often correct. Siegler's work suggested that one shouldn't be overly ambitious in what one expect students to interpret from a learning task.

The work on expert and novice differences emphasises the importance of understanding how tasks are perceived or represented when considering the quality of the task outcome. While experts are faster at completing tasks overall, they often spend longer than novices on the initial problem representation (Flower, 1981). Once they have completed the representation phase of the process they are able to access solution patterns quickly. These findings support the notion that a student's initial perception of the task contributes to how effectively it is dealt with. However, the interest in this work has been in distinguishing between experts and novices; it has little to say about distinguishing between different novices.

### **3.2 Test Expectancy**

One aspect of student's task appraisal that has received some attention is the effect of the expected answer format. Students adapt their learning behaviour in response to the format in which they expect to be examined (Lundeberg & Fox, 1991; Entwistle & Ramsden, 1983). A meta-analysis conducted by Lundeberg and Fox of both classroom and laboratory studies on the effects of anticipating *recall*, *recognition*, *essay*, *multiple-choice* or *true-false* test items found that when students sat tests in a format they had expected, they performed better than when the test

was in an unexpected format. This finding has been explained as resulting from more precise and specific encoding by students (Tulving, 1983).

Students seem to infer task demands from knowledge of the expected answer format. This format influences their selection of strategies, which consequently affect their test performance (Watts & Anderson, 1971; Lundeberg & Fox, 1991). Ramsden (1988) suggests that students make inferences about the depth of understanding required for particular tasks based on the answer format. Similarly, Rothkopf, (1968) found that the "*...most intriguing single result from our work is that the character of questioning tends to shape the character of the knowledge which is acquired*" (p. 127).

The earliest work on anticipated answer format was conducted by Meyer (1934; 1936). He found that students anticipating an essay format did better on either multiple-choice or essay formats than those who expected a multiple-choice test. Prevailing wisdom since that time has suggested that students should study as though for an essay test, regardless of the actual expected format (Langan & Nadell, 1980). In the fifty years since these studies, the Meyers findings have never been replicated in a classroom context (for example, Vallance, 1947; Hakstian, 1971). The meta-analysis conducted by Lundeberg and Fox (1991) challenged Meyer's test expectancy effect, concluding that the classroom and field studies available suggested that students performed best when the answer format they anticipated was the one they receive.

The studies at Göteborg University in the mid-1970's also stressed the significance of students' perception of anticipated assessment demands (Marton & Säljö, 1976a; 1976b). They found that students' approaches to learning depended on their conception of learning. They wrote, "*... learning seems to be defined differently depending on, for instance, anticipated task demands...*" (p.124). Further Marton & Säljö (1976a) showed that if students were not given information about the type of questions they would be asked they made their own judgements about task requirements. When the actual questions they received differed from what they had

expected, they adjusted their subsequent strategy to meet the new *perceived* task requirements. Two broad levels of task demands were identified: tasks which required a memorisation of facts; and those which needed understanding.

If answer format influences the way students perceive the demands of a task then it should be expected that congruence will be found between the answer format anticipated and other appraisals of the task demands.

### 3.3 Analysing the Learning Task

The lack of attention to student appraisal of task demands is surprising for two reasons. First, teachers have been analysing learning task demands for the purpose of instructional design for many years. Secondly, the frequency of references made in studies for a need to understand how students perceive learning contexts (Hill, 1981; Marland & Edwards, 1986; Marton, Carlsson & Halász, 1992). For example, Ramsden (1988,) wrote, "*Students often react to educational situations differently from the ways teachers or experimenters predict. This is because they react to the requirements they perceive, not always the ones we define.*" (p. 24). Earlier he stated that students often misinterpreted learning tasks as needing to remember large quantities of facts, believing that a large store of factual information distinguished an "expert" from a novice. Ramsden exhorted teachers to change these student perceptions, but offered no suggestions on how they might understand the nature of these misperceptions. This section examines tools used by instructional design for analysing learning tasks. Such analyses of the task have enabled designers to make appropriate decisions about teaching the task. While these tools have been modified over time, they have proved to be useful in improving the quality of instruction. It would seem that in the absence of other measures these tools might be adapted for students to describe how they represent a learning task.

An enduring theme in educational research over the past 50 years has been the need to appropriately structure and sequence content to enhance student learning. To achieve this a variety of methods have been posited to help analyse and define content domains. Of interest to the instructional designer is task complexity,

specification of expected behaviour of the student on the task and the relationships between the task components (Bloom, Englehart, Furst, Hill & Krathwohl, 1956; Gagné, 1965; Skinner, 1954; Merrill, 1983; Hunt, 1986). With this information the designer can sequence instruction, control for difficulty level and ensure that all content is covered and appropriately interrelated. If such a detailed analysis of the learning task can assist the instructional designer in organising the teaching of that content, it seems reasonable to assume that a similar analysis or understanding of the task will assist students to more effectively deploy their learning resources when dealing with the task.

The work on test expectancy suggests that students interpret task demands in terms of the level of understanding or thinking that's required of them as, for example, in rote reproduction. Level of thinking, as a dimension of task demand, fits comfortably with traditional forms of analysis done by instructional designers who employ different levels of thinking as measures of task complexity (Bloom et al, 1956; Gagné, 1965; Merrill, 1983). Content type is a second dimension of importance. This dimension focuses on the analysis of a subject matter in terms of its structure such as facts, concepts, procedures or principles (Merrill, 1983). A knowledge of content and/or content type is helpful in determining instructional strategies, and while it could be argued that such a knowledge would be an advantage to students there is no evidence that they spontaneously categorise tasks according to these dimensions. Therefore, it is suggested that the aspect of learning task analysis used by instructional designers that is of most value as a measure of students' perceptions of learning task requirements, is the *level of thinking* that is needed for a particular task.

### **3.3.1 Methods of Analysing Tasks for Instructional Design**

The huge demand for technical skill training created by the demand for qualified military personnel in World War II generated the development of a systems approach to learning (Reiser, 1987). Part of the legacy of this trend has been the growth of systematic approaches to learning and the pre-requisite structuring of knowledge which has found form in systems such as programmed instruction

(Heinich, 1970), task analysis (Miller, 1962) and the use of behavioural objectives (Gagné, 1965).

Training task analysis has been defined by Yaney (1974) as the systematic definition and classification of tasks, sub-tasks, job elements, working conditions and standards for the purpose of improving job performance. The purpose of a task analysis is to simplify complex tasks by dividing them into sub-components, and to determine the relationships between those sub components. This process provides a blueprint for defining all of the important parameters in a task and suggests appropriate sequences for training people in that task (Merril, 1987).

During the 1950's R. B. Miller refined task analysis procedures with the development of a detailed task analysis methodology (Miller, cited in Reiser, 1987). The continuation of interest in task analysis stimulated a cross fertilisation between job-based task analysis and a cognitive analysis of learning tasks such as found in Gagné's learning hierarchy (Gagné, 1965).

Another type of learning task analysis is the specification of behavioural objectives. While objectives in education have been available since World War I, they tended to be used to identify content goals for learning rather than the specific behaviours students were expected to demonstrate. The development of objectives which stated the learning outcomes in observable, behavioural terms is usually credited to Tyler (Reiser, 1987). Widespread use of such objectives did not take place until after the publication of *Taxonomy of Educational Objectives* by Bloom and others (1956). By the early 1960's the use of behavioural objectives became standard practice in education and was popularised by the writing of Robert Mager (1962) and others.

The taxonomy of educational objectives developed by Bloom and his colleagues (Bloom et al, 1956) was designed as a theoretical framework for classifying the intended outcomes (objectives) of the educational processes that could be used to facilitate educational assessment. The emphasis was on evaluation rather than instruction. However, the taxonomy later came to be used as an instructional design

tool (Davies, 1976). In this role the taxonomy suggested that rather than an unlimited range of skills and knowledges (or tasks) which could be measured, a few, functionally distinct classes of intellectual behaviours could be identified. These could be applied across different contents and different levels of education (primary, college and university) in order to facilitate a focus for teaching strategies. Each of these categories represented a qualitatively different level of thinking that would be required by the student to achieve objectives within that category.

The organisation of these categories was from simple to complex (see table 3.1), with *knowledge* the most simple level of thinking a student could do, and *evaluation* the most complex.

**Table 3.1** *The Six Major Categories of Bloom's Taxonomy*

<u>Categories</u>	<u>Definitions ( Biggs &amp; Telfer, 1987 p.463)</u>
1.00 Knowledge	rote reproduction of the correct answer
2.00 Comprehension	explaining the response in the students' own words
3.00 Application	applying knowledge to a practical situation
4.00 Analysis	isolating crucial components of the knowledge
5.00 Synthesis	recombining elements to yield new knowledge
6.00 Evaluation	applying higher order principles to test the worth of the new knowledge

Bloom stated that these categories had cumulative properties.

*"Our attempt to arrange educational behaviours from simple to complex was based on the idea that a particular simple behaviour may become integrated with other equally simple behaviours to form a more complex behaviour. Thus our classifications may be said to be in the form where behaviours of type A form one class, behaviours of type AB form another class, while behaviours of type ABC form still another class. (Bloom and others, 1956 p. 18)*

The assignation of objectives to different levels in this classification system had important implications for the sequencing of instruction and assessment. It provided instructors with a way of understanding the demands a learning task made on a student in that it identified the complexity or cognitive load rather than just offering a statement of content to be learned. Seddon (1978) in an attempt to validate the proposal that each of these categories did in fact represent different levels of complexity, reviewed those studies that had used statistical methods to validate the taxonomy. He concluded that the strongest evidence came from Kropp, Stoker & Bashaw (1966) and Madaus, Woods & Nuttall (1973) suggesting that *knowledge*, *comprehension*, *application* and *analysis* were positioned in the appropriate hierarchical order, but that *evaluation* and *synthesis* were not. Madaus (Madaus, Woods & Nuttall, 1973) proposed a y-shaped structure rather than the linear hierarchy of the earlier Bloom model (see fig. 3.1). *Evaluation* and *synthesis* was felt to measure a generalised ability level that could not be directly influenced through teaching, rather like Merrill's *find* level.

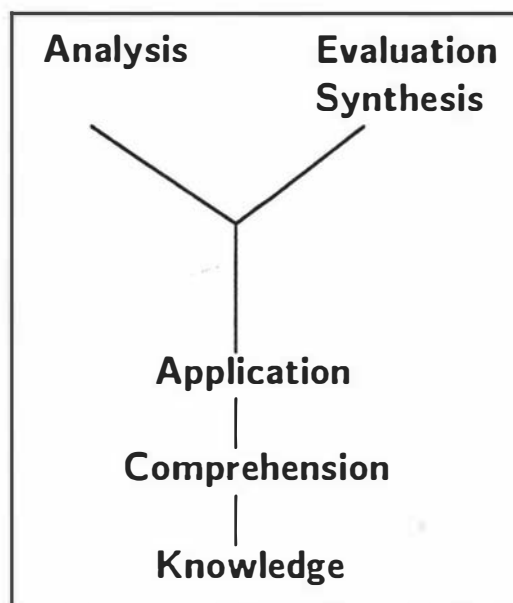


Fig. 3.1 Y-Shaped Structure of Bloom's Taxonomy

### 3.3.2 Gagné's Learning Hierarchy

In the 1960's, Gagné and others (Gagné, 1962) proposed that objectives could be classified into one of five broad categories (see fig. 3.2). In his later writings he stated that each of these categories represented a qualitatively different human capability (Gagné & Briggs, 1979). One of the major categories he identified, *intellectual skills*, was further elaborated into five sub-categories: discrimination, concrete concepts, rules (which included defined concepts,) and problem solving.

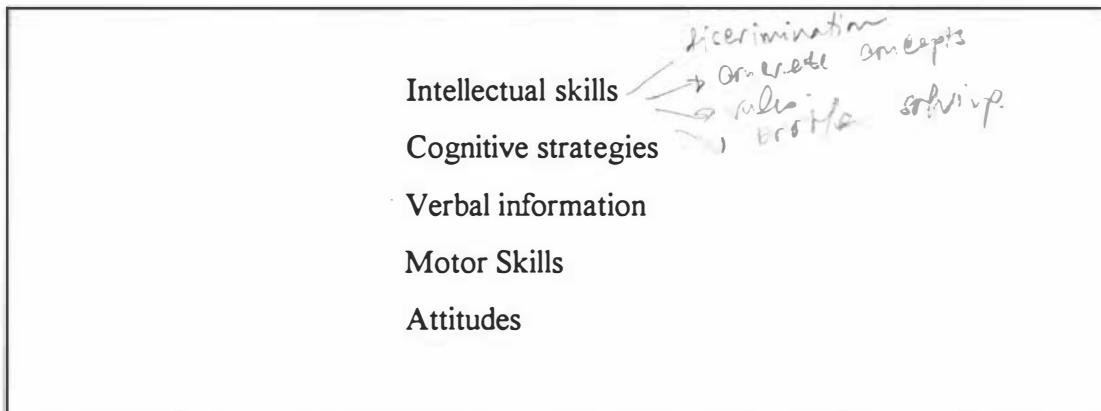


Fig. 3.2: Gagné's Five Categories of Human Capability (Gagné & Briggs, 1979)

Objectives could be classified according to these categories to indicate the kind of learning represented by the objective and to determine the necessary conditions for learning. Objectives could then be further analysed to determine the discrete prerequisite behaviours required for them. Gagné (1965) stated that the knowledge needed for any given task could be organised as a set of subordinate skills and knowledge ascending to a criterion objective. This process began by specifying the desired outcomes of a performance and asking the question "*what would the individual have to know or be able to do in order to achieve this performance, when only instructions are given?*". This question could then be repeated for each subordinate competency until a level was reached in which all the prerequisite behaviours are possessed by the learner. The answers to each iterative question provided the list of contributing skills which formed the abilities hierarchy for the objective. The acquisition of the criterion objective was made dependent upon the acquisition of all the subordinate behaviours ( Hunt, 1976)

Each level of a learning hierarchy embodied the intellectual skills which formed the basis of a knowledge or skills requisite to achieving more complex learning. These knowledge and skills were often referred to as enabling objectives. Gagné's hierarchy differed from Bloom's taxonomy in that the elements of his hierarchy were the integral skills and knowledge that needed to be taught. In contrast, Bloom's taxonomy provided the cognitive difficulty levels for use in evaluating the outcomes of previously learned behaviour.

Three of Gagné's categories are particularly pertinent. Intellectual skills define "*how to do something*" as opposed to learning that "*something exists*". This latter category he called *verbal knowledge* (Gagné & Briggs, 1979). In an information processing model of learning this *verbal knowledge* equated with Glaser's *declarative knowledge*, and *intellectual skills* with *procedural knowledge* (Gagné & Glaser, 1987). The third category, *cognitive strategies* may be defined as strategies which govern the student's own learning and thinking behaviour. These have been called *mathemagenic* behaviours by Rothkopf (1971), *self-management behaviours* by Skinner (1968) and more recently *metacognitive skills* (Peterson & Swing, 1983; Gagné, 1988).

### 3.3.3 Merrill's Component Display Theory

The Component Display Theory (CDT) evolved from an attempt to clarify Gagné's hierarchy. The theory is extremely narrow in its perspective, dealing with only a single idea, such as a single concept or principle at a time. CDT starts from the same assumption as Gagné's hierarchy, assuming that there are different categories of outcome and that each category requires a different procedure for promoting the capability represented by that category. However, Merrill expanded Gagné's single dimension to incorporate both content and thinking level, into a matrix of performance and content (Merrill, 1983) as illustrated in figure 3.3. The intersection of any two dimensions, for example to *use* a *concept* requires a discrete set of instructional strategies.

PERFORMANCE		CONTENT			
Find					
Use					
Remember Paraphrase Verbatim					
	Facts	Concepts	Procedures	Principles	

Fig. 3.3 Merrill's CDT Matrix

Note: The facts-use and facts-find intersections are blocked out because the only level of performance appropriate to facts is "remember".

The content dimension has four categories: facts, concepts, principles and procedures. In terms of this model all knowledge can be classified as belonging to one of these categories. From such a classification it is possible to deduce *what* information is required for learning. For example, to teach a concept such as "conifer tree", the information given to the students must include the name (conifer), the superordinate class (tree), its attributes (needle-like leaves and seed-bearing cones) and the relationship between attributes (the term "and" tells us that it is an intersection relationship between the two stated attributes, that is, both are required to qualify as a conifer).

The second dimension of the model is a categorisation of the cognitive performance. This cognitive performance is the processing level at which the student is expected to apply the content being learnt. The three levels: *remember*, *use* and *find* are associated with either associative or algorithmic memory.

In associative memory, information can be stored in two ways, either literally, that is without any structural change, or in subordinate, superordinate or coordinate relationships, that is, stored in a way which requires some minimal integration.

Asked to perform at this level a student would be required to remember verbatim (stored literally), or remember paraphrase (stored in a relationship). These levels are equivalent to Gagné's *verbal knowledge*, in that a student is required to know that a particular knowledge exists, but not necessarily be able to apply that knowledge. Like Merrill, Bloom used two categories to describe this kind of learning performance: His *knowledge* category equates with Merrill's *remember verbatim* and his *comprehension* matches Merrill's *remember paraphrase*.

Algorithmic memory is a more dynamic form which integrates information into a structure. When the information is retrieved, it is the result of the integration that is produced, not the original information. This kind of processing is called the *use* level. The integration process calls for a personalising of the new information and a continuity with existing cognitive structures so that the student is able to apply the information in new situations and problems. The *use* level fits neatly with Gagné's *intellectual skills* and Bloom's *application* as they all require the student to be able to "do something with" that information.

A more complex use of algorithmic memory involves the reorganisation of information. New schemata (cognitive structures) are created internally, as opposed to being modified and accommodated into existing structures. The student uses an inductive process to examine a set of phenomena and create new schemata to account for similarities, differences, or changes observed in the phenomena being studied. This type of processing is the *find* level which is quite a different category to Gagné's *cognitive strategies* and much more closely related to Bloom's *analysis*, *synthesis*, and *evaluation*. As with Gagné's cognitive strategies, Merrill has suggested that the *find* level can't be directly taught but must be internally developed by the learner.

Each of these three classification systems measures the level of thinking a student must use when learning or performing a particular task or objective; they quantify a significant part of a task's demand. They were developed to assist teachers in improving instruction and assessment by identifying the demand or complexity of

the learning task. A comparison of the three systems reveals a strong similarity in meaning between the different levels of complexity. It is suggested that the basic categories of these systems could be usefully modified into a hierarchy for measuring students' perceptions of the thinking level required by a particular task. Table 3.2 shows this proposed hierarchy which incorporates the levels used by Bloom, Gagné and Merrill, but using simplified terms more readily understood by students.

**Table 3.2 Equivalent Levels of Task Performance**

B. Bloom et al	R. Gagné	D. Merrill	L Hunt
Knowledge	Verbal	Remember verbatim	Memorise
Comprehension	Knowledge	Remember paraphrase	Explain
Application	Intellectual skills	Use	Use
Analysis Synthesis Evaluation		Find	Analyse

Gagné's *cognitive strategies* have been omitted from this classification because they are functionally different from the rest, referring as they do to the executive strategies with which students monitor and evaluate the effectiveness of their learning strategies. While these are critical to learning, they are more related to the student's own level of cognitive maturity, than an appropriate measure of the performance level required by a task. Gagné's single category *verbal knowledge* has been differentiated by other researchers into two sub-categories. This differentiation is also used in denoting *memorise* and *explain* (table 3.2) because such a differentiation within Gagné's *verbal knowledge* category appears justified in terms of a qualitative difference between the two levels. The first level, *memorise* implies that the student need only remember the information without any understanding, whereas at the *explain* level, the student is required to have elaborated the

knowledge to such a level of sophistication that he or she is able to explain the idea in his or her own words.

The content dimension of Merrill's CDT is important for instructional design purposes because instructional strategies are determined by the intersection of performance levels (remember, use and find) and content types (facts, concepts, procedures and principle). Students make decisions about the performance level that is appropriate for a given task. However, there is little evidence they analyse tasks into content types. For this reason the content dimension has been omitted from the simplified categories.

### 3.3.4 Determining the Task Parameters

**Conciseness** Needs assessment, task analysis and behavioural objectives are all methods by which an instructional designer can specify the boundaries of the task domain and the structure of relationships that link concepts and principles within a domain (Hunt, 1986). This is considered an important aspect of determining relevant *teaching* content. However, how do students determine relevant *learning* content? Usually, they are presented with lecture notes, recommended reading lists, set texts and study guides as the raw material for studying. Not all of this material is *essential*. Effective learning requires that they decide which material to include and which to exclude from study considerations. This judgement of inclusiveness of information is regarded as an integral part of assessing the task's demands.

Good learning objectives can help a student in this respect by providing criteria for evaluating the importance of information, and while evidence suggests that some students use these (Kueter, cited in Melton, 1978), many students do not. A more universal measure of this aspect of task demand may be the student's ability to accurately estimate the degree of conciseness, or amount of background material presented in the course.

**Interrelatedness** Earlier it was suggested that instructional designers analyse tasks to determine the relationships between sub-components. An important reason

for this, and of particular concern to Gagné (1965), was the need to ensure that prerequisite skills were learned before more complex skills were taught. This kind of sequencing is more important in some subjects than others. For example, in a subject like mathematics, to teach or learn multiplication before addition may result in failure if multiplication builds and elaborates on the skills and knowledges of addition. Without understanding the principles of the latter it may be impossible to achieve the former. Other subjects have less rigid demands. For example, social studies has many topics which do not have to be learned in any particular order. It is important that students are able to recognise tasks as being either tightly interrelated or loosely connected if they are to effectively manage their learning.

### 3.4 Summary

That the type of strategies a student uses to process information affects the quality of learning is evident from the many studies in which strategy training has improved task performance (Swing, Stoiber & Peterson, 1988; Charles & Lester, 1984; DeCorte & Verschaffel, 1981). When students are not directed to use a particular strategy, what influences their choice of strategy? One area that has received little attention is the interpretation by students of learning tasks. If students consistently apply particular strategies to learning tasks because their understanding of the task or assessment demands lead them to believe that those strategies are appropriate, rather than because of a limited strategy repertoire or a particular motivation orientation, then remedial treatments will need to differ. Teaching students how to analyse a task and thereby to identify the appropriate learning strategies may be much more effective than trying to teach a variety of strategies themselves.

Task analysis has long been used by instructional designers as a means of clarifying task components, structure and demands. Students need to make a similar analysis to determine the best strategies and procedures for learning. In the absence of a method for student analysis of a task it is suggested that methods used by instructional designers be adapted for use by students. As for instructional designers, the four areas which are likely to yield the most useful information to

students are: the *level of thinking* required (memorise, explain, use and analyse); the *conciseness of material* presented for study; the degree of *interrelatedness* between components and the *expected answer format*.



## Chapter Four:

### Study management skills and Learning Strategies

#### Introduction

In previous chapters it has been argued that more specific diagnostic learning tools are needed for understanding and improving learning. These tools will be most useful if they examine the learning process through the student's perception of the experience. The last chapter presented the view that students interpret the learning task in order to determine an appropriate learning response. If such interpretations contribute to the manner in which students approach learning, then being able to identify them may enable educationalists to help students make more accurate interpretations, hence altering the student's approach to the learning process. In this chapter the argument is extended to include two further factors which may affect the student's learning effectiveness; study management skills and learning strategies.

Even at the height of behaviourism, there was a substantial school of thought which rejected the notion that a learner simply responded to teaching stimuli and that all other motives or internal influences were irrelevant factors to his or her learning. Cognitive psychologists emphasised the role of the student as an important active agent in the learning process. For example, Bruner, Goodnow and Austin (1956) found that different strategies were differentially effective for concept learning. Since those early days, cognitivism has replaced behaviourism as the dominant influence on educational psychology, and interest in the role of the student as an active agent in the learning process has flourished. It is now widely accepted that the contribution made by the student is pivotal, and the focus of current research is identifying the precise nature of that contribution.

The student's role in learning has two components: the internal cognitive processes which are used in the act of learning (learning strategies); and other behaviours in which a student may engage that influence learning (study management skills), such

as the amount of time spent studying. In order to understand those elements of the student's contribution which affect success it is important that a clear distinction between these two components be made. Study habits, study skills, study behaviour, study methods, study strategies and learning strategies are all terms that are used interchangeably at one time or another in the literature. Confusion seems to arise from a broad, but common, interpretation of the term *study* to mean all activities undertaken by a student directed towards learning, including learning strategies (Selmes, 1987; Entwistle, 1977; Biggs, 1987). For the purpose of this study the term *study management skills* will be used as a more accurate description of the study skills involved and the term *learning strategies* for the cognitive processes used in learning.

This chapter will attempt to distinguish between learning strategies and study management skills in a way that enables their respective contribution to learning performance to be clarified, to specify which student behaviours should be classified as *study management skills* and to identify as many learning strategies as possible. To avoid confusion the term *study behaviour* will be used as a general term to encompass learning strategies, study management skills and motivation/attitudes. Until the mid 1970's when the work of Ference Marton's group at Göteborg University gave impetus to the influence of learning strategies, researchers used the term *study behaviour* to refer primarily to study management skills and motivation, with less recognition of learning strategies (Entwistle & Entwistle 1970; Entwistle 1971; Entwistle & Brennan, 1971; Holtzman, Brown & Farquhar, 1954; Maddox, 1963). After this time *study behaviour* has been used to mean mainly learning strategies and motivation, with less importance being attached to study management skills.

#### 4.1 Study Management Skills

Structured learning experiences that occur in formal educational institutions differ markedly from other learning experiences. The content, organisation, sequencing and evaluation of learning is largely determined by the institution, not the learning

individuals who are the subject of the learning processes, as might be found in more naturalistic learning contexts. The context and the parameters of learning in educational settings impose a need for skills in addition to those normally required for learning. For example, Piagetian theory (1963) advocates that babies and young children be allowed to learn new behaviours and skills as they reach developmental maturity. While this invariably follows the same sequence, each child arrives at the appropriate state of readiness in his or her own time. Children begin to walk and talk when they are ready, not according to some predetermined timetable. The logistics of dealing with groups of students at schools and universities preclude this individualised approach. Each course has a set time frame within which it must be completed; even demonstrations of learning have rigidly prescribed times (examinations). Not only is time limited, but students have limited access to learning resources such as individual tuition, library books and laboratories. These constraints need to be managed if students are to maximise their learning ability.

Study management skills are functionally different to learning strategies. Study management skills are those behaviours associated with organising and managing learning resources, for example, using a study timetable. Learning strategies, on the other hand, may be defined as "*any cognitive interaction between the student and the learning content for the purpose of remembering or understanding*". This is similar to Dansereau's description of learning strategies as internal processes by learners to identify, understand, retain and utilise information (Dansereau, 1978). Examples of learning strategies include relating new information to existing knowledge, identifying main points and summarising information. Whereas study management skills describe the manner in which the student arranges the *conditions* under which learning occurs, learning strategies relate directly to the *activity* of learning itself. Although these two concepts are recognised as making relatively important independent contributions to learning outcome, they are not always clearly distinguished in the literature (Weinstein, 1987).

Early attempts at identifying effective learning behaviour were based upon analyses of responses of good and poor students (Brown & Holtzman, 1955). The major

focus of efforts to identify and teach good learning and study management skills, in order of decreasing importance, were: (1) reading; (2) methods of learning and memorising; (3) examination techniques; (4) note-taking; (5) planning and budgeting of time; and (6) motives (Maddox, 1963). Many early studies found low correlations between grades and scores on study management skill inventories (for example, Locke, 1940). Even more alarming, a number of studies found that many of the *good* study management skills were practised more by poor students than successful students (Cuff, 1937; Maddox, 1963; Lafitte cited in Biggs, 1970a).

Biggs (1970a) viewed these results as evidence that there was no such thing as *good* study behaviour for most people, most of the time. Brown and Holtzman (1955) argued that the results were either based on inadequate empirical evidence, or came about because not enough emphasis was placed on the importance of motivation. Indeed their own *Survey of Study Habits and Attitudes* (SSHA) which gave a substantial weighting to attitudes, improved these correlations from almost nothing to .50 (men) and .52 (women). An important point in considering these early studies is that the relationships identified were correlational, not causal. Study management skills existed in the presence of high learning performance, but might not necessarily be the cause of it.

A third explanation for the differential effect of study management skills on learning performance may lie in the fact that many inventories which measure study management skills are made from some combination of study, learning strategies, learned abilities (such as reading and note-taking) and attitudes (for example, *Survey of Study Habits and Attitudes* (Brown & Holtzman, 1955); *Study Behaviour Questionnaire*, (Biggs, 1970a); *Student Attitude Survey*, (Entwistle, Nisbet, Entwistle & Cowell, 1971). Three of these components; learning strategies, learned abilities and attitudes, are known to have a direct effect on performance, but not study management skills (Marton & Säljö, 1976a; Boekaerts, 1987). In the presence of one or more of the other three, performance may be enhanced by good study management skills because they (the study management skills) create favourable learning conditions. In the absence of appropriate learning strategies, learned

abilities or positive attitudes, study management skills may act as a crutch to the student, but not contribute greatly to his or her ability to understand or remember information. This situation may account for the fact that while good study management skills were present in both groups of students, they had little effect on poorer students. This view was supported by Biggs (1970a) who found that study organisation (which includes time management and organising learning resources) "*...may be as much a refuge for the poor student as a factor making for success in the good student.*" (p. 290).

A further justification for this interpretation can be found in a study by Spring (1985) who examined the text-learning strategies of good and poor readers. He found that good readers used more *comprehension* strategies, but that both groups used the same amount of *study* strategies. *Study strategies* were defined in this study as those strategies used for remembering after the initial comprehension of the material, such as, outlining the text material. *Comprehension* strategies, such as identifying logical relationships, were used for initial understanding. Spring concluded that poor students relied heavily on study strategies without properly understanding the material first, thereby neutralising any benefit that might have been derived from using these strategies. While *study management skills* are not the same as Spring's *study strategies*, they do play a similar support function. The parallels between Spring's investigation and the learning strategy/study management skills distinction made earlier would seem to merit further investigation of the differential effects that these two classes of strategy, learning and study management skills, might have on learning performance.

#### **4.1.1 Identifying Study Management Skills**

Brown and Holtzman (1955) defined study habits as "*...the mechanics and conditions of studying.*" (p. 77). From this definition they devised two sub-scales to measure study management skills in their *Survey of Study Habits and Attitudes*. They were work methods and delay avoidance. *Work methods* focussed on

organising learning resources such as taking clear notes, and *delay avoidance* measured the student's ability to organise and manage their time.

Entwistle, Nisbet, Entwistle & Cowell (1971) developed a similar questionnaire which was substantially based on the Brown & Holtzman inventory, and modified for use in Britain. *The Student Attitude Inventory* (Entwistle, Nisbet, Entwistle & Cowell, 1971) had 14 items that measured *study methods*. Four of these related to mood or attitude rather than study methods, for example the item "*Background music helps me to study more effectively*". The remaining ten items measured time management, organising resources and goal setting. An example of time management was: "*My habit of putting off work leaves me with far too much to do at the end of term*". "*My lecture notes are often difficult to decipher afterwards*." was an example of an item measuring organising resources. "*I usually plan my week's work in advance, either on paper or in my head*." was an example of goal setting.

At approximately the same time as Entwistle was developing *The Student Attitude Inventory*, Biggs' (1970a) in Australia, was producing the *Study Behaviour Questionnaire* (SBQ), later to become the *Study Process Questionnaire* (SPQ). One of the scales in the SBQ, called *study organisation*, equated with Entwistle's *study methods*. It included items which measure scheduling of work (time management) and organising resources (for example, re-reading lecture notes to check legibility). Biggs added *planning exam answers in advance* to the study organisation scale, whereas Entwistle used a separate scale for examination techniques. The later version of Biggs' questionnaire, the SPQ, collated these study management skill items into an *achieving strategy* scale. The seven items in this scale placed more emphasis on *organising resources* (for example, "*I keep neat, well-organised notes for most subjects*."), and less on *time management*.

The *Learning and Study Strategies Inventory* - LASSI (Weinstein, Schulte and Palmer, 1987) was developed by a research group at the University of Texas as part of a project to address the problem of academically under-prepared students in

tertiary education. A major obstacle identified by the team was the lack of appropriate instruments for diagnosing student learning and studying difficulties, prompting the development of the inventory. The LASSI has 10 scales which measure three clusters: learning strategies, study skills and attitudes. Two of the scales that relate most directly to study skills are time management and study aids. The time management scale evaluates the students' ability to create and use schedules to make the most effective use of their time. How well students can use cues in learning materials to identify important ideas, the degree to which they check the completeness of their learning resources and whether or not they take advantage of aids such as review sessions, are all behaviours measured by study aids. The study aid scale is primarily concerned with organising learning resources, although it includes some learning strategies.

Consistent in the study management skill inventories reviewed from 1955 to 1987, and across different countries, from Britain, Australia and the United States of America, were the two components: *time management*; and *organising learning resources*. It is suggested that these two components describe the essential ingredients of the term *study management skills*. Some of these inventories also include items which measure attitudes, exam techniques and learning strategies, but such inclusions would seem to reflect idiosyncratic biases rather than any broad based agreement.

Study management skills can be defined as *student behaviours which attempt to manage the constraints on learning*, imposed by formal institutions of learning. They include making the most effective use of time by planning, goal setting, and avoiding procrastination, as well as effectively organising learning resources. Examples of learning resources might include lecture notes, libraries, extra tutorials, old examination papers, mentors and textbooks. Students who are good at organising their learning resources access additional opportunities for learning such as extra tutorials, have full study notes, complete the required readings and know how to use the cues in textbooks to identify significant information. These behaviours are essentially organisational in nature and differ functionally from

*learning strategies* which describe how students process the information they are trying to learn. Learning strategies are cognitive in nature, though they may manifest themselves in activities such as drawing diagrams.

## **4.2 Learning Strategies**

Learning is achieved through using strategies to attend to, select from, organise, store, retrieve and use information. This contrasts with the behaviourist view of a passive absorption of information in the presence of the appropriate stimuli (Weinstein, 1978; Rigney, 1978; Tulving & Donaldson, 1972). These processes are called *learning strategies*. As such they exclude metacognitive strategies which are also important to learning, but function as executive managers of the cognitive process rather than as part of the process itself. Metacognitive strategies monitor and evaluate learning strategies, but are not learning strategies in terms of the definition given above (Snow & Lohman, 1984; Sternberg, 1984).

### **4.2.1 Learning Strategies and Learning Performance**

The literature on learning strategies is reviewed with two aims in mind: first, to confirm that learning strategies do in fact impact directly on learning performance and secondly, to identify the widest possible range of learning strategies that might fall within the definition given earlier.

The first of these aims was to establish a relationship between learning strategies and learning outcomes. Bloom & Broder (1950) addressed this issue in their studies which found four significant differences between good and poor problem solvers. They were:

1. the manner in which they understood the nature of the problem;
2. their understanding of the specific ideas contained in the problem;
3. their approach to the solution;
4. their attitude towards the solution.

Good problem solvers were overall much more active in each of these areas. Poor problem solvers were passive, seeming to believe that learning is a process of absorbing information that is later repeated. "*If you don't have the information (that is, know the solution) then nothing can be done to solve the problem*". Their study suggested that good problem solvers or learners more actively processed information. These learners tended to use learning strategies other than rote repetition.

Bloom & Brody's findings were later supported by Craik & Lockhart (1972) who proposed a *levels of processing* hypothesis. They stated that memory of an event was a by-product of perceptual analyses. Shallow analysis focussed on the physical or structural features of the object, while deeper analysis aimed to extract meaning and create associations with existing knowledge. Deeper analysis resulted in more sophisticated encoding, enabling higher levels of recall. Later work suggested that the original interpretation had been overly simplistic in accounting for all the perceptual and cognitive analyses that could be used during encoding. Later some modifications were made to the model, but the central concept of depth of processing remained (Craik & Tulving, 1975; Lockhart, Craik & Jacoby, 1976).

At about the same time other investigators were reaching similar conclusions but from different perspectives. Biggs (1970a; 1970b) sought to establish the relationship between personality traits, such as neuroticism, and academic achievement. He found only weak direct links, but made the more important discovery that particular learning behaviours evidenced a much stronger relationship to academic achievement. He concluded that personality traits predispose students to use particular strategies. When the nature of the learning task matched these strategies a positive effect on performance could be detected. Implicit in these findings is the notion that learning strategies are differentially beneficial depending upon the context. Successful students in any particular context use different strategies to less successful students. However, in a different context these same strategies may not lead to the same success. Later studies by Biggs (1976)

confirmed that some strategies, in particular rote learning, are consistently associated with poor performance.

The Göteborg studies of the mid-1970's gave sharper focus to the learning strategy-learning outcome debate. Two broad classes of learning strategy were identified: deep and surface (Marton and Säljö, 1976a; 1976b). Deep strategies were associated with more meaningful and sophisticated levels of performance outcome, while surface strategies were reflected in qualitatively lower levels of understanding. These studies used small groups and focussed on one type of academic task; namely reading text extracts from social sciences.

Work at Lancaster University, under the direction of Entwistle (Entwistle, 1987) extended the work of Ference Marton's research group to examine students in a wide range of academic tasks. They established that a deep approach included a variety of learning strategies and that some groups of strategies were more appropriate in one academic area than in another. Also, students seem to achieve understanding in a deep approach by different routes. While some preferred to relate evidence to conclusions and examine the logic of the argument (operation learning), others tried to personalise learning by relating new ideas to previous knowledge and everyday experiences (comprehension learning). Entwistle (1981) suggested that an interplay between both comprehension and operation learning was the most effective deep approach.

From the above studies it can be concluded that successful students interact with a learning task in a more complex and sophisticated cognitive manner than less successful students. This is not to suggest that all successful students slavishly follow the same procedure. On the contrary, different contexts and different individual preferences implicate a variety of possible strategy combinations. However, these strategies are qualitatively different to the surface strategies adopted by less successful students.

#### 4.2.2 Identifying Learning Strategies

As it was argued in Chapter Two, broadly classifying a student as having a *deep* or *surface* approach to learning provides little information on what a student is doing wrong, or not doing at all, in relation to a particular learning task. Such a diagnosis requires a measure of the complete strategy mix a student uses. Inventories which selectively measure strategy use may miss important aspects of the student's strategy orientation in any given situation. To avoid the hazards of selectively measuring strategies, this study has identified an extensive list of learning strategies, both in the literature and from working with students. Those learning strategies found in the literature are described in the following section.

One of the most extensive lists of learning strategies was developed for inclusion in the *Learning and Study Strategies Inventory - LASSI* (Weinstein, Schulte and Palmer, 1987). This inventory had ten scales, five of which measured learning strategies. Some of the five scales purporting to measure learning strategies also included measures of study management skills. These five scales, plus a sample item from each were presented in table 4.1. A complete list of learning strategies suggested by items in the inventory that conform to the definition, "*any cognitive interaction between the student and the learning content for the purpose of remembering or understanding*" is shown in Appendix A.

**Table 4. 1: Scales and sample items from LASSI**

Scale	No. Items *	Example
information processing	8 out of 8	I translate what I am studying into my own words
selecting main ideas	5 out of 5	I have difficulty identifying the important points in my reading
study aids	6 out of 8	I use special helps, such as italics and headings, that are in my textbooks
self testing	7 out of 8	I try to identify potential test questions when reviewing my class material
test strategies	2 out of 8	When I study, I have trouble figuring out just what to do to learn the material.

\* number of items in the scale that measure learning strategies according to the definition of learning strategies used in this study

All of the items of the *information processing* and *selecting main ideas* scales fit the definition of learning strategies given earlier. The remaining three scales contain some learning strategies, but many items are measures of other than these strategies. For example, item 50 from the study aids scale "*I make drawings or sketches to help me understand what I am studying.*", is a learning strategy because changing information from note form into diagrammatic form requires that the student to identify relationships between the ideas being studied. Item 24 on the other hand, "*I compare class notes with other students to make sure my notes are complete.*", requires the student only to identify the presence of information, not to interact with it. Therefore it conforms more closely to the definition of a study management skill.

The Australian equivalent of the LASSI, Biggs' *Study Process Questionnaire* (SPQ) evolved from an original project to predict student performance at university (Biggs, 1987). The SPQ combines matched sub-scales of strategies and motives for learning to produce an overall "approach" to learning. The strategy scales include learning strategies, but also other types of strategies such as organisational and study

management skills. Three classes of strategy are identified; *surface*, *deep* and *achieving*, each with a corresponding set of motives.

The two scales that contain items measuring learning strategies are *deep strategies* and *surface strategies*. While the strategies from the deep scale all conform to the learning strategy definition, some of the items on the surface scale also measure attitudes and preferences. For example, " *I think browsing around is a waste of time...*" is an item measuring attitude. The complete list of learning strategies from the SPQ is given in Appendix B.

Ian Selmes, a geography teacher in Edinburgh, researched learning in Scottish secondary schools (Selmes, 1987). As part of his research he developed the "*Studying at School Inventory (SASI)*" which has five scales: *deep approach*, *surface approach*, *organisation*, *motivation* and *hard work*. The first two of these scales, *deep* and *surface* approaches, contained items relating to learning strategies. A number of items in the surface approach scale were deemed not to measure learning strategies, but preferences for structure. Many of the items in these scales are closely related to the *deep* and *surface* strategies in the SPQ. The complete list of learning strategies from the SASI is given in Appendix C.

Spring (1985) hypothesised that the learning strategy profiles of good and poor readers would differ. He found that comprehension learning strategies were a powerful discriminator between the two groups of students, but that a group of learning strategies he called *study strategies*, which he defined as those used for "...remembering text material *after* initial comprehension of that material." (p. 58), were used equally by both groups. Poor readers relied heavily on study strategies without first understanding the material. The learning strategies, both comprehension and "study", which were identified by Spring are included in Appendix D.

An important group of learning strategies that seemed to be universally ignored in questionnaires and inventories is mnemonics. These are techniques for making

information more memorable either by reducing the information, as in the use of acronyms (for example, NZ for New Zealand), or by elaborating the information, as in associating a word with other words, meanings or visual images (for example, remembering someone's name as Helen - think of melon and a rotund person). The power of mnemonics has been repeatedly demonstrated (Bower, 1970; Wood, 1967), usually in the context of a task performed by two groups. In these studies a control and an experimental group made up of students who have been taught a particular mnemonic strategy, are compared. Many mnemonic strategies are sophisticated devices passed down or developed from systems used by the early Greeks (Weinstein, 1978) and are unlikely to be used as such spontaneously by students, which may explain their omission from learning inventories. However, it is suggested that the basic principles of mnemonics, such as using rhymes, visual, phonetic and semantic associations, are used by students as a means of helping them remember important information. These strategies are often an important part of check-lists in aviation or control systems where critical procedural steps must be undertaken in sequence. In spite of this usage there appears to be little research evidence for its spontaneous use in student learning.

Mnemonics are a group of learning strategies that may be too important to ignore in any study of learning for the following reasons: (1) many studies have demonstrated that they are extremely powerful for improving memory when compared with the alternative, rote rehearsal, and (2) remembering significant amounts of information for examination purposes is characteristic of most educational systems (Watkins & Morstain, 1980; Weinstein, 1978).

### **4.3 Summary**

Study management skills and learning strategies are two functionally distinct groups of processes which make independent contributions to learning performance. Study management skills are those behaviours the student uses to manage the constraints and conditions of learning. The literature suggests that the two important components of study management skills are time management and organising

learning resources. Some researchers also include goal setting, which is a close relative of time management.

Study management skills may have a positive effect on performance in the presence of appropriate learning strategies by creating conditions which allow these strategies to be maximised. For some students who rely on rote learning, or other inappropriate strategies, study management skills may act as a placebo to make them feel better. In reality there is little evidence that they contribute much to a student's ability to remember, understand and use information.

The quality of the learning strategy used impacts directly on the learning outcome. A wide range of learning strategies can be identified from the literature, but the important point is that all learning strategies are not equally effective or appropriate. The quality of learning outcome is best when the nature of the task, individual preference and learning strategy are matched.



## Chapter Five

### Learner Characteristics

#### Introduction

Three factors have been presented as contributing to learning: the students' interpretation of the learning task, their study management skills and their learning strategies. This chapter presents the view that certain characteristics of the individual student also influence the manner in which the student responds to a learning task.

Learner characteristics can be defined as those personal variables which are likely to influence the quality of educational achievement for a given student. Traditionally, a rather restrictive view has been held for this dimension; namely, the effect of an individual's intelligence quotient. In more recent times learner characteristics have been more broadly conceived as including a student's age, gender, personality type, cognitive style, level of trait and state anxiety, cultural background, motives for studying and prior knowledge. To date, no study has attempted to explore the cumulative effect of these variables on individual performance. This study also has not attempted to estimate the impact of the sum of these personal variables on learning performance. However, some of these variables have been well researched and are clearly important contributors at different stages in the learning process. For example, age (Watkins, 1982b; Biggs, 1985) and motive (Biggs, 1987) have been identified as important learner characteristics which affect a student's choice of learning strategies. Prior knowledge has been identified as a key determinant to learning success (Chi, Feltovich & Glaser, 1981; Chi, Glaser & Rees, 1982). Its role in learning has been extensively researched and its importance consistently established. In this study only those learner characteristics which had been previously identified as important by other researchers in the field have been included. These are: age, motive and prior knowledge. An exception was made in the case of gender. Gender as an influence

on learning behaviour has been largely ignored in studies on learning strategies. To redress this neglect it was also included in this study. A further description of each of these attribute variables follows.

### 5.1 Age

Biggs (1987) has argued that as an individual ages he or she tends to use deeper learning strategies. A similar view is presented by Perry (1970), who through a series of interviews with a group of students over a four year period proposed a kind of intellectual maturation. In the early stages students saw knowledge of the world as black and white; right or wrong. Over time the student moves through a period of confusion with regard to the nature of knowledge but, finally reaches a state of *relativistic reasoning*. At this point the student has developed a personal interpretation of the world and a recognition that others may hold alternative views of reality. The student interprets new knowledge in light of the personal philosophy and experience of life that he or she has developed. Both Biggs' and Perry's views are consistent with the notion that the increase in knowledge from studying or life experiences provides a broader context for understanding new content, thus fostering the use of comprehension strategies which relate the new content to existing knowledge.

### 5.2 Gender

The issue of differences in patterns of learning between males and females has been relatively neglected (Richardson, 1993). Generally, the small group of studies which have examined these differences have produced results that are statistically reliable, but small in magnitude and inconsistent between studies (Watkins, 1982b; Watkins & Hattie, 1985; Harper & Kember, 1986; Miller, Finley & McKinley, 1990). By and large most studies have matched gender differences to content types - females being more effective in global content areas and males in analytical contents. As Richardson (1993) has suggested "...*there has developed in the last decade a very influential research tradition which maintains that female students exhibit conceptions of knowledge, truth and learning in their intellectual development that*

*are qualitatively different from those of male students...Nevertheless, there is no clear evidence of differences between male and female students either in their general orientations to their studying or in particular aspects of studying behaviour”* (pp. 10-11). This contradiction in perception suggests the need for determining the veracity of this learner characteristic variable.

### 5.3 Motive

The link between motive for studying and learning approaches is well established in the literature (Marton & Säljö, 1976a; 1976b; Biggs, 1978; 1985; 1987; Entwistle & Ramsden, 1983 ). The three motives identified in these studies were surface, deep and achieving. It is plausible to expect from these studies that motive is likely to influence a students' choice of learning strategy. Contrary to the close link found in these studies Sternberg has argued that the methodological restrictions intrinsic to experimental manipulation of *motive* make it extremely difficult to identify the direct effects of this variable in learning. As Sternberg (1984) has said “...*despite decades of research and countless attempts to measure this attribute there exists no generally accepted measure of human motivation that seems to predict or define this construct across a variety of tasks and situations...*” (p. 137). It seems clear that no study involving a student's choice of learning strategy can be understood without an attempt to take into account the individual's motives for choosing such strategies

### 5.4 Prior Knowledge

A major argument presented in a previous chapter revolved around the importance of learning strategies to learning outcome. Learning strategies are most effective when used in conjunction with an adequate body of prior knowledge. Prior knowledge can be defined as content related information and skills, that is, relevant knowledge the student already possesses (Gagné, 1980). It seems reasonable to expect that a student's existing knowledge of a set of cognitive structures will have a facilitative effect in the attainment of related, but different, cognitive structures. In fact, Gagné (1970) suggested that the previously learned capabilities may enable a student to “skip over” a particular sub-ordinate skill and learn a more complex

super-ordinate skill without referring to its sub-ordinate elements. In terms of learning efficiency this could mean that when antecedent elements of a particular knowledge structure are present, related new structures could be learned more easily than when no antecedent elements were present (Hunt, 1976).

Much of the research on prior knowledge has concerned the predominance of either strategies or prior knowledge on learning effectiveness. Early work in the 1960s and 1970s emphasised the importance of strategies using *knowledge-lean* tasks (Minsky & Papert, 1974). While these studies provided some insight into information processes they contributed little to the advancement of educational learning with its *knowledge-rich* domains. More recent work has moved the focus back to these knowledge domains. These studies have illustrated the critical importance of prior knowledge to successful learning, and the interesting relationship between strategies and knowledge structures (Glaser, 1987b).

High prior knowledge students are able to demonstrate better recall and superior processing ability (de Groot, 1965; Chase & Simon, 1973; Chi, 1978; Chi & Koeske, 1983). The better performance of high knowledge students can be attributed to their knowledge of the content rather than their use of processing strategies *per se*. Changes in the student's knowledge base appears to facilitate changes to processing capabilities. As Siegler & Richards (1982) conclude "*knowledge of specific content domains is a crucial dimension of development in its own right and that changes in such knowledge may underlie other changes previously attributed to the growth of capacities and strategies*" (p. 930).

A sufficient knowledge base is prerequisite for the implementation of some strategies (Gagné, 1980; Baker & Brown, 1982) and an extensive knowledge base facilitates the effective deployment of strategies (de Groot, 1965; Chase & Simon, 1973; Chi, 1978; Chi & Koeske, 1983; Glaser, 1987b). Equally, the kind of strategy used affects the extent to which a knowledge structure is learned (Sweller & Levine, 1982). It has been suggested that the relative importance of either strategies or knowledge to successful task performance depends on the degree of structure in the

task (Alexander & Judy, 1988). When a task is ill-structured the student must contribute to working out *how* to perform the task as well as actually performing it. Well structured tasks tend to have more clearly defined procedures for performance. The key to success is skill in performance.

Studies which demonstrated the importance of prior knowledge (for example, Chi, Feltovich & Glaser, 1981; Chi, Glaser & Rees, 1982) were conducted in areas which were procedurally rich or highly structured. Tasks that were ill-structured favoured the use of strategies (Greeno, Magone & Chaiklin, 1979; Lundeberg, 1987; Voss, Blais, Means, Greene & Ahwesh, 1986). An important consideration in this is, as Greeno Magone & Chaiklin (1979) point out, the task representation. A well-structured task with a rich knowledge base may appear ill-structured to a student with low prior knowledge.

Learning occurs as a result of the interplay between strategies and prior knowledge. Each facilitates and enhances the other. Students learn when they use learning strategies to interpret new knowledge in terms of what they already know. Available knowledge fosters an improved ability to create even more complex knowledges that may in turn be restructured and modified.

## 5.6 Summary

Traditionally, learning opportunities have tended to be constrained by age. Older students have been thought of as being less able to acquire complex knowledge structures typical of tertiary learning experiences. Similarly, gender has been viewed as an inherently predisposing variable which has justified the exclusion of certain content areas to one or the other gender. Neither of these assumptions have sufficient empirical evidence to justify the exclusion of these variables in a study of learning behaviour.

Biggs has stated the learning process complex is presumed to refer primarily to motives and strategies for learning (1987). In this context a student's encoding strategy of a learning context is thought to be directly influenced by the motives he

or she may have in pursuing the purpose of the learning itself. Thus a study which presumes to interpret strategy constructs must take into account the underlying motives which might trigger the use or non-use of a particular array of learning strategies.

The argument for the effectiveness of prior knowledge as a determinant of the quality of learning outcome is irresistible. Evidence demonstrates an interaction between strategies and prior knowledge during the learning process. No study of learning strategies could be usefully undertaken without consideration to the role of prior knowledge.

### **Summary of Literature Review**

This literature review has suggested the need for more specific tools for diagnosing learning performance. Some weaknesses with existing instruments were discussed and alternative approaches suggested. The case was made for viewing learning in two stages. First, identification of those variables which influence the selection of learning strategies. Others have tried to improve learning with strategy training, however, understanding the *cause* of strategy selection may provide more effective ways of changing strategy use. It has been proposed that an important but underrated influence in this process is the manner in which the student represents the learning task. In the second stage the importance of learning strategies to learning outcome is examined. The contribution of prior knowledge to this process is noted. It is further suggested that the interaction between learning strategies and prior knowledge may be affected by the conditions under which the interaction takes place. An important sub-set of learning conditions is the study management skills which the student possesses. Good study management skills are thought to foster the learning process by maximising learning resources, while poor skills create obstacles that limit opportunities for learning.

In all of this the context of the learning task will dictate the student's response to that learning task. As the context changes so will the student's perception of the task and the tools he or she brings to bear on the problem.

## Chapter 6

### Methodology

#### 6.1 Research Problem

In Section One of this study the case was made for an investigation of the effects of student interpretation of a learning task, the nature of the task itself, learner characteristics and the use of study management skills on the choice of learning strategies; and the influence of learning strategies, study management skills and prior knowledge on learning outcome. It was argued that previous approaches to analysing learning behaviour were deficient in that the traditional macro focus of these studies failed to take cognisance of specific strategies and variables which might, in more idiosyncratic ways, provide diagnostic information for improving the quality of learning. Throughout the literature review an argument was presented for shifting the focus of attention from normative macro-based studies of learning to micro-based profiles of student learning, in which the specific influence of task context on choice of learning strategies could be traced through to the resultant effect of those learning strategies in conjunction with study management skills and prior knowledge on the achievement of the task. Specifically the research questions to be answered were these:

1. What patterns of learning strategy use do students exhibit?
2. How do students represent tasks?
3. What study management skills do students use?
4. How do study management skills, task, task representation, motive, age and gender influence the selection of learning strategies?
5. How do study management skills, prior knowledge and learning strategies influence learning outcome in a generic context?
6. How do study management skills, prior knowledge and learning strategies influence learning outcome in a task specific context?

## 6.2 Overview of the Research Methodology

The first stage of the research methodology was to find or develop suitable measurement instruments. This was carried out over a two year period from 1990 to 1991. An existing questionnaire, the Study Process Questionnaire (SPQ), was trialled but found to be weak for reasons which have already been discussed. Other learning strategy and study management skills questionnaires were also examined, but rejected for similar reasons.

Based on the weakness of the previously analysed instruments a new tool was constructed which focussed on the three pertinent dimensions hypothesised as critical determinants for learning. These dimensions, learning strategies, study management skills and task representation, were progressively developed and trialled through a series of instrument studies. These instrument studies are described in the sections dealing with the development of each of the three measures. In parallel the SPQ was administered to provide comparative information, with the motive scales being used to measure students' motives for learning. No measures of students' task representation could be found and this measure was developed based on instructional design principles.

Each of the measures were trialled in late 1991 on a final sample of 27. Reliability measures were determined for each measure resulting in some minor changes to some of the items. From this effort the final research questionnaire was constructed.

This questionnaire, called the *Approaches to Learning Inventory* (ALI), consisted of five parts: Study Management Skills; the Study Process Questionnaire; Learning Strategies; Learning Task Profile (task representation) and Learner Characteristics. This instrument was administered to five selected classes from two university faculties in April 1992 a few days after they had completed an assignment for the course. The marks from these assignments were used as a dependent variable and were added to the data when they became available.

### **6.3 Population**

The population for the study was made up of second year students from the Business Studies faculty and second and third year students from the Technology faculty at Massey University. At the time of the study there were 655 second year students enrolled in the Business Studies faculty, 169 second year students and 152 third year students in the Technology faculty. First year students were excluded from the study to avoid any lingering effects of “surface” learning strategies from high school. This effect is apparent in about half of first year University students (Entwistle & Robinson, 1976; Marton & Säljö, 1976a). As students progress through the University system they begin to adopt a deeper learning style (Perry, 1970).

### **6.4 Sample**

Second year classes were targeted in preference to third years because they are generally larger. One third year class which met the criteria of size was included. Class size was an important determinant of inclusion because it was intended to group students on the basis of class for some of the analysis. After consultation with Heads of Departments, three possible 200-level Business Studies classes were identified, namely: accounting, management and human resource management. Unfortunately, the course controller of the management class declined access to her class and another management class was substituted. Two further classes were identified in the Technology Faculty; mechanical systems, and technical mathematics.

#### **6.4.1 Selection**

Students were invited to participate in the study late in the first term. This was done to allow the class rolls to settle and to coincide with the completion date of the first assignment for all of the classes.

One week before the administration of the instrument the five classes were addressed by the researcher. The purpose and objectives of the research were

explained and students were invited to take part by turning up the following week at their regular class time. Those who volunteered to participate were offered individual feedback on their responses and a booklet on learning strategies. A final sample size of 479 was achieved. The break-down of this sample into classes is shown in table 6.1. An inspection of the responses from the two technology classes suggested no discernible differences in student characteristics, the variables measured, the nature of the learning task or learning outcomes so the two classes were combined for analysis.

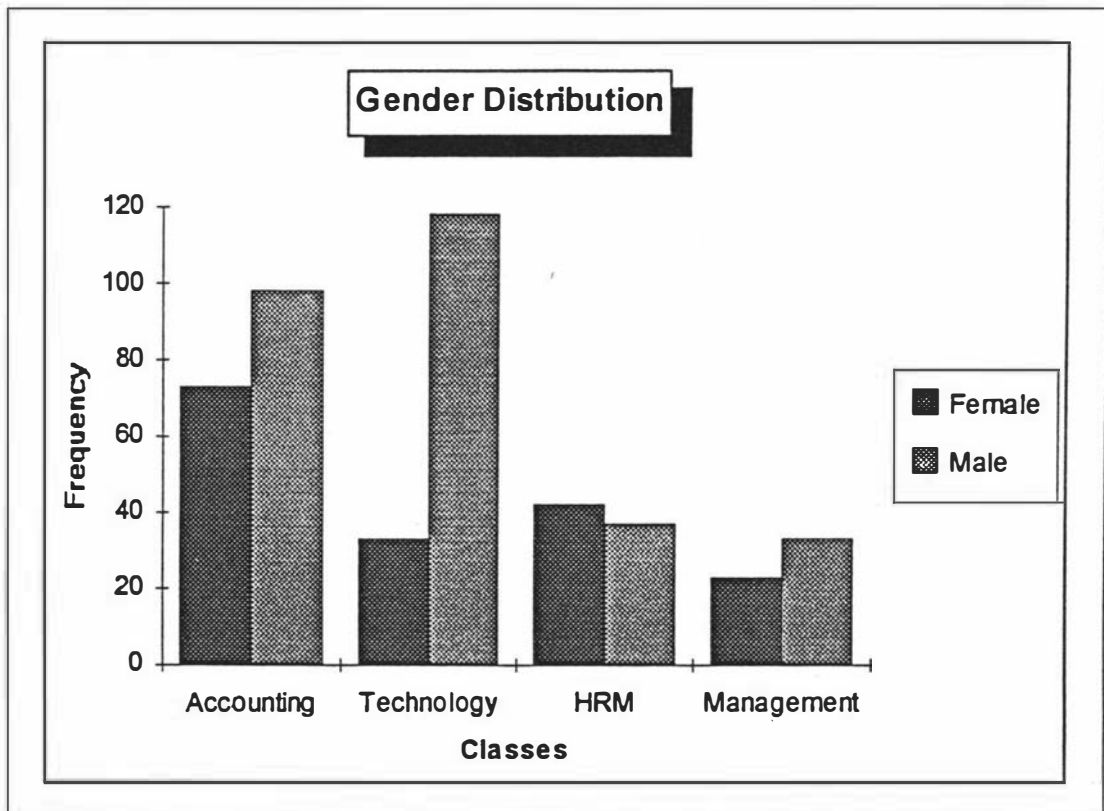
**Table 6.1**      **Distribution of Students across Classes**

	Accounting	Technology	HRM	Management	Total
Class size	175	152	93	59	479

-

#### **6.4.2 Characteristics of Sample**

Of the 479 respondents, 296 (62%) were male and 181 (38%) were female and all were enrolled as second or third year students at Massey University. Figure 6.1 shows the distribution of gender across the four classes. Males dominated the technology classes and are more pronounced in the accounting class. Both management and the human resource management classes had relatively even distributions.



*Figure 6.1: Gender Distribution Across Classes*

Figure 6.2 illustrates the age distribution of students across the four classes. Three of the classes (accounting, technology and management) are characterised by a large proportion of students under 25, this is particularly noticeable in the technology class. The human resource management class has a more evenly distributed age range, though with a small number of under 20 year olds.

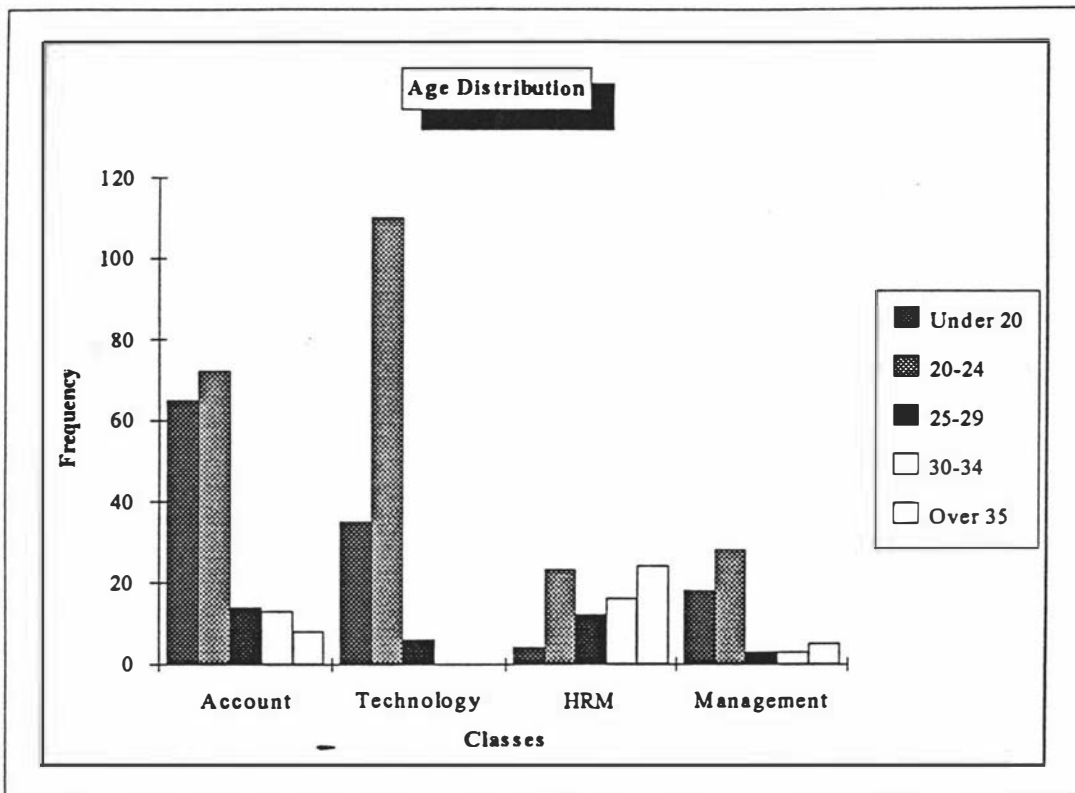


Figure 6.2: Age Distribution Across Classes

The distribution of students according to ethnicity, shown in figure 6.3, was not significantly different across classes. Europeans represented 85.7% of the sample, Asians 7.7% and Polynesians (including Maoris) 6.3%.

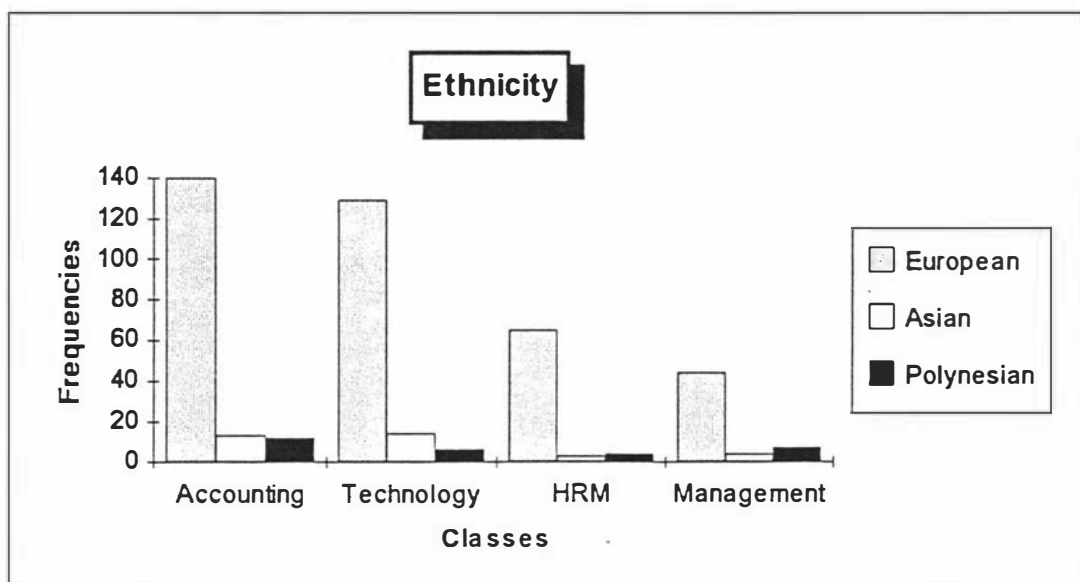


Figure 6.3 Ethnicity

### 6.4.3 Data Collection Methods

The questionnaire was administered in the students' regular classroom during a scheduled lecture session shortly after they had handed in their first assignment for the course. Students were informed that their responses would be confidential. Some students expressed concern that the results may in some way be used as part of their assessment for the paper. They were assured that this would not be the case. Students were able to complete the questionnaire in 35 to 50 minutes. Results from their assignments were collected directly from the lecturers after the assignments had been marked and were added to the data.

## 6.5 Description of the Questionnaire

A total of five measures were administered: Study Management Skills, the Study Process Questionnaire (SPQ) from Biggs (1985), Learning Strategies, Learning Task Profile as a measure of the students' task representation and learner characteristics were collected in the biographical information in the very last section. Four of these measures were developed for this study. Their development from three instrument studies and a final pilot study before the main administration is described. Definitions of variables, explanations of the purpose of each test, and how they were constructed is now presented along with details of their reliability and validity.

### 6.5.1 Study Management Skills

To make a clear distinction between learning strategies and study management skills, *study management skills* are defined in this study as “*those behaviours associated with organising and managing learning resources and opportunities, including time*”, for example, using a study timetable. They are seen as the manner in which the student arranges the *conditions* under which learning occurs and are functionally different to learning strategies.

Study management skills inventories reviewed from 1955 to 1987, and across different countries, from Britain, Australia and North America (Holtzman, Brown, & Farquhar, 1954; Entwistle, Nisbet, Entwistle & Cowell, 1971; Entwistle and Ramsden, 1983; Biggs, 1985; Selmes, 1987; Weinstein, Schulte, & Palmer, 1987; Zimmerman, 1989) suggested that the two components of *time management* and *organising learning resources* described the essential ingredients of *study management skills*. Scrutiny of these inventories revealed time management as having two underlying dimensions, “*keeping to a regular timetable*” and “*procrastination*”. Organising resources has the dimensions of “*having notes that were complete, clear and organised*” and “*accessing important information*”.

Before developing a new instrument, the suitability of existing instruments was investigated. Though a number of questionnaires were identified as having useful items, no instrument could be found that measured study management skills as they have been defined in this study. For example, of the 14 items in Entwistle, Nisbet, Entwistle & Cowell’s (1971) *The Study Attitude Inventory* that measured *study methods* 4 related to mood or attitude (for example: “*Background music helps me to study more effectively.*”). The SPQ (Biggs, 1985) has a scale *achieving strategies* which evolved from the *study organisation* scale in his Study Behaviour Questionnaire, but the emphasis in this scale is on organising resources and time management or planning are not strongly represented. The LASSI (Weinstein, Schulte, & Palmer, 1987) includes a scale on time management and another on study aids but these contain a number of items that might more properly be called learning strategies than study management skills, for example: “*I use chapter headings as a guide to identify important points in my reading.*”. In order to clearly distinguish between study management skills and learning strategies it was deemed necessary to develop a new measure which more adequately measured study management skills. Items from the reviewed instruments were selected and reworded. Rewording was necessary to ensure the questionnaire had credibility with a 1990’s New Zealand audience. Scales were developed to represent the two components identified earlier: time management and organising learning resources.

From the reviewed questionnaires all items relating to *keeping to a regular timetable, procrastination, having notes that were complete, clear and well organised* and *accessing important information* were extracted. Items were inspected for duplication and a number were deleted. The remaining items were then rewritten into more appropriate terminology resulting in a twenty-one item questionnaire.

This questionnaire was trialled on a small group of students (N=7) in the second instrument study. An analysis of the results and discussions with the students resulted in a number of changes. Four items were dropped for being either ambiguous, repetitive or not characteristic of student behaviour. For example, one item *After a lecture I check over my notes* was unanimously rejected by students as not representing normal student behaviour. All students agreed that it was ideal behaviour, but claimed study pressures were such that it wasn't feasible. This view was substantiated by many students subsequently questioned by the researcher. Two additional items were suggested by students relating to goal-setting and attending review sessions. The final version contained 19 items, 17 of which were reworded items from existing questionnaires and two from students. Students rated how closely the items reflected their own study behaviour on a five point Likert-type scale shown below.

- |   |   |                              |
|---|---|------------------------------|
| 1 | - | rarely or never true         |
| 2 | - | not so often true            |
| 3 | - | true about half the time     |
| 4 | - | generally true               |
| 5 | - | always or almost always true |

The 19 items which made up the Study Management Skills were piloted on another 27 students. The 19 items, as a total measure of study management skills, had good internal reliability with a coefficient alpha of 0.80. The scale of time management with 9 items had a coefficient alpha of 0.69 and for the organising study materials scale (10 items)  $r=0.63$ . One question (item 9) was rewritten into a positive format.

The students agreed the questionnaire had face validity (Nevo, 1985). The scales are presented in tables 6.2 and 6.3. The sources from which the items were derived are shown in table 6.4.

**Table 6.2 Items Measuring Time Management**

2.	I often find myself working late the night before a test or assignment.
3.	I start each study session with the aim of getting through as much material as possible.
5.	I set aside regular periods for study and stick to them.
7.	When I set myself a study timetable I often find other things crop up and ruin it.
8.	I set specific goals for myself every time I study.
10.	When faced with an assignment or study I find it hard to know where to begin..
11.	I complete assignments comfortably before the due date.
12.	I work out exactly how much I'll cover in a study session.
15.	I plan a study timetable well in advance of examinations.
18.	I usually leave assignments or study until the last minute.
19.	I find out all the assignment and examination dates early in the course.

**Table 6.3 Items Measuring Organising Study Materials**

1.	My lecture/study notes are complete and well organised.
4.	I always have the text available to check references in lectures and when studying.
6.	I find it difficult to sort my notes into logical units for studying.
9.	I'm usually good at taking notes at lectures.
13.	I make it a priority to get all the information I can on how the course will be assessed.
14.	I add notes from additional readings to my lecture notes.
16.	When they are available I attend tutorial/lecture review sessions.
17.	I can usually get down the main ideas clearly at lectures.

**Table 6.4 Sources from Which Items were Derived**

Sources that suggested items:	Item
Student Attitude Inventory (Entwistle, Nisbet, Entwistle & Cowell 1971), many of these items also appear in a later version Approaches to Studying Inventory (Entwistle & Ramsden, 1983)	1, 2, 4, 5, 7, 9, 10, 11, 14, 15, 17, 18.
LASSI: Learning and Study Skills Inventory (Weinstein, Schulte, & Palmer, 1987)	1, 2, 5, 7, 18.
Study Process Questionnaire (Biggs, 1985)	1, 6, 14, 15, 18.
Studying at School Inventory (Selmes, 1987)	1, 2, 6, 9, 14, 17, 18.
Self-Regulated Learning Strategies (Zimmerman, 1989)	3, 4, 6, 12, 13, 19.
Students	8, 16.

The Study Management Skills measure was designed to investigate generic student study patterns. Unlike learning strategies, these behaviours were expected to be relatively stable from task to task and so the questionnaire was not administered in the context of a specific learning task.

### 6.5.2 Motive for Learning

*Why* students are studying for a particular qualification influences *how* they go about that task (Biggs, 1987; Marton & Säljö, 1976a; Marton & Säljö 1976b). The motive scales from the SPQ (Biggs, 1985) were used in this study to measure *motive for learning*. These motives are defined below.

**Table 6.5 Motive Scales from SPQ with Definitions**

<b>Surface Motive</b>	Surface motive is instrumental: main purpose is to meet requirements minimally: a balance between working too hard and failing.
<b>Deep Motive</b>	Deep motive is intrinsic: study to actualise interest and competence in particular academic subjects.
<b>Achieving Motive</b>	Achieving motive is based on competition and ego-enhancement: obtain highest grades, whether or not material is interesting.

*Source:* John Biggs (1987) *Student Approaches to Learning and Studying*. Australian Council for Educational Research: Melbourne.

The reliability of these three motive scales has been measured by different researchers with a number of different tertiary samples and all agree that the scales have moderate internal reliability using the alpha coefficient.

In 1981 Hattie and Watkins sampled four faculties of an Australian University (N=225) and found that the surface motive had the lowest internal reliability,  $r=.60$ . Deep motive had an alpha coefficient of  $.67$  and achieving motive was the most reliable with  $r=.70$ . This pattern was confirmed by subsequent studies. O'Neil and Childs (1984) used the SPQ on 245 polytechnic students in the UK and found a reliability of  $.55$  for the surface motive,  $.64$  for deep and  $.72$  for achieving. Biggs' own study (1987) looked at both Australian polytechnic (CAEs) students and university students and the results closely reflected those of the previous studies. For polytechnic students internal reliability of the surface motive scale was  $0.51$  (*cf* the UK group  $r=0.55$ ); the deep motive  $0.63$  (*cf* UK  $r=0.64$ ); and the achieving motive  $r=0.71$  (*cf* UK  $r=0.72$ ). The university students also showed results similar to previous university reliabilities, surface  $r=0.61$  (*cf* Hattie and Watkins  $r=0.60$ ), deep  $r=0.65$  (*cf* Hattie and Watkins  $r=0.67$ ) and achieving  $r=0.72$  (*cf* Hattie and Watkins  $r=0.70$ ).

Two issues arise from these results; the lower reliability of the scales from the polytechnic samples and secondly, the lower reliability of the surface motive scale. Biggs (1987) suggested that university students have clearer perceptions of the interrelatedness of their motives and this accounts for the greater consistency of the scales for university students. The replication of this pattern in both UK and Australian samples lends support to the argument that university students work at a higher cognitive level, creating a greater self awareness.

The lower reliability of the surface motive scale probably results from the juxtaposition of two different components, “meal-ticket” aspiration, and fear of failure, in the single scale. Watkins (1982b) has argued that they should be measured on separate scales but Biggs (1987) has resisted such a solution. His factor analysis indicates that the two do go together, but warns that the scale is clearly not as unidimensional as the others.

### 6.5.3 Learning Strategies

Learning strategies are defined here as “*any cognitive interaction between the student and the learning content for the purpose of remembering, understanding or improving skills*”. Such interactions, while essentially cognitive in nature, may manifest themselves in activities such as drawing diagrams or rewriting notes.

Research on learning strategies gained attention in the 1970’s with the work of Marton Ference and his team at Göteborg University and interest in the area has continued to the present time. A number of learning strategies instruments resulted from this activity and these were reviewed, but none proved to give a pure measure of learning strategies. Some, such as the LASSI (Weinstein, Schulte, & Palmer, 1987), contained *scales* that included both learning strategies and other variables such as attitudes or study management skills. Others, such as Biggs SPQ (1985), contained *items* that combined learning strategies with other variables. For example, item 4 “*I think browsing around is a waste of time.*” is a negative measure of reading more widely (learning strategy), but also of attitude.

A further problem with existing instruments was their dependence on selective *sampling* learning strategies used by students rather than capturing the total range of strategies used. For classifying students into one or two broad groups such as deep or surface learners, sampling is appropriate. To provide a more comprehensive picture of how students learn, a scale was developed that focussed on the sorts of strategies the students themselves say they used. This questionnaire was developed over a period of time with several groups of University aviation and human resource management students. The process of arriving at the final version of the learning strategies questionnaire is described below

### **Development of an Item Pool**

Two issues were of concern in developing the learning strategies measure: question format and the learning context. The first issue was to select the most effective format for identifying learning strategies from either closed questions, that is asking students to rate a given learning strategy (recognition task), or open questions which require students to recall strategies on their own (production task). It was noted that most other instruments asked students if they used particular strategies (closed questions). These strategies had been previously identified by the instrument developer as characterising a learning style or approach, such as a deep or surface approach (Biggs, 1985).

The use of closed questions raised two further issues. One, how representative were the strategies identified by the researcher of the students' total repertoire? It is possible that students could use different but functionally similar strategies to those identified in the questionnaire and these, although serving the same purpose would not be measured. As there are many more sophisticated learning strategies than surface or rote strategies it is likely that the opportunity to miss deep strategies is greater thereby making it probable that such instruments would underrate the complexity of a student's approach to learning.

The second issue related to the use of closed questions was the problem of students responding in a socially desirable way. This is particularly easy with a recognition

task as opposed to a production task. Recognition tasks generally overestimate the students knowledge or skill (Fraser, Bellugi & Brown, 1963). The solution to this problem is described in Section 6.5.2 which explains the approach used to reduce the probability of students answering in the way they feel they ought to do rather than what they do.

The influence of context on student responses was also of concern. Most instruments measured learning from a macro perspective in which the value of the variables was thought to be relatively stable across all learning tasks (Biggs, 1985; Entwistle & Ramsden, 1983; Weinstein, 1987; Selmes, 1987). However, the literature quite consistently states that learning behaviour changes with context (Biggs, 1970; Laurillard, 1979; Entwistle, 1982). This macro approach was rejected in favour of a context-specific approach.

Both questions of format and the influence of context were explored in a series of three small-scale instrument studies using both questionnaire and interview methods.

**Instrument Study One** The first of these studies asked students to identify learning strategies in two contexts, remembering and understanding tasks, using two open-ended questions. Students were asked to describe the "*tricks, techniques or methods*" they used to help them *remember* and to *understand* information.

Data were collected from aviation and human resource management students in their first or second year at University, providing a total sample size of 102.

Between them, students were able to remember 44 unique learning strategies for *remembering*, and 46 strategies for *understanding* (see appendix E). Fifteen students were unable or unwilling to identify any strategies for remembering, though of these 15, six were able to identify 2 to 4 strategies for understanding. A further sixteen students listed no strategies for understanding, but seven of them were able to list one to three strategies for remembering. Nine students failed to identify any strategies at all.

Despite the high total number of strategies identified, each student was able to remember only a relatively small number for each task. Seventy-one students (69.6%) listed between one and three strategies for remembering, while exactly the same number identified between two and four strategies for understanding. Nobody identified more than five strategies for remembering, though three students identified 6, 7 or 9 strategies respectively for understanding (see table 6.6).

**Table 6.6** Number of strategies identified by individual students for remembering and understanding

No of strategies identified	No of students who identified <i>remembering</i> strategies	No of students who identified <i>understanding</i> strategies
0	15	16
1	18	9
2	27	27
3	26	23
4	12	21
5	4	3
6		1
7		1
8		0
9		1
<b>Total</b>	<b>102</b>	<b>102</b>

Students in this study were rarely able to identify more than three or four strategies for each type of task suggesting that students are generally unused to reflecting on their own learning behaviour. Very open-ended questions did not produce much insight into the individual student's learning strategies because they offered little support to the student in performing a complex and unaccustomed task. However, limited as the responses were at an individual level, they did provide evidence that students use different strategies for different types of task.

**Instrument Study Two** A second questionnaire was administered to a second sample, followed by interviews. In this second study students were asked structured questions, in the context of specific academic tasks such as mathematics or naming New Zealand cities. The questions were designed to provide students with a framework for thinking about their learning behaviour without suggesting what those behaviours or strategies might be. The previous instrument study established that when students were asked how they would respond to understanding and remembering tasks, they recognised these tasks as requiring different types of learning strategies. This second study tried to extend the original findings by presenting students with specific learning tasks and determining if they made the same distinctions between tasks, but without being cued as to whether the tasks were *remember* or *understand*. The answer being sought was whether their learning and studying behaviour changed as they moved between tasks that were different in content and level of processing.

Eight intensive case studies were carried out with the second year University aviation students. The group filled in a lengthy questionnaire called the *Study Inventory* and were then interviewed.

The Study Inventory presented five hypothetical learning tasks and asked the same questions in relation to each. The questions and directions given for answering the questions are shown below.

**Table 6.7 Questions for Instrument Study Two****Directions:**

*This is a questionnaire to find out how you go about studying or working out a problem. For each of the five situations listed at the bottom of the page, answer each of the following questions.*

**Questions:**

1. What resources would you use?
2. How would you organise your study notes?
3. Explain how you would you organise your time?
4. As you are learning the material:
  - a. What sort of things do you write?
  - b. What sort of things do you read?
  - c. What sort of things do you try to think about?
5. When you've answered all the questions you can in a test or examination, describe how you go about checking your answers. If you don't ever check, please say so.
6. When you are studying for a test or examination, how do you decide whether or not you know the material well enough? Please describe anything you think or do in as much detail as possible.

**Situations**

1. Studying for a maths examination.
2. Studying a novel, play or poem for an English examination
3. Studying the names of all the cities and major rivers in New Zealand.
4. Studying the road code.
5. Studying a pre-flight check-list.

The more structured questions and specificity of the task produced more strategies per student than in the previous study. This group was able to identify an average of 5.6 writing strategies and 5.25 thinking strategies per person. There appeared to be few differences between writing and thinking strategies. Writing included some

strategies not amenable to thinking such as drawing diagrams and summarising notes. Thinking strategies not mentioned in the writing list included generic remember (“*I would try to remember the information*”), and understand (“*I would try to understand what it means*”) strategies. The total range of strategies was still limited, only 17 unique strategies in all. Frequencies for the strategies can be found in appendix F.

The distribution of strategies to tasks showed marked differences. The two more complex tasks of mathematics and English literature generated a greater quantity and variety of strategies than learning geographical names, the Road Code or learning a check-list. The three simpler tasks used a sub-group of strategies associated with the more complex learning tasks. These were generic understand, remember and mnemonic strategies, identifying key points, practice and using examples.

The questions on reading strategies, checking they have studied enough and checking answers in an examination produced no useful information.

Asking students to respond in relation to specific tasks improved the quality of the information obtained. More strategies per task were produced, and these strategies varied across content. In informal interviews, when students were asked to comment on the questionnaire, several mentioned that they found it quite tiring. It may be that the apparent differences found between tasks related more to an attrition factor namely, increasing fatigue during the course of administration, rather than any inherent complexity in the task.

The results from instrument study 2 suggested that students recognise tasks of different complexity as requiring different learning strategies. However, the order of decreasing complexity in which the five tasks were presented to the student raises the doubt that response fatigue may have had more influence than the tasks themselves. A third instrument study was designed to resolve this issue. Unlike instrument study 2 this third study focussed only on levels of processing and

learning strategies. No questions regarding study methods or time management were included.

**Instrument Study Three** A third study was designed to explore students' perception of the processing levels of tasks and the learning strategies associated with these levels. The aim of the third study was to determine: (a) how students rated the processing level of given tasks; and (b) whether their strategy use varied for the same content when they were asked to learn it at different levels of processing. A new sample of 10 second year aviation students answered the questionnaire and took part in a group discussion.

In part one of the questionnaire respondents were given thirteen specific learning tasks presented in the form of a question. They were asked to select the level of learning (processing) required by that question. In the second part of the questionnaire students were presented with small segments of content from five subject areas (content types included marketing, physics, English literature, meteorology and computer programming). Copies of the content types used in the questionnaire are presented in appendix G. Subjects were asked to look at each content segment and write down the strategies they would use to remember the content. They were then asked to look at them again and to list strategies they would use to learn the content so that they could explain it in their own words. Finally, they were asked to study the material again and identify strategies that would enable them to use the material in a practical application (see table 6.8).

**Table 6.8 Questions for Instrument Study Three****Part One***Instructions:*

In each of the boxes on the sheet accompanying this questionnaire is a simple description of some content to be learned, then a question about that content. For each question select the kind of learning from those described below, that you would engage in to be able to answer the question.

Circle a, b or c.

1.     a.     remember exactly as it is.
- b.     be able to explain in your own words
- c.     be able to use content to solve a problem, reach a solution or gain  
              new information.

**Part Two**

Look at the five content types on the accompanying sheet. To be able **ONLY** to reproduce this information describe each step you would take to learn it for an examination.

Look at the five content types on the accompanying sheet. To be **able to explain** this information in your own words describe each step you would take to learn it for an examination.

Look at the first content type again. To be **able to use\*** this information to develop a strategic plan for a company describe each step you would take to learn it for an examination.

Look at the second content type again. To be **able to use\*** this information to work out the time for any given pendulum describe each step you would take to learn it for an examination.

Cont'd p.88

**Table 6.8 continued**

Look at the third content type again. To be **able to use\*** this information to analyse the value of Shakespeare's plays describe each step you would take to learn it for an examination.

Look at the fourth content type again. To be **able to use\*** this information to make weather predictions describe each step you would take to learn it for an examination.

Look at the fifth content type again. To be **able to use\*** this information to write computer programs describe each step you would take to learn it for an examination.

\* The application of "use" changed slightly from content to content. To clarify each application, the question was written out fully for each task content.

When presented with a range of tasks and asked to state the level of processing required for that task (Part One of the questionnaire), students were in strong agreement on which task fitted which category. However, many students felt that some tasks had elements of two processing levels and had difficulty settling on one.

In the second part of the questionnaire students were asked to identify the learning strategies they would use for learning particular content at three different levels of understanding. First, they were requested to identify strategies they would use if they only had to remember the information, then if they had to be able to explain it in their own words and finally, if they had to be able to use it. Rather than identifying completely different strategies for each level of processing, students tended to subsume the strategies they had identified for the previous level. So for instance, the strategies they identified for learning at the *explain* level included the same strategies they had previously identified for *remembering* the information, plus additional strategies which aided understanding. Since more complex levels of processing subsumed lower levels, this pattern was not unexpected.

This study produced a much fuller range of strategies and an insight into the way students adjusted their strategies for different tasks. However, this additional information came at a price. The more specific the learning event under analysis, the heavier the cognitive demand it made on the student. Discussions with the students suggested that it got harder and harder to make the effort to think about each new task.

From the three instrument studies it was concluded that students gave the most specific and complete information when asked about learning specific tasks. Because students are unused to reflecting on their own learning, have difficulty in articulating the processes they engage in and feel burdened by the cognitive workload required to express these processes (Baird & White, 1982), it was decided that items for the questionnaire would simply list as many learning strategies as could be identified in the context of only one task. Students would respond to the importance of these strategies for their own learning. A full list of strategies identified by students was made from the three studies. Replicated strategies were deleted. The learning strategies were described in simple phrases, retaining as closely as possible the terminology students themselves had used when identifying them originally, rather than providing complete sentences as is often more common. Using short phrases had the effect of reducing the length of the item, allowing the student to scan and respond to the learning strategies quickly. Complete sentences would have doubled the length of the questionnaire and reduced the probability of students responding carefully to each item.

**Pilot Study** From the three instrument studies, once replications had been deleted, sixty-one learning strategies were identified. These were used in the final measure. A further six open ended items were provided to allow students to add any strategies that had not been included in the list of sixty-one. Students were asked to rate the importance of these strategies in relation to a learning task using a Likert-type scale as shown below.

- NA - Not applicable
- 1 - Not important
- 2 - Slightly important
- 3 - Quite important
- 4 - Important
- 5 - Very important

The final version of the questionnaire was trialled on a further sample of 27 second year aviation students who had not taken part in any of the previous surveys. After completing the questionnaire the group spent about an hour discussing the format, wording, time and extensiveness of the learning strategies. As a result of these discussions minor amendments to the wording of some items were made. For example, items which had been written by the researcher in the second person (“*memorise until you can recall without error*”) were changed to the first person (“*Memorise until I can recall without error*”). Some items were expanded slightly to clarify meaning, for example “reciting” became “recite notes out aloud”. One item was not completely understood by several of the students, “*identify links (eg causes) between ideas*”. This item was deleted.

It was expected from the literature that the learning strategies would cohere functionally (Dansereau, 1978; Weinstein, 1978; Prawat, 1989), and that these functional classes would correspond to different levels of processing demanded by the learning task, that is memorising, explaining, using and analysing (Merrill, 1983). These functional categories are ordered from the most simple level, remembering, to the most complex, hypothesising. In learning it would generally be expected that the simple levels would be used in the early stages of learning a task, and progressively more complex levels engaged in later. To minimise the cognitive load experienced by students, learning strategies were grouped together according to function, and the functional categories ordered from simple to complex in the questionnaire, corresponding to the most likely pattern of strategy use. While studies on the effects of item order have produced inconsistent conclusions, Schurr & Henriksen (1983) provide evidence that grouping items does not systematically

increase the means of items. The set of strategies called *organising* would be idiosyncratically applied concurrently with other strategies. This group was placed at the end of the strategy list. Definitions of these functional classes which are represented as scales in the measure are provided below.

**Table 6.9 Strategy Classes and Definitions**

Remembering	These strategies simply help the student to remember information, either by repetition or making the information itself more memorable as with mnemonics. They do not contribute to understanding. (Weinstein, 1978; Volet & Chalmers, 1992)
Comprehension	These strategies help the student understand the information, for example by relating it to their existing knowledge structures or working out the relationship between ideas. (Spring, 1985; Volet & Chalmers, 1992)
Anchoring	These strategies act like remembering strategies but work best when they are used after information has been comprehended. (Spring, 1985)
Proceduralising	For students to be able to use information to a higher level than <i>declarative</i> they must actively reprocess it using these strategies. This has the effect of cognitively reorganising information to make it more accessible and usable (Glaser, 1988b)
Hypothesizing	When students have reached a degree of "expertise" in a subject area they can extrapolate information that is not immediately apparent. When they engage in this activity they are usually predicting, projecting or synthesizing information. (Glaser, 1988b; Volet & Chalmers, 1992)
Organising	These strategies seem functionally distinct from the others in that they are concerned with organising the information into a more suitable order for the student to process. It is probable that these strategies are used idiosyncratically rather than conforming to one "best" way.

Strategies were sorted into these functional groups *a priori* by the researcher and arranged in the instrument from the simplest to more complex. This would seem to mirror the most likely order of using the strategies and so would facilitate student responding. The reliability of the scales was tested with Cronbach's alpha. Items appropriate for memorising information were measured on a *remember* scale and had a reliability of  $r=0.89$ .

An *explain* (comprehension) level task required that the student understood material in order to be able to explain it in his or her own words. Therefore, comprehension strategies were appropriate to this task. Spring (1985) identified two classes of strategies operating at this level of processing; comprehension followed by *anchoring* strategies. Spring used the word *study* to describe these anchoring strategies, but to avoid confusion with the study management skills described earlier, the word "anchoring" has been used rather than "study". This group of strategies behave somewhat like the remember strategies in that they anchor or fix the information in the students mind once the material has been understood (Spring, 1985). The comprehension scale had good internal reliability ( $r=0.82$ ) with 19 items and the anchoring scale, moderate reliability at  $r=0.70$  with 4 items.

Strategies appropriate to a *use* level task required *proceduralising* strategies (Prawat, 1989; Glaser, 1988). These strategies reorganise declarative knowledge (information that has been comprehended at the explain level) in a format that improves accessibility and usability (Glaser, 1988; Chi, Feltovich & Glaser, 1981). Ten strategies were identified as serving this function. The internal reliability for these strategies was  $r=0.86$ .

The highest level of processing, *analyse*, was expected to equate to hypothesizing strategies in which the student practiced extending the meaning of the information at hand. An example of such a strategy might be *determining trends or predicting outcomes*. Five items were designed to measure this class of strategy and these were found to have a moderate reliability of  $r=0.75$ .

After each of these scales had been classified, a group of strategies remained that didn't fit easily into any of the processing level categories. These strategies could all be described as organising strategies in that they were concerned with the way the learning task was organised or ordered for learning. Examples of these items were *practice on simple tasks first, take notes point by point and learn each*. The reliability of these eight items within this scale was tested and found to have an internal reliability of  $r=0.75$ .

The questionnaire as a whole was tested for internal reliability. The learning strategies measure produced a reliability co-efficient of 0.95. This high degree of internal consistency was very satisfactory.

The items that make up the scales are presented in table 6.10. While the learning strategies were all identified by students, many of the strategies could also be found in the literature. These literature sources are shown in table 6.11.

**Table 6.10: Items and Sub-scales of Learning Strategies Questionnaire**

<b>Remember Scale</b>	
1.	copy out notes/diagrams/words
2.	recite notes out aloud
4.	memorise until I can recall without error
5.	put ideas into a pattern that is easy to remember
6.	associate new idea with something easy to remember, for example: Skinner - skinny man
7.	mentally picture what is described
8.	take first letter from a phrase to make a word (acronym)
9.	expand a word or group of letters into a sentence
10.	number each item in a list
11.	put information into lists
12.	put information into groups
13.	label groups of information
14.	make up rhymes or rhythms
<b>Comprehension Scale</b>	
15.	summarise information
16.	rewrite notes into a more concise form
3.	read over my notes & texts
17.	identify main or significant points
18.	identify points of confusion/difficulty /misunderstanding
19.	read notes/text and make general statements
20.	get more background information to help understanding
21.	read more widely on the subject
22.	find out more about the context in which the ideas were developed
23.	talk to other people about topic/subject
24.	collect extra information from a variety of sources
25.	relate ideas to my own experience/knowledge of a problem or situation
26.	relate ideas to other subjects
27.	relate ideas to my own views/beliefs/emotional reactions

**Table 6.10: Items and Sub-scales of Learning Strategies Questionnaire cont**

30.	work out how ideas are related to each other
32.	reduce notes to get a skeleton structure of main ideas
36.	change notes into diagrams
37.	change formulas into words
38.	change diagrams into words
<b>Anchoring Scale</b>	
34.	put notes/information into a different order
35.	underline or high-light points
40.	use headings and sub-headings
41.	identify key words and phrases
<b>Proceduralising Scale</b>	
39.	explain ideas to myself to test understanding
28.	think how I might use the information in some aspect of my life
44.	try using information in new situations
42.	work through new examples
45.	apply to real world situations
33.	work through given examples
43.	find my own or new examples
29.	ask myself or get others to ask me questions to check understanding
49.	use principles with different data
47.	complete set exercises/assignments
48.	complete extra exercises/assignments
<b>Hypothesizing Scale</b>	
50.	determine trends or patterns
51.	practice predicting outcomes/results
52.	identify or simulate consequences or results of doing something in a certain way
53.	do something and try to explain to yourself why it happens
46.	try doing something the wrong way to see what happens

**Table 6.10: Items and Sub-scales of Learning Strategies Questionnaire cont**

<b>Organising Scale</b>	
54.	practice on simple tasks first
55.	get a basic overall picture then fill in details
56.	learn information to a higher level of understanding than required
57.	study examples first, then theory
58.	study theory first then examples
59.	break task into parts and learn each separately
60.	take notes point by point and learn each
31.	put learned parts back together to see how they fit

**Table 6.11 Sources which Confirmed Items Also Identified by Students**

<b>Sources which suggested items</b>	<b>Items</b>
Approaches to Studying Inventory (Entwistle & Ramsden, 1983)	4, 20, 21, 26, 27, 30, 39, 45, 55, 60.
LASSI: Learning and Study Skills Inventory (Weinstein, Schulte, & Palmer, 1987)	3, 4, 7, 15, 17, 25, 26, 28, 29, 30, 35, 36, 39, 40,
Study Process Questionnaire (Biggs, 1985)	4, 15, 20, 21, 24, 25, 26, 27, 29, 31, 45.
Studying at School Inventory (Selmes, 1987)	1, 4, 15, 17, 20, 21, 23, 24, 26, 27, 31.
Self-Regulated Learning Strategies (Zimmerman, 1989)	20, 21, 22, 34, 35, 36, 37, 38.
Learning Activities Questionnaire (Weinstein, 1978) items that were not included in the later version of LASSI.	1, 5, 6, 8, 9, 10, 12, 13, 14, 23, 27, 32, 41.
Reading Strategy Questionnaire (Spring, 1985)	1, 3, 15, 27, 28, 29, 30, 32, 35, 36, 39, 45.
Cognitive Skills Inventory (Moreno & Di Vesta, 1991)	1, 2, 4, 7, 11, 16, 25, 34, 39, 45, 59.
Students	18, 19, 33, 43, 44, 46, 47, 48, 49, 50, 51, 52, 53, 54, 56, 57, 58.

Developing learning strategies from student responses rather than just from the literature had a number of advantages. First, the strategies were expressed in the students own words and these are more readily recognised by other students than the language of the "experts". By surveying students it was possible to have greater confidence that many of the strategies used by students were identified. Such confidence could not be placed in a literature review because of the tendency of researchers to select representative samples of strategies. The short phrases describing strategies that were suggested by students could be responded to faster than the cumbersome items found in the literature, enabling more strategies to be included without causing response fatigue.

Learning strategy items in the literature tended to be expressed less specifically than those identified by students themselves. This has two possible consequences. Students may not understand this generic format and respond negatively. Secondly, generic items often summarise more than one possible strategy. For example, "*I try to identify the underlying meaning in what I read*" (SPQ, Biggs, 1985). A number of different strategies could be used to achieve this *understanding*, such as identifying the main points, relating the content to prior knowledge or identifying relationships. Knowing which of these the student specifically uses gives us a clearer understanding of the student's learning process.

To conclude, the satisfactory levels of reliability determined in the pilot study, and the comments of students themselves suggested that the rather elaborate, qualitative process of identifying learning strategies from students themselves produced a measure that had face validity with students, reflected their experiences of learning in meaningful terminology and was comprehensive enough to capture a very specific and accurate representation of student learning in a given context.

#### **6.5.4 Learning Task Profile (Task Representation)**

Each class had completed an assignment as a regular part of their study programme immediately prior to administration of the questionnaire. These assignments were the learning tasks which became a focal point of the study. Students were recorded

as belonging to assignment groups on the basis of the name and number of the course they filled in at the beginning of the questionnaire on learning strategies. The two technology classes were combined because of the similarity of the content area of their course and their responses. This left four task groups: an essay (accounting); practical project (technology); and two case studies (management and human resource management).

Much learning research has examined the relationship between learning behaviour and learning outcomes and has tried to find factors that may account for such relationships (for example, Justice & Weaver-McDougall, 1989). An underlying assumption of this approach is that a task is a constant. It is seen to be by both teacher and student as the “same thing”. Building on the suggestions of others (Svensson, 1977; Laurillard, 1978; Entwistle & Ramsden, 1983) this study tried to measure *students’ representations* of the task, recognising that these may be quite different to those of the teacher, and even other students. If students do indeed have idiosyncratic views of tasks, it is to be expected that these representations may account for differences in the way students interact with the learning task.

The task perceptions of students may be measured along a number of different variables. For instance task perception may be based upon confidence (to achieve the task), success, interest, difficulty and relevance (Volet & Chalmers, 1992). The specific task perception of interest in this study is task representation, that is, the way in which the student perceives the nature of the task in terms of its complexity and demands on cognitive processing. Instructional designers have measured learning task demands by assessing the complexity of the cognitive processing required to perform the task (Bloom., Englehart, Furst, Hill, & Krathwohl, 1956; Gagné, 1965; Merrill, 1983). No evidence could be found in the literature of attempts to measure a student’s perception of these cognitive demands. Clearly, if students perceive a learning task as requiring a simple level of cognitive processing, such as *remembering*, this will affect the strategies they select to deal with the task. In addition to level of processing the literature suggested three more variables to describe the manner in which students could view a task: the *answer format* that

would be used in assessment of the task (Laurillard, 1979; Lundeberg & Fox, 1991; Entwistle & Ramsden, 1983; Tulving, 1983; Ramsden, 1988), the *interrelatedness* of the task (Gagné, 1965) and the *workload* (conciseness) associated with undertaking the task (Entwistle & Ramsden, 1983; Entwistle & Tait, 1990; Chambers, 1992).

**Levels of Thinking (Processing)** The level of cognitive processing is a measure of the cognitive effort that the student must make. These processing levels have long been used by instructional designers as a way of measuring the cognitive demands a task places on a student and as a basis for selecting the most suitable instructional strategies for teaching and assessing such a task (Bloom., Englehart, Furst, Hill, & Krathwohl, 1956; Gagné, 1965; Merrill, 1983). Although there is no direct evidence in the literature that students explicitly identify tasks as requiring qualitatively different responses, it is assumed that students do make implicit judgements, since they are frequently successful in responding appropriately during the learning process (Keislar, 1960; Marton and Säljö, 1976a; 1976b).

The research on deep and surface learning makes assumptions about the students' perception of the processing level of a task from the strategies they use. These studies do not directly measure this perception (Marton and Säljö, 1976a; Biggs, 1985; Entwistle and Ramsden, 1983). In contrast, rather than inferring student perceptions of the task processing level, this study tried to directly measure those perceptions. Because there were no models in the literature on which to base such a strategy, constructs previously developed by educational psychologists for measuring the cognitive demands of tasks were used. These are described next. The terminology was modified to make them more comprehensible to students.

The four levels used to measure the perceived processing demands of the student were modified from Merrill's Component Display Theory (1983), which was in turn derived from Gagné's learning hierarchy. These levels are shown in table 6.12 as they appeared in the questionnaire with the definitions and examples to help students understand the terms.

**Table 6.12 Items Measuring Cognitive Processing Levels**

**Directions:** Using the same assignment as in the last set of questions, choose the level of thinking you believe is required to learn this type of material for a test or exam. You may choose only one, in which case you should put 100% in the box beside that choice, or divide the percentage between the four different levels. A brief definition of each level is given below with some examples of questions at that level.

Levels of Thinking	
<b>Memorisation</b>	- To remember without necessarily having to understand.
<b>Explain</b>	- To explain ideas in your own words.
<b>Use</b>	- To actually do, perform or carry out something.
<b>Analyse</b>	- To interpret information/data.

1. **Memorise** - to be able to remember or recall without any depth of understanding.

Examples of questions that require only memorisation are:

Who invented the telephone?

On what date did the Resource Management Bill have its first reading?

Label the components on the accompanying diagram.

Give Gagne's definition of "instructional psychology".

State the law of diminishing returns.

List the steps to shutdown a computer.

**MEMORISE**  %

2. **Explain** - to explain or describe ideas or how things work in your own words.

Examples of questions that require you to be able to explain are:

Describe what accounting procedures you would use in a small business.

Explain what the term "stress management" means.

Explain the law of supply and demand.

**EXPLAIN**  %

3. **Use** - to do something or to apply knowledge to a problem or situation to get a solution as opposed to just talking about it as in the "explain" category above.

Examples of questions that require you to use information are:

Design a lesson to teach communication skills using good principles of instruction design.

Develop a marketing plan for the organisation described below.

Calculate the fuel needed to get to Napier from Palmerston North in a Piper Warrior given the weather conditions below.

**USE**  %

4. **Analyse information** - to extract information or meaning from data or use it to predict future trends or events.

Examples of questions that require you to analyse information are:

Use the information in the graph below to decide which instructional strategies can be matched with which students.

From the information collected in the questionnaire what recommendations would you make.

Conduct a literature search of all the significant theorists in this area and determine the major themes or schools of thought in the 1970's.

**ANALYSE**  %

Students were asked to choose the level(s) of processing (the term “levels of thinking” was used in the questionnaire to avoid confusing students with jargon) they believed was required to learn the task (that is, the assignment they had recently completed). This they did by determining what percentage of the task required memorising, explaining, using or analysing. It was made clear that one level could be chosen, that is, the task requires only one type of processing, or that some proportion of all levels could make a contribution to achieving the task.

Volet & Chalmers (1992) identified three of these levels as: basic acquisition and recall (memorise); understanding and integrating new concepts (explain); and critical reflection and theory building (analyse). In their study, processing levels were conceived of as learning goals and students asked to rank the importance of these goals. The goals were expressed in terminology very similar to that used in the present study, for example “*remember key information of economic theories and the economic world*”.

A Likert-type scale was considered inappropriate for measuring processing levels because it would be possible to rate the four levels independently of each other resulting in nonsense data. For example, rating the task as being both highly “memorise” and highly “analyse” would not make any sense. It was expected that students would see the task as being predominantly one level with contributions from other levels. The basis of this assumption came from the third instrument study described previously. In this instrument study a sample of students was given thirteen specific learning tasks. They were asked to select the level of learning (processing) required by that question from three choices:

- a. remember exactly as it is. (memorise)
- b. to be able to explain in your own words (explain)
- c. be able to use content to solve a problem, reach a solution or gain new information. (use/analyse)

Students were in strong agreement on which task fitted which category. However, many students selected two processing levels for at least some of the tasks. When students were asked in an interview why they had circled two options they said that some tasks didn't fit easily into just one category. Rather than forcing students into selecting one level, or ranking tasks as in the Volet & Chalmers study, it was considered that students would feel that they could make a more accurate expression of their judgement if they stated what percentage of the task fell into each of the four levels.

**Answer Format** Anticipating the answer format of a test improves performance if that expectancy is met. Students who anticipate an essay format perform better if they are tested with essay questions. Students expecting a multiple choice test perform better when their expectations are met (Lundeberg and Fox, 1991). The general consensus seems to be that the improved outcome results from more effective processing during learning; the student either uses different strategies for different purposes or uses strategies differently (Entwistle and Ramsden, 1983; Trigwell and Prosser, 1991; Prosser, 1993). Therefore it was expected that anticipating a particular answer format would influence the types of learning strategies a student would select.

From the literature two major answer formats were identified as essay/report and short answers (Apps, 1982; Langan & Nadell, 1980; Lundeberg & Fox, 1991). A major omission was the practical question or exercise. In the studies reviewed, the researcher classified the task (Apps, 1982; Langan & Nadell, 1980; Lundeberg & Fox, 1991) and this information was conveyed to the student. In this study students were asked to state how strongly each of the three formats characterised the learning task using a Likert-type scale (1 = not at all: 5 = strongly). While lecturers might think of the task only as an essay, a practical exercise or short answer, students were able to say that in their view the task contained elements of each of these formats.

A total of three items, one for each answer format (see table 6.13), measured the extent to which the learning task could be characterised as essay/report, short answer and practical. In the pilot study these had an alpha reliability coefficient of 0.63.

**Table 6.13** Items Measuring Answer Format

<b>Directions:</b> Rate the same assignment as previously used on the following features according to <b>how strongly they describe</b> the work you are required to do.					
1	-	Not at all	4	-	Quite a lot
2	-	A little	5	-	Strongly
3	-	Some			
5.	Essay/report writing	.....	1	2	3 4 5
6.	Short answers	.....	1	2	3 4 5
7.	Practical exercises (including written)	.....	1	2	3 4 5

**Interrelatedness** Instructional designers tend to see strong relationships between components of a course content. This is more evident in some subjects than others. For example mathematics clearly builds upon previous learning. The work on deep and surface approaches suggest that students may make quite independent assessments of the interrelatedness of material. Surface processors see learning tasks as fragmented, unrelated accumulations of pieces of knowledge irrespective of the task. Deep processors, on the other hand, see relationships within content, and similarities with other contexts (Biggs, 1987). The researchers in these areas drew these descriptions of students' interpretation of the task from questions that measured learning strategies, rather than asking students directly to describe the learning task (Biggs, 1985; Marton and Säljö, 1976a; Marton and Säljö, 1976b; Entwistle & Ramsden, 1983). Thus students who selected rote strategies were assumed to perceive tasks as being fragmented. Without necessarily denigrating the validity of these inferences, it seems logical that clearer information could be obtained by simply asking students how they perceived the interrelatedness of the task.

As no suitable items could be found in the literature to measure student perception of the interrelatedness of learning tasks, four Likert-type scale items were developed *a priori* (see table 6.14). In the pilot study these items had an alpha Cronbach reliability coefficient of 0.55. Item 9 was reworded from “*highly structured information*” to “*each new section depends on understanding previous sections*” in order to improve comprehension. The scale used in this study measured the extent to which the students perceived the content of the learning task as being fragmented or interrelated.

**Table 6.14** Items Measuring Interrelatedness

<b>Directions:</b> Rate the same assignment as previously used on the following features according to <b>how strongly they describe</b> the work you are required to do.					
1	-	Not at all	4	-	Quite a lot
2	-	A little	5	-	Strongly
3	-	Some			
8.		Many discrete or unrelated parts.....			1 2 3 4 5
9.		Each new section depends on understanding previous sections .....			1 2 3 4 5
11.		Need to learn only selected aspects.....			1 2 3 4 5
13.		Ideas which build on related ideas.....			1 2 3 4 5

**Workload (Degree of Conciseness)** The workload imposed on students has been identified by several researchers as contributing to the use of surface learning strategies (Entwistle and Ramsden, 1983; Entwistle and Tait, 1990; Chambers, 1992). However, measuring workload has some difficulties. Asking students to estimate in retrospect the numbers of hours spent working (McKay, 1978), or to keep a running log of their hours (University Grants Committee, 1964, cited Chambers, 1992) produces less than accurate accounts because people generally are

poor record keepers, and students often feel a need to report hours they think are in keeping with teacher expectations (Chambers, 1992).

Chambers (1992) reports that asking students to report their perceptions of workload using a Likert-type scales generated responses that included much more than just workload. For example, respondents referring to high workload situations may in fact have been influenced in their assessment by stress caused by illness, family difficulties or anxiety. Chambers identified the amount of additional background reading or research, in conjunction with the specification of assessment requirements to be an alternative measure of workload for a particular task. The greater the number of separate sources of information or references, the heavier the workload students regarded themselves as experiencing. This workload was perceived to be intensified when students were given no guidance on which parts are crucial and which are just interesting background. The amount of background research and clarity of assessment requirements as measures of workload were examined in the second instrument study.

The eight students from the second instrument study first completed a written questionnaire, and then were interviewed to provide them with an opportunity to expand on their written answers and so to determine if any important questions had been missed. All of the interviews were semi-structured; the same main ideas were raised with each student, but the order and manner in which questions were phrased varied. The written questions asked students how they went about studying and learning particular tasks. The interview questions first went over the responses students had given to the questions, then asked students what factors influenced *how* they went about studying and learning. One answer given by all students was *work pressure*. Students were then asked to describe what work pressure meant to them. A quote from one student regarding this, neatly summarises the various comments made. *"Mostly the amount of assessed work you have to do. Some papers have heaps of tests and assignments and you just spend your time doing the minimum to survive. You have to try to be organised and concentrate only on what's really needed. You don't have time to get interested in stuff. If you have a*

*couple of papers with lots of assignments and tests that puts the pressure on other papers too. The worst papers are the ones that are a bit vague. The instructor doesn't tell you exactly what's wanted and you have to work it out for yourself. Its not always easy to ask some instructors exactly what they mean. If you have to spend lots of time in the library finding things its a lot harder than just using Study Guides or a textbook. "*

As can be seen from the quote above students typically think of workload at three levels: the total workload created by the academic course of study being followed; the workload of individual papers (courses); and the workload created by a single assessment task. The unit of interest in this study was the workload of a single task. The two dimensions which best measure this variable, the amount of additional student research necessary (conciseness of material) and clarity of assessment criteria, are suggested in the literature (Chambers, 1992; Entwistle & Ramsden, 1983) and were independently verified by student responses in the second instrument study. Finding suitable instruments from the literature to measure workload at this specific level proved difficult, as most items focussed on measuring workload at the course level. Consequently, items had to be developed *a priori*. In keeping with the other sections of the questionnaire which related to a single task, the simple, single phrase format was used in preference to a complete sentence (see table 6.15). Students rated how strongly these items characterised the learning task under scrutiny using a Likert-type scale. This scale, called 'conciseness', was found to have an alpha Cronbach coefficient of 0.67 in the pilot study.

**Table 6.15** Items Measuring Conciseness (Workload)

<b>Directions:</b> Rate the same assignment as previously used on the following features according to <b>how strongly they describe</b> the work you are required to do.					
1	-	Not at all	4	-	Quite a lot
2	-	A little	5	-	Strongly
3	--	Some			
10.		Includes lots of background material .....			1 2 3 4 5
12.		Clear, well defined assessment requirements.....			1 2 3 4 5
14.		Students must find much information for themselves .....			1 2 3 4 5
15.		All required information given in lectures, study guides and course texts.....			1 2 3 4 5

To conclude, the Learning Task Profile had four scales: processing levels, type of learning task, interrelatedness and workload (conciseness). This measure was the most exploratory of the measures developed for the study. Most of the items were developed *a priori* as no similar measure could be found in the literature, although support for the constructs were found. The moderate reliability of the scales reflects their humble pedigree.

### 6.5.5 Learner Characteristics

Learner characteristics of interest were: age, because of its expected influence on choice of learning strategies, gender, grade point average (GPA) as a measure of prior knowledge and assignment results as a measure of learning outcome. Except for the assignment results which were obtained from the course lecturers, all other data were collected in the biographical section. Details of how this information was collected is described below.

**Biographical Data** Students indicated their age by marking one of five categories: under 20, 20-24, 25-29, 30-35, over 35. They responded to the gender question by ticking either the male or female option. Other biographical information

was collected, namely ethnicity, degree sought, major and favourite academic subject, by asking the student to write in the appropriate information.

**Prior Knowledge** Prior knowledge is relevant background knowledge the student has about a subject before he or she begins a course of study. This background knowledge acts as a context for understanding new information.

For this study grade point average of the student's previous year's work was used as a measure of prior knowledge. Students were asked to list the university subjects they had taken the previous year and give the results for those papers as a grade (they are given only grades, not marks for their official results). Grades were then coded with a number as shown in Table 6.16.

**Table 6.16 Grades**

A+ =12, A=11, A-=10, B+=9, B=8, B-=7, C+=6, C=5, R=4, D=3, E=2, DNC=1
---

These numbers were summed and divided by the number of papers taken to compute a grade point average. Grade point average was used as a generic measure of prior knowledge as these students were all in their second or third year at university and it was assumed that in the majority of cases the previous year's work would be related to the current work.

An alternative measure of prior knowledge could have been obtained by using the results of the first assignment as prior knowledge and the results of a second assignment for learning outcome. It would have been possible to delay administration of the questionnaire to the second assignment or test, but this would have been late in the winter term, a time of high attrition and often overwhelming workloads for students. High attrition may have affected the representativeness of the sample selection and workload pressures are known to affect the normal learning strategy use of students (Entwistle & Tait, 1990; Chambers, 1992), consequently this option was rejected.

**Learning Outcome** Learning outcome was measured using the mark (in a percentage format) that the students received for their assignment. Normalisation of scores for the purpose of comparing results across tasks was considered but rejected as the raw score gave a more accurate measure of learning *success* as judged by content experts (lecturers).

The validity of using grades to assess the quality of learning outcome has been questioned. A study by Watkins and Morstain (1980) found that only half the lecturers and even fewer students believed that grades were accurate indicators of learning. The author considered remarking assignments using the SOLO (structure of the observed learning outcome) taxonomy as developed by Biggs and Collis (1982) and recommended by Watkins (1983). The taxonomy is an hierarchical structuring of components describing the complexity of the students response to the learning task. The SOLO taxonomy is considered a significant advance in qualitative evaluation of student learning, eliminating many of the problems of subjectivity. However its application in this study proved to be impossible. One method was to have the researcher remark all of the assignments using the SOLO Taxonomy. Unfortunately, four different subject areas required a range of expertise the researcher did not have. Asking the lecturers to remark all the assignments would have entailed many hours of extra work in addition to teaching them to use the SOLO, which seemed an unreasonable request of these lecturers who had already given generously of their time and teaching schedule. Unfortunately no other easily administered measure of learning outcome is available. Results from using grades as a measure of learning outcome must therefore be considered with caution and interpreted conservatively.

The reliability of assignment marking can be improved by taking a number of simple measures, such as using a marking schedule or model answer, blindly remarking a selection of papers when several different markers are involved and holding discussions with all the markers to ensure a standardised approach (Sax, 1989) Each of the lecturers involved was interviewed to discuss the extent to which these measures were used.

The Accounting lecturer took the most precautions to ensure assignment mark reliability. The class was a large one and a number of tutors were involved in the marking. They began the process by meeting to discuss the marking procedure. A marking schedule was developed, apportioning marks for different components of the task. Ten percent of each tutor's papers (selected from the top, middle and lowest marks) were given to the lecturer and blindly remarked (she didn't see the original mark). Based on the remarking tutors then modified their marks to compensate for lenient or hard marking.

The management class also involved several markers. They had a meeting at the start of the process to discuss procedures and also a marking schedule. However, no further attempts were made to ensure consistency in marking between tutors.

The two engineering classes had single markers and both used model answers.

The human resource management class had a single marker who developed a marking schedule and a range of statements describing criteria for assigning marks.

## **6.6 Instrumentation**

When designing the measures for this study considerable thought was given to the format and structure of the questionnaire (see Appendix H). As has been described, a series of instrument studies were used to discover how students responded to different types of questions under different conditions. The information from these instrument studies was invaluable in determining the content, format and structure of the final questionnaire. Each structural decision was made after careful examination of the relevant literature. This decision-making process is elaborated further in the following section.

### 6.6.1 Choice of Instrument

Investigations of students' learning processes have used both quantitative and qualitative methods of data collection. Qualitative approaches include: intensive interviews or case studies (Marton & Säljö, 1976a; Marton & Säljö, 1976b; Svensson, 1977; Laurillard, 1979), classroom observations (Naiman, Fröhlich, Stern & Todesco, 1978; Rovegno, 1993), verbal protocols (Zhu & Simon, 1987) and retrospective reports (Gagné, Crutcher, Anzalc, Geiman, Hoffman, Schultz & Lizcano, 1987). Quantitative approaches include: questionnaires (Biggs, 1987; Entwistle & Ramsden, 1983; Weinstein, Schulte & Palmer, 1987), and meta-analytical techniques (Haller, Child & Walberg, 1988; Wang, Haertel & Walberg, 1990). Closely related to the method of data collection is the matter of context: naturalistic field studies or laboratory settings. Both the contexts and data collection methods affect issues of validity and reliability. It is probably unreasonable to suggest that there is one best way of investigating learning behaviour. Each context and data collection method has its own advantages and disadvantages - the purpose of the study dictates which is most appropriate.

This study was carried out in a naturalistic classroom setting to ensure ecological validity. This is discussed in detail later in this section under "Context". Both qualitative and quantitative methods of data collection were used to capitalise on the advantages of each. These are now discussed in greater detail.

**Qualitative Methods of Data Collection** Qualitative methods are characterised by richer information reflecting the idiosyncratic behaviour and perceptions of the individual. Using these methods it is possible to convey more clearly to the subject the intention of the questions, to probe for further information and generally to be more responsive in helping the subject articulate their responses.

There are several disadvantages of qualitative studies. The major problem is that such methods are time consuming and consequently sample sizes tend to be very small. This problem is further exacerbated if any of the data are lost or compromised before analysis (for example, Gagné, Crutcher, Anzalc, Geiman, Hoffman, Schultz

& Lizcano, 1987). Small sample size limits the extent of statistical analysis that can be performed and the generalisability of the results (Entwistle, 1981).

A second criticism that has been levelled against qualitative studies is that of their subjectivity. Researchers seldom work from a completely neutral perspective and may unwittingly impose their own interpretation on responses, or lead subjects into giving desired responses (Watkins, 1983; Rovegno, 1993). This difficulty can be minimised by using “blind” raters and checking for inter-rater reliability.

A third criticism arises from the individual nature of the responses given by subjects. While they may well describe individuals, it may be hard to compare the responses from different subjects. In addition, students are unused to reflecting on their cognitive processes and may have difficulty expressing these processes in open-ended questions that are generally used in interviews. Methods of minimising these difficulties have been developed, for example, the procedures recommended for interviews by Ericsson and Simon (1984).

Specific qualitative methods have specific problems. Classroom observation methods, if used alone, produce very few overt instances of learning strategies ((Naiman, Fröhlich, Stern & Todesco, 1978) and significant observation episodes may be missed by the observer (Gagné, Crutcher, Anzelc, Geiman, Hoffman, Schultz & Lizcano, 1987). These difficulties can be improved when observations are used with retrospective interviews using videotapes or similar retrieval cues (Gagné, Crutcher, Anzelc, Geiman, Hoffman, Schultz & Lizcano, 1987).

**Quantitative Methods of Data Collection** Quantitative methods are not without their problems. Questionnaires, particularly with closed questions, the preferred format for large scale studies, force students into a set of predetermined responses which may not accurately reflect the “truth” as seen by the subject. Thus, they can contain built-in distortion. Additionally, they may not capture all of the possible responses, losing essential insights into the issue under investigation. These

difficulties can result in the instrument shaping the findings rather than being an unobtrusive neutral aid in data collection.

The advantages of quantitative methods are that they can be simply administered to large numbers of students. Responses are directly comparable and data are suitable for multivariate analysis.

**Using Both methods of Data Collection** Many studies capitalise on the advantages of both methods (White, 1993). This study used qualitative methods (interview and case studies) in the preliminary stages of the work to measure the *variability* in students' learning processes and explicate the range of possible responses. These responses were then incorporated into questionnaires which measured the *consistency* between students in these processes. In this way information rich in the experiences of learning reality for individual students were able to be captured in a format that could then be administered to large groups of students. The disadvantages of qualitative methods, such as small sample sizes, are largely negated by the results of the larger study. The tunnel vision sometimes caused by quantitative methods was avoided by making the students' perception of *their learning reality* the basis of the large scale questionnaire.

**Context** Traditionally, laboratory settings have been favoured by experimental psychologists for studying learning. The student is given a task, often meaningless to avoid the contamination of prior knowledge, then careful psychometric measurements are taken of the variable under investigation. These studies have the advantage of being carefully controlled and significant relationships readily found. Unfortunately, these studies rarely generalised to the classroom setting and make little contribution to the application of teaching or learning. More recently it has been considered that ecologically valid models of learning are more likely to result from studying students in their natural habit; the classroom, performing real and meaningful tasks (Entwistle and Hounsell, 1979; Watkins, 1982b). For these reasons, this study was conducted in a natural university setting, with students performing learning tasks that contributed to their assessment for the course. It was

recognised that such a study would contain a great deal of “noise” in the data and that the measurement of some variables, such as learning outcome (assignment mark) would be broad indicators rather than specific indices of such outcomes.

### **6.6.2 Strengths and Limitations of the Questionnaire**

A booklet containing five self-report measures was used in the main study to assess task representation, study and learning behaviour of tertiary students. The advantages of this instrument over alternatives such as case studies and interviews, and the manner in which potential problems are avoided are described below.

**Ease of Administration** For all but one small section (thinking levels of tasks) and the collection of biographical data, the questionnaire used Likert-type scales to record student responses. This method of data collection was familiar to students and required no special training or instruction. In addition, a large number of questions were able to be answered in minimal time, avoiding response fatigue.

The researcher was also able to administer the questionnaire to large groups of students in a relatively short time frame.

**Objectivity of Responses** The closed questions on this self report questionnaire ensured minimal investigator influence. The data collected were directly relevant to the research questions, easily quantified and coded.

**Suitability for Statistical Analysis** Both the format (likert-type scale questions) and the large sample size (N=479) made the data obtained suitable for multivariate statistical analysis with good potential for generalisability.

**Response Rate and Avoidance of “Desired Response”** Several classes were identified as possible sources for subjects. Getting as many students as possible from each class to respond was considered important to avoid the selection bias that might occur if moderate to large groups of students decided not to take part. It was

also of concern that students might respond in a socially desirable way, that is, answer in the way they believed a “good” student might answer.

Both of these potential problems were addressed by telling the students they would be given individual feedback on their responses and a booklet on learning strategies. The importance of answering honestly, if they were to get a useful profile of their learning behaviour, was stressed. On an approximate estimation nearly 100% of students who attended the initial briefing returned the following week to complete the questionnaires.

**Student Comprehension of Questions** The researcher personally administered all of the questionnaires and was available to answer any questions. In the event, questions were asked only by three Asian students, for whom English was a second language. The questions related to words of whose meaning they were unsure. The words in question were “intrinsic”, “discrete” and “recite”.

**Pilot Study** The questionnaire was trialled on a small sample of 27 to identify and correct potential problems. Subjects were asked to comment on difficulties or ambiguities in the questionnaire. Some minor adjustments resulted from the pilot study. These have been described in earlier sections of the chapter.

## 6.7 Summary

The questionnaire had five sections, four of which were developed for this study. These included learner characteristics (mainly biographical information), study management skills, learning strategies and task representation. The last three of these represented a departure from instruments previously used to gather this type of information. First, both qualitative and quantitative methods for gathering information were used. The instrument studies used a range of written and oral techniques to allow students to describe their versions of the learning and studying processes as fully and as accurately as possible. They also contributed substantially in determining the best format for asking students about their perceptions. On the basis of the realities described by students, quantitative measures were developed.

The instruments themselves were designed to obtain separate measures of study management skills and learning strategies. Other inventories have tended to blur the distinctions between these two despite the fact they make different contributions to the learning process.

The learning strategy instrument is a more comprehensive and "pure" measure of learning strategies than others reviewed in the literature. Only by recognising all of the learning strategies used by a student can an accurate diagnosis be made of the student's learning profile.

The importance of the context to learning outcome has been widely discussed (Laurillard, 1979; Entwistle & Ramsden, 1983; Chambers, 1992). However, one aspect of context has escaped scrutiny; the student's representation of the task. Although many ideas can be found in the literature to identify the contents of this measure, finding a suitable instrument on which such items could be modelled did not appear to be available. This measure was completely new.

The final format and organisation of the questionnaire resulted from information obtained from the instrument studies and a review of the literature. The instrument studies were responsible for the use of short phrases, rather than complete sentences, the terminology of many of the items, especially in the learning strategy section and the specific content of some items. The literature influenced the use of both qualitative and quantitative methods of data collection, the decision to use a classroom, rather than laboratory setting and the Likert-type format of most of the items.

The next chapter presents the results from the questionnaire described in this chapter.

## **Chapter 7**

### **Results**

#### **Introduction**

This chapter presents results from the analysis of the questionnaire. The results are presented in three parts; first for the principal components analyses of the three measures that were developed for the study, secondly for multiple regressions and thirdly for logistical regression results. The multiple regression results are presented in three stages. Stage one investigated the influence a number of independent variables had on the selection of learning strategies. In stage two the effects of learning strategy choice, study management skills and grade point average on learning outcome were examined. Finally, the strategy scales of the SPQ were regressed on to learning outcome for comparison with the learning strategies developed for this study.

#### **7.1 Principal Component Analysis**

Principal component analysis was used to explore three sections of the questionnaire; learning strategies, study management skills and task representation. Principal component analysis was considered an appropriate method of identifying underlying structures, and reducing these three sections to a more parsimonious representation of the relationships being measured (Tabachnick & Fidell, 1989). It had the further advantage of producing principal component scores that could be used in additional analysis of the data. The PCA results for each of these three sections are now presented.

### 7.1.1 Learning Strategies

Learning strategies form the central component in the two relationships this study examines. First, the study is concerned with factors that influence the selection of learning strategies, and secondly, the influence of learning strategies on learning outcome. The complexity of these relationships indicates the need for intrinsically multivariate techniques. The choice of principal components analysis to reduce the number of learning strategies to a smaller number of components was influenced by the large number of learning strategies, the need for uncorrelated components to be used in later regression analysis and to determine the presence of underlying relationships between the learning strategies.

The analysis was carried out in four steps. First the appropriateness of the data for factor analytical techniques was evaluated. A correlational matrix was computed for all variables and the presence of correlations greater than 0.3 determined the likelihood of some underlying processes. The size of the sample needed for the number of variables has been widely debated (O'Neil & Child, 1984), however the ratio of sample size to items of 7.85 to 1 meets many of the more stringent guidelines (Tabachnick & Fidell, 1989). The Kaiser-Meyer-Olkin of .90069 as a measure of sampling adequacy is described by Kaiser (1974) as "marvellous". The KMO together with Barlett's test of sphericity (13843.36;  $p \leq .0000$ ) established the appropriateness of the data for principal component analysis.

In the second step, components were extracted. A scree test supported the retention of seven components (Cattell, 1966; Tabachnick & Fidell, 1989). While a scree test is not always very exact, the large sample size, generally high communality values and the high loading of variables on each component favoured the use of a scree test for determining the number of components (Gorush, 1983). To avoid overspecification, component loadings were set at .40. Variables that cross-loaded were assumed to load on the component for which they had the highest loading. To minimise errors in interpretation, components were described by considering loadings in descending order. This seven-factor solution extracted 49.9% of the variance. Information on the seven components is set out in Table 7.1.

In the third step, orthogonal rotation with varimax was chosen for simplicity of reporting and because it was intended to use component scores for further analysis (Tabachnick & Fidell, 1989). Adequacy of the rotation was determined by the presence of a simple structure (Thurstone, 1947). Several variables correlated highly with each component, and generally only one component correlated highly with each variable. Three variables had high loadings on a second component. These were item 49 which loaded primarily on component 1, but also had a 0.45 loading on component 5, and items 51 and 53 from component 6 which also loaded 0.40 and 0.48 on component 1. This cross loading is not altogether unexpected as component 5 may be described as a more advanced or complex version of component 1. The difference in the loading on the two components was sufficiently large to justify retaining the three variables.

Finally component scores were computed for each case using the regression method.

**Table 7.1 Principal Components Analyses of the Learning Strategy Inventory**

Component 1: Practice	I	II	III	IV	V	VI	VII
Work through new examples	.84	.17	-.04	.08	-.03	.09	.05
Work through given examples	.79	.22	-.05	.07	-.10	.11	.02
Complete set exercises/ assignments	.71	.15	.04	-.00	-.03	.14	.03
Complete extra exercises or assignments	.69	.11	-.06	.10	.01	.06	-.01
Find own or new examples	.67	.01	.19	.01	.16	.15	.00
Practice on simple tasks first	.61	.20	-.05	.09	-.15	.38	.05
Use principals with different data	.54	.08	.03	.06	.12	.45	.08
Change formulas into words	.47	.07	.02	.35	.27	.04	.01
Explain ideas to self to test understanding	.45	.39	.22	.15	.12	.17	-.01
Try doing something the wrong way to see what happens	.44	-.15	.06	.18	.29	.33	.07

<b>Component II: Identifying Key Ideas</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>
Identify main or significant points	-.07	.65	.03	-.03	.18	.05	.18
Summarise information	.03	.62	.04	.03	.03	.15	.25
Reduce notes to get a skeleton of main ideas	.13	.61	.15	.21	-.03	.12	.00
Read notes/text & make general statements	.03	.57	.12	.06	.21	.13	-.13
Rewrite notes into a more concise form	.11	.54	.01	.20	-.01	-.01	.20
Use headings and sub-headings	.08	.52	.29	.19	.12	-.05	.16
Take notes point by point & learn each	.28	.52	.09	.23	-.03	.07	-.02
Underline or highlight points	.24	.51	.17	.11	.25	-.03	.18
Identify key words & phrases	.24	.49	.22	.16	.12	-.12	.27
Break task into parts & learn each separately	.29	.45	.10	.18	-.05	.11	.07
<b>Component III: Relate to other contexts</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>
Relate ideas to own experience of a problem or situation	-.01	.10	.78	.16	.09	.05	.05
Think how I might use the information in some aspect of my life.	.05	.15	.75	.10	.07	.09	.15
Apply to real world situations	.01	.11	.74	.06	.16	.17	.10
Relate ideas to own views/beliefs/ emotional reactions	-.16	.06	.73	.22	.15	.01	.19
Relate ideas to other subjects	.10	.07	.68	.20	.09	.11	.11
Try to use information in new situations	.36	.08	.47	.15	.25	.25	.17
Work out how ideas are related to each other	.09	.36	.40	-.07	.26	.33	.12

<b>Components IV: Remember information</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>	<b>V</b>	<b>VI</b>	<b>VII</b>
Take first letter from a phrase to make a word	-.02	.15	.16	.77	-.03	.11	.05
Make up rhymes or rhythms	.13	.03	.11	.70	.05	.09	.17
Associate new idea with something easy to remember	.11	.18	.14	.67	.07	.27	.01
Memorise until I can recall without error	.15	.36	-.00	.54	-.13	-.00	.00
Recite notes out aloud	.17	.07	.23	.49	.01	-.17	.08
Change diagram into words	.37	.15	.09	.41	.28	.01	.09
Change notes into diagrams	.30	.12	.16	.41	.23	.05	.09
<b>Component V: Background filling</b>							
Read more widely on subject	-.09	.09	.11	-.01	.83	.05	.01
Get more background information	.03	.24	.03	-.00	.78	.07	-.01
Collect extra information from variety of sources	.01	.04	.11	.08	.76	.09	.13
Find out more about the context in which the ideas were developed	.01	.14	.30	.08	.64	.17	.03
Talk to other people about topic/subject	.21	-.07	.18	.07	.42	.06	.22
<b>Component VI: Projecting/ Predicting</b>							
Practice predicting outcomes	.41	.05	.09	.08	.03	.66	.02
Do something & try to explain to self why it happens	.48	.04	.06	.06	.13	.62	.02
Determine trends or patterns	.21	.15	.08	.05	.12	.60	.14
Identify or simulate consequences of doing something a certain way	.29	.03	.13	.02	.16	.59	.15
Mentally picture what is described	.07	.23	.19	.37	0.0	.47	.05
Get a basic overall picture then fill in details	.09	.34	.27	.11	.11	.42	.08

Component VII: Grouping	I	II	III	IV	V	VI	VII
Put information into groups	-.02	.18	.10	.05	.19	.22	.77
Label groups of information	.07	.23	.14	.09	.13	.17	.76
Put information into lists	.02	.21	.22	.18	.02	.02	.75
Number each item in list	.09	.15	.22	.26	.03	.05	.63
Eigenvalues	14.07	4.68	3.21	2.54	2.04	1.83	1.59
% of variance	23.4	7.8	5.3	4.2	3.4	3.0	2.6
Reliability Coefficient	.88	.83	.86	.81	.81	.80	.84
Mean	2.77	3.67	2.79	2.33	2.76	2.83	2.98
SD	1.06	.74	1.06	1.20	1.01	1.04	1.19

**Interpretation of Learning Strategy Factors** Each component that emerged represented a group of related learning strategies which perform a particular learning function. For example, strategies in component VI help the student to memorise information.

Although the principal component analysis did not set out to confirm a particular hypothesis a review of the components that emerged did indicate support for the tentative classification of learning strategies according to function suggested in the methodology chapter. The six suggested categories were: remember, comprehend, anchor, proceduralise, hypothesise and organise. The *proceduralise* strategy class appeared almost completely intact as Component I, called *practice*. The *comprehend* strategy class formed three new components, *identifying key ideas* (component II), *relating to other contexts* (component III) and *background filling* (component V). Each of these three components can be described as fulfilling a comprehension role but represent a clearer specification of the manner in which the strategies work. The *hypothesise* scale was replicated nearly entirely in component VI, *projecting/predicting*. The *remember* strategy class emerged as two components, *remembering information* (component IV) and *grouping* (component VII). The *anchor* strategy class was absorbed into component II (identifying key ideas). Half the items on the *organise* strategy scale disappeared due to low loadings. The remainder were absorbed into component II (items 59 and 60),

component I (item 54) and component VI (item 55). A comparison of the suggested functional classification and the components which appeared is shown in Table 7.2.

**Table 7.2 Comparison of Suggested Function Classification and Components**

Original Strategy Classes	Principal Components
Remember	Remember information (component IV) Grouping (component VII)
Comprehension	Identifying key ideas (component II) Relating to other contexts (component III) Background filling (component V)
Anchoring	Identifying key ideas (component II)
Proceduralising	Practice (component I)
Hypothesizing	Predicting/projecting (component VI)
Organising	Half disappeared. Remainder absorbed into other components

Scales were created for each of the seven components. Items, component loadings, eigenvalues, means, standard deviations and alpha coefficients are reported in Table 7.1. Given that students may not use all of the strategies in one component for any given task it might be expected that the alpha coefficient values would be low. In the event they were quite high, ranging from 0.80 to 0.88. Each of these components is now discussed in more detail.

**Practice Strategies** The first component to emerge described *practice* learning behaviours. The ten items in this component reflect strategies students use after some initial attempt at comprehending information. Practice strategies enable the student to manipulate and apply knowledge. Comprehension strategies create declarative knowledge structures (that is, *knowing about*), but if the student intends to be able to use or apply information, rather than just talk about it, they must first use *practice* strategies. These practice strategies *proceduralise* the student's knowledge into a format that enhances accessibility and usability (Chi, Feltovich &

Glaser, 1981; Glaser, 1988b). Once knowledge has been proceduralised it is ready to be used.

The *practice* strategies described here mean more than the repetitive drill exercises that might normally be associated with *practice*. The student is practicing *using* the information in some way. This implies at least a minimal level of understanding. One type of practice involves students working through processes or procedures which they must be able to use. An example of this might be a student completing a set exercise of mathematics problems. Practice is also exemplified by strategies which *test* the robustness of the new knowledge structures in contexts that are different to the one in which they were learned. The student is *practicing* using it in new situations. Changing a formula into words that describe the relationship contained in the formula is an example of this type of practice.

The importance of examples in this component is interesting. No other learning inventories could be found that included the use of examples as a learning strategy, yet *examples* are considered essential to learning and teaching (Reigeluth, 1983). Examples can aid understanding because they are a concrete manifestation of an abstract concept, procedure or principle, and concrete ideas are easier to learn than abstract. Examples also provide a prototype or blueprint to the students. By modelling their own actions on the example they can be guided through the process. Anthony (1991) noted that students used examples in this manner in their early attempts at working out new mathematics problems. Working through new examples or finding one's own represents a more advanced use of examples. In these cases the student is demonstrating his or her ability to apply abstract principles to new or unseen (to the student) concrete instances. For example, when a meteorological student looks at the sky and identifies a particular cloud as being a cumulus nimbus she is showing that she can *apply* a definition of this cloud type (abstract concept) to a particular instance.

Item 54 *practice on simple tasks first* differs from the other items in this component in that it is organisational in nature. Those learning strategies which might be

described as organisational had been suggested by students in the instrument studies but without any clear indication of the context in which they would be used. These organisational learning strategies were each associated with different components rather than cohering as an organisational component. The appearance of item 54 in the practice component suggests that students may consciously seek simple tasks first then move to more complex tasks as their skills develop.

**Identifying Key Ideas** The second component to emerge comprises 10 strategies collectively called *identifying key ideas*. This is one of the three components that appear to serve a comprehension function. The first five items in this component came from the original *comprehension* scale (see Table 7.2) and have the highest loadings. Of the remaining five, three (items 35, 41 and 40) came from the original *anchoring* scale. According to Spring (1985) these strategies don't aid comprehension, but assist in *remembering* after comprehension has taken place. The low loadings of these items on the *remember information* component don't lend much support to this assertion. It is possible, however, they may act in a support capacity to other component II strategies. In fact, it is difficult to see how they might usefully be used in the absence of one or more of those strategies.

Eight of these component II strategies describe the different ways in which information can be reduced or condensed to extract key ideas. Each of these involves the student evaluating the significance of the ideas. In the process of doing this the student should come to understand the content. By stripping away the less important information the student may be more likely to reveal and recognise the relationships between key ideas in the knowledge structure, further enhancing understanding. The organising strategies associated with this component of breaking the task into parts and dealing with each facilitate the use of other comprehension strategies by organising the information into a more suitable format.

**Relating to Other contexts** Component III, called *relating to other contexts*, is made up of 7 learning strategies. As with component II, these strategies perform a comprehension function, but at a more sophisticated level. In component II

(identifying key ideas) the student would appear to simply recognise the meaning of the information; when students relate information to other contexts (component III) they not only recognise the intrinsic structure of the information but are able to make connections between this structure and other knowledge structures. They are working to extend their level of understanding to a more complex plane. No particular organising strategy was identified with this class of strategies.

**Remembering Information** Component IV which also has 7 strategies is *remembering information*. In the pilot study an attempt was made to distinguish between *rote* and *mnemonic* scales, however reliability was improved when the two scales were combined to a single remember scale. This component also combines items that might be called *rote* and *mnemonic*.

These *remember* strategies organise or interact with information to increase its memorability, without changing the students' level of understanding. Such strategies are appropriate for information that needs no understanding (for example, being able to name all the bones in the human body) or for remembering the details of information that has already been *comprehended*, such as remembering the order of steps in a procedure.

**Background Filling** Component V is made up of 5 strategies and called *background filling*. All of these strategies came from the comprehension scale and load convincingly on this component. The items all describe the different methods students can use to collect additional material about the information they are learning. Building background can improve comprehension by developing the students' context for understanding the information they are learning.

**Projecting/Predicting** Component VI comprises 6 strategies called *projecting/predicting* strategies. These strategies are used when the student abstracts meaning from the information and uses it to predict or project information beyond its immediate, apparent meaning, for example predicting a trend. The strategy of visualisation may be used in conjunction with other strategies from the

group. The organising strategy associated with this group of learning strategies is getting an overall picture before filling in the details. Building a framework before determining the details is a logical strategy in the context of *projecting or predicting* information as it is the framework or structure that is extended, not the details which may serve as distracters.

**Grouping** Component VII is comprises 4 strategies collectively called *grouping*. These strategies organise and label information in a manner that enhances memory rather than understanding. All of the items came from the remember scale and load heavily only on component VII.

### 7.1.2 Study Management Skills

Study management skills were expected to influence the selection of learning strategies by creating important conditions under which learning strategies were used. Before this relationship could be tested it was necessary to determine if the 19 variables that made up this section could be represented by a small number of interpretable components.

Principal component analysis was used to explore the data in four stages. An examination of the correlational matrix showed a number of coefficients were greater than 0.3 and the ratio of sample size to items of 25.2 to 1 was more than adequate (Tabachnick & Fidell, 1989). Bartlett's test of sphericity (1920,7004;  $p \leq .0000$ ) and the Kaiser-Meyer-Oklin measure of sample adequacy (0.81519) established the appropriateness of the correlational matrix for component analysis (Norusis, 1990).

Determining the number of components appropriate to fit the data while at the same time remaining parsimonious is one of the critical decisions in a component analysis (Tabanick & Fidell, 1989). Unfortunately, no single test or procedure provides an adequate answer to this problem and most sources recommend a combination of strategies (Comfrey, 1978; Tabanick & Fidell, 1989). Three eigenvalues greater than

1.0 were obtained and then subjected to the scree test (Cattell, 1966; Tabachnick & Fidell, 1989). As Gorsuch (1983) points out, when the sample size is large, communality values high, and each component has several variables with high loadings, the results of the scree test are more obvious and reliable. Both of these measures supported the retention of three components. Component loadings were set at 0.40 and considered in descending order. This three component solution accounted for 42.1% of the variance.

A fairly simple structure was produced with only a small amount of cross loading on some of the components. Component scores were computed for each case.

**Interpretation of Study Management Skills Factors** A review of existing study management skills inventories, described in the literature review and in the methodology chapter, suggested these skills had two main components; time management (with subscales of *procrastination* and *keeping to a regular timetable*) and organising learning resources (subscales of *having complete, well organised notes* and *accessing important information*). In the event, two of these subscales emerged as components; *procrastination* and *having complete, well organised notes*. The time management scale appeared to reflect the broader concept of *planning*, which also incorporated elements of time management. Collectively these components describe the organisational and management skills of the student. Scales were created for each of the three components. Items, component loadings, eigenvalues, means, standard deviations and alpha coefficients are reported in table 7.3. These components are now discussed in more detail.

**Planning** Component I (*planning*), made up of nine items, represents the amount of planning and preparation students make for the learning process. Three distinct dimensions contribute to this component: planning their time effectively, preparing for study by having appropriate information available when its needed and setting goals.

**Procrastination** The second component of three items represents a *procrastination* component. These items measure the degree to which students delay or avoid starting study.

**Organised Study Materials** The five items that made up component III, *organised study materials*, load strongly on this component (from 0.48 to 0.75) and do not significantly cross-load on other components. These items describe how complete and organised the students study materials are, particularly their own notes.

**Table 7.3 Principal Components Analysis of Study Management Skills Inventory**

<b>Component I: <i>Planning</i></b>	<b>I</b>	<b>II</b>	<b>III</b>
I set specific goals for myself every time I study	.64	.11	.07
I set aside regular periods for study and stick to them	.63	.34	.05
I work out exactly how much I'll cover in a study session	.58	.30	.07
I plan a study timetable well in advance of examinations	.56	.21	.19
When they are available I attend tutorial/lecture review sessions	.62	-.05	.11
I find out all the assignment and examination dates early in the course	.51	-.05	.32
I always have the text available to check references in lectures and when studying	.47	.13	-.02
I add notes from additional readings to my lecture notes	.56	.12	-.00
I make it a priority to get all the information I can on how the course will be assessed	.44	-.21	.31

<b>Component II: Procrastination</b>			
I often find myself working late the night before a test or assignment	-.09	.79	.04
I usually leave assignments or study until the last minute	.32	.73	.12
I complete assignments comfortably before the due date	.32	.68	.19
<b>Component III: Organised Study Materials</b>			
I'm usually good at taking notes at lectures	.03	-.05	.75
I can usually get down the main ideas clearly at lectures	.01	.00	.70
I find it difficult to sort my notes into logical units for studying	1.0	.22	.59
My lecture/study notes are complete and well organised	.24	.16	.48
When faced with an assignment or study I find it hard to know where to begin	-.06	.27	.48
Eigenvalues	4.47	1.72	1.62
% of variance	23.5	9.1	8.6
Reliability Coefficient	.75	.76	.64
Mean	2.97	3.34	3.24
SD	.690	.713	.453

### 7.1.3 Task Representation

Task representation was the most exploratory of the three principal component analyses. There was little guidance in the literature as to what variables might be most useful or how those variables might cohere. The primary intention of this component analysis was to determine the presence of relationships among variables that might describe the different representations of a learning task held by students. A secondary aim was to understand how these components might influence a student's choice and use of learning strategies.

Principal component analysis with varimax rotation was performed on 15 items from the *Learning Task Profile* section of the questionnaire. The correlational matrix included several sizeable correlations greater than .30 suggesting the presence of some underlying processes (Tabachnick & Fidell, 1989). Support for the factorability of the data came from both Bartlett's test of sphericity (1081.4925;  $p \leq .0000$ ) and the Kaiser-Meyer-Olkin measure of sample adequacy (.69760).

Four components were extracted for rotation. Tabanick & Fidell (1989) suggest that if the number of variables is small (less than 40), and the sample size large then dividing the number of variables by 3 to 5 should give the number of components with eigenvalues greater than 1.0. In this case 15 variables divided by 4 gives almost 4 components and exactly four components did have eigenvalues greater than 1.0. The scree test also supported the retention of four components. (Cattell, 1966). All the variables had a loading greater than .40 and these were grouped in descending order. This four component solution accounted for 50.6% of the variability.

Orthogonal rotation was used for conceptual simplicity and ease of description. Component scores were computed for each case.

Scales were created for each of the four components. Items, component loadings, eigenvalues, means, standard deviations and alpha coefficients are reported in Table 7.4.

**Table 7.4 Principal Components Analysis of Task Representation Inventory**

<b>Component I: Declarative</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>
Essay/report writing	.77	.18	.11	-.08
Practical exercises (reverse score)	.71	.12	-.22	-.21
Explain in own words	.65	.01	-.00	1.0
Use or apply knowledge (reverse score)	.64	-.02	.07	.26
Includes lots of background material	.46	.35	.44	-.11
<b>Component II: Investigative</b>				
All required information given in lectures, study guides and course texts (reverse score)	.17	.72	-.24	-.06
Student must find much information for themselves	.32	.68	.16	-.15
<b>Component III: Contained</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>
Each new section depends on understanding previous section	-.10	.09	.71	.15
Ideas which build on ideas	.14	.09	.70	-.23
Clear, well defined assessment requirements	-.00	-.36	.52	.05
<b>Component IV: Fragmented</b>				
Memorise information	.19	.06	-.00	.68
Short answers	-.19	.02	.21	.63
Many discrete or unrelated parts	-.08	.49	-.04	.52
Need to learn only selected aspects	.07	-.14	-.20	.41
Eigenvalues	2.9	1.7	1.6	1.3
% of variance	19.4	11.6	10.8	8.7
Reliability Coefficient	.71	.65	.45	.43
Mean	2.91	3.33	2.59	1.95
SD	.884	.601	.762	.649

**Interpretation of Task Representation** Four components emerged that described different ways of viewing a learning task from the student's perspective.

**Declarative** Component I, labelled *declarative* and made up of five items describes a declarative task. A declarative task representation is one which the student perceives as requiring them to *know about* something, to be able to talk about the information but not apply or use it in any practical sense. It may include a lot of background reading. These tasks are closely associated with essay tasks and an *explain* level of processing.

**Investigative** Component II originally emerged from 3 items, but reliability testing suggested that only 2 items contributed to its validity. This component, called *investigative*, defines a task which requires students to find much of the information themselves, and contrasts with a task in which the parameters are clearly defined and all of the information supplied directly by the lecturer. Interpretation of this component with only two variables is made cautiously however, and its retention justified only by the very exploratory nature of the analysis. Replication of these results with only two items is extremely unlikely. Further development of the component is indicated.

**Contained** Tasks described by component III, *contained* are seen by students as having content whose structure is known and understood and with clear assessment requirements. The relatively low reliability of this component ( $r=0.45$ ) suggests that the component hasn't been fully rounded out by the variables in the component analysis. Three items make up the component and these load heavily on the one component. One item (Clear, well defined assessment requires) has a low negative loading on the *investigative* component.

**Fragmented** The fourth component, *fragmented* comprises four items. Tasks perceived in this way have content made up of many isolated, unrelated fragments. Students fail to identify any relationships between the ideas presented. Memorising

information without understanding is the processing level strongly associated with such tasks and short answers the expected format of assessment. One item (many discrete or unrelated parts) also loaded on the *investigative* component. The reliability of this component is also very low,  $r=0.43$ , so interpretation must be treated cautiously.

In summary, task representation defines the student's situation analysis of the learning task. Whereas a task can be objectively described, a task representation is an individual's subjective appraisal and describes not just the task, but the student's relationship to the task. For example, a fragmented task representation appears to suggest a student with little understanding of the task. In this case the student may be unable to identify the structure or relationships between elements of the task. For this student the nature of the task is that it is fragmented (as opposed to being an essay for instance) and he or she must find some appropriate response to the fragmentation.

#### **7.1.4 Summary of Principal Component Analysis Results**

Principal component analysis was performed on the three sections of the questionnaire developed for this study to determine coherent subsets of variables that could be used to describe students' learning behaviour and task representation, and in further analysis to understand their role in the learning process and learning success. PCA of the learning strategies provided robust components with good reliability. The other two sections produced more tentative results, particularly the task representation analysis. However, these results were of great interest in that they gave insight into the students' analysis of the learning task and now provide a platform for further development and research of these components.

## 7.2 Regression

Standard multiple regression was performed for three reasons: firstly, to identify the determinants of learning strategy selection; secondly, to examine the influence of these learning strategies on learning outcome; and thirdly, as a means of comparing learning strategies with the strategy subscales of the SPQ (Study Process Questionnaire, Biggs, 1985) as predictors of specific learning outcomes. Multiple regression was chosen as an appropriate measure for predicting the influence of several independent variables on a dependent variable. The flexibility of the regression technique was particularly useful in this field study in which the variables could not be reduced to an orthogonal design as they might in a laboratory setting.

The multiple regression results are presented in three stages. In the first stage the independent variables of task representation, the task itself, study management skills, motives for studying, age and gender are regressed on to seven learning strategy components. These learning strategies then become independent variables in the second stage when they, along with prior knowledge and study management skills are regressed on to learning outcome. Finally, the three strategy scales of the SPQ are regressed on to learning outcome.

### 7.2.1 Determinants of Learning Strategy Selection

The first set of regressions identified those variables that predicted the student's selection of learning strategies. A number of variables were identified as possible influences on the students' choice of learning strategies. These independent variables included; task representation, the task itself, study management skills, motives for studying, age and gender. The seven learning strategy components that emerged from the principal component analysis were used as the dependent variables. Standard multiple regression in which all of the independent variables were entered in a single block was used as there was no strong theoretical basis for ordering their entry into the equation (Tabanick & Fidell, 1989). Analysis was performed using SPSS\* Regression.

An evaluation of assumptions made from the frequency distribution and the scatterplot of residuals revealed a slight skewness in the data, but otherwise it was linear and homoscedastic. One outlier was found using Mahalanobis distance ( $p < .001$ ) and eliminated from further analysis. From a total sample size of 479, listwise deletion of cases with missing data caused a reduction in size. The size varied for each of the equations but ranged from 392 to 398. The lowest case to independent variable ratio was 26.5:1, well above the minimum requirements for regression (Tabanick & Fidell, 1989). Tables 7.5 to 7.11 display the correlations between variables, the intercept, the standardised regression coefficient (beta), T ratios, the  $R^2$ , the adjusted  $R^2$ , the F score and its significance.

Fifteen independent variables were regressed on to each of the seven strategy groups. The amount of variance accounted for varied across the strategy components, ranging from 16.2% to 35.9%.

**Task Representation** Although the contribution of the independent variables varied for each group of learning strategies, a number of broad general trends emerged. Task representation consistently makes significant contributions to the selection of strategies in each of the strategy groups. This influence is particularly strong in three of the learning strategy groups; *practice* (CI), *key ideas* (CII), and *projecting/predicting* (CVI).

*Fragmented Task Representation* A *fragmented* task representation (TR4) predicts the selection of all learning strategies except *grouping* strategies. This representation predicts so many different learning strategies it raises the possibility that students may respond in a variety of different ways to a task they perceive as being made up of many isolated fragments that don't cohere in any obvious way. It may be that some students use strategies, such as key ideas and relating, to help them to overcome this fragmented view by understanding and integrating the task, while others use *remembering* strategies as a coping mechanism to avoid deep processing but still pass the assessment procedures. Still other students may

inappropriately try to use *practice* strategies even though they haven't fully understood the task.

*Investigative Task Representation* An *investigative* task representation (TR2) is significant to all learning strategy components except *remembering* strategies. Since this task representation requires a strong input of student research and effort, the unimportance of *remembering* strategies is not surprising. The student selects the information to be learned, implying a level of understanding. Such information, that has been personally selected and understood, probably requires little effort to remember.

*Contained Task Representation* Task representation 3 (*contained*) describes a task that is seen as self contained and clearly understood. This task representation has a significant negative correlation with strategy selection for all learning strategies except for *grouping* (CVII) which has a positive, but non-significant correlation and *background* which has a non-significant negative correlation. It may be that this group of students feel they have no need of comprehension or practice strategies, but are able to complete the task with little or no further learning. A *contained* task representation also correlates negatively with both a *fragmented* task representation (TR3) and an *investigative* task representation (TR2), suggesting it is mutually exclusive to these other representations.

*Declarative Task Representation* A *declarative* task representation has a strong negative correlation with *practice* strategies, but not with other strategies. Tasks seen as declarative are those which the student understands as requiring only the knowledge to explain or describe, not apply. *Practice* strategies are more appropriate to tasks which require the student to use or apply the information.

Task representations describe the task as the student sees it; it may not be an accurate representation of the task itself. The students' task representation reflects the students' appraisal of the learning task which dictates to a large extent how they subsequently respond, in particular what learning strategies they use. This is an

important missing link in understanding *why* students choose particular approaches to learning. Rather than the learning strategy training that has been a feature of attempts to improve learning, these results suggest a fruitful source of remediation might be directed at student task-analysis.

The results described above demonstrate that students generally make appropriate learning strategy responses to their representation of the task. The relationship between the task itself and the choice of learning strategies reveal a slightly different picture.

**The Learning Task** The nature of the learning task was expected to influence the students' choice of learning strategies. Four tasks from different departments in the University were selected to provide a variety of task types. These included an essay (accounting), a practical project (engineering technology), and two case studies; one involved writing a research proposal (management) and the other advice to a young teacher on developing and structuring her teaching notes (human resource management).

The contribution made by the four tasks was measured using three dummy variables (D1, D2 and D3). The *essay* task was used as the referent. D1 expressed a comparison between the *essay* and *project* tasks; D2, the *essay* and *case study 1*; and D3, the *essay* and *case study 2*. Tasks were important to six strategy groups: *practice* (CI), *key ideas* (CII), *relating* (CIII), *background* (CIV), *grouping* (CVII) and *projecting/predicting* (CVI). The task did not seem to exert a specific influence on the use of *remembering* strategies (CIV).

**Essay Task** The essay task had a strong negative correlation with *relating* strategies (D1) and a strong positive correlation with *background* strategies (D3). These students chose to develop their background knowledge, but were not sufficiently motivated to want to relate this knowledge to other aspects of their lives. This fits with the nature of the course which was "Accounting for Non-Accountants", a compulsory paper for non-accounting students doing the Bachelor

of Business Studies degree. Students would use *background* strategies to develop a context that would improve their understanding of the content, but were averse to the use of *relating* strategies which are normally associated with a deep motive and an intrinsic interest in a subject (Biggs, 1987).

*Project Task* The practically-based project task correlated strongly with *practice* strategies (D1), and less strongly with the more advanced *projecting/predicting* strategies (D1). Both of these strategy groups proceduralise information and organise it in a manner that facilitates its application to a new situation, and are therefore highly appropriate for learning this type of task.

*Case Study 1* The case study 1 task predicts *key ideas* and *relating* strategies both of which build comprehension. A case study task is in effect a simulated practical task, and as such should generate some practice strategies. The reliance on comprehension strategies suggests these students may be interpreting this task as a declarative task rather than the simulated practical exercise that was intended. The presence of *relating* strategies, associated with an intrinsic interest in the subject, reflects the fact that this class was part of the students' chosen major in Human Resource Management.

The use of *grouping* strategies for case study 1 was also interesting as no other task predicts these strategies. It seems likely that *grouping* strategies may be used to organise and structure *key ideas* which are favoured by these students.

*Case Study 2* In contrast to case study 1, case study 2 students do use *practice* strategies. These students clearly see the task as a simulated practical task. No other strategies were significantly predicted by this task.

The nature of the task influences which strategies students choose to learn the task. However, overall the beta weights in each equation indicate that in most cases this influence is not as strong or pervasive as task representation. The learning strategies

that are consistently selected for a task are generally appropriate responses to the task.

**Study Management Skills** A further expected influence on the choice of learning strategies was the student's study management skills. These provide conditions under which the learning strategies are used. Less favourable conditions, such as a shortage of time due to poor planning, are likely to reduce the range of learning strategies options available to the student, or diminish the effectiveness of the strategies.

Three study management skills were identified by the principal component analysis, however, only one of these significantly predicts learning strategy selection. Planning (SMS1) contributes to the use of *practice, relating, background* and *grouping* strategies. The first three of these learning strategies have significant additional time requirements when compared to strategies such as *key ideas*. *Grouping* strategies are organisational in nature and are probably used in conjunction with other strategies, such as *key ideas*, and thus would also require time and forethought.

**Learner Characteristics** Individual learner characteristics have been recognised as influencing learning behaviour since the 1960's (Glaser, 1970; Gagné, 1967). The influence of age, gender and motive on learning strategy selection was examined. Age and gender exhibited some interesting effects on strategy selection. Age is strongly positively correlated with *relating* strategies. As people get older their knowledge and experience grow and they appear to use this knowledge base as a context for understanding new learning. In this way they are constantly relating new ideas to other contexts, hence the use of *relating* strategies in older students is expected (Biggs, 1987). Age is strongly negatively associated with *grouping* strategies. It may be that younger students use more comprehension strategies such as *key ideas* rather than *relating* and this requires an organisational strategy to provide structure. *Relating* derives its structure from the context that is used to understand the information.

Being female predicts the likely use of *key ideas*, *remembering*, *background* and *grouping* strategies.

*Achieving* (AM) and *surface* (SM) motives showed no tendencies to influence strategy choice, but *deep* motive (DM) was very important to the selection of *relating* (CIII), *background* (CVI) and *grouping* strategies (CVII), and of some importance to *projecting/predicting* strategies (CVI). *Relating*, *background* and *projecting/predicting* strategies all require the student to seek further than the information immediately available. The extra effort needed is more likely to be forthcoming from deeply motivated students. As *grouping* strategies are probably used in association with other strategies, these also need extra effort.

### **7.1.2 Summary of Determinants of Learning Strategy**

As this study was exploratory in nature the focus of interest was on the main effects. No analysis of moderating or intervening variables was undertaken. It is noted that study management skills were influential both in the selection of learning strategies and in determining the quality of learning outcome. It may be that these skills are playing a more complex role in the process than has been revealed by this study. This is an area that might fruitfully be pursued in further research.

The choice of learning strategies is the students' response to a particular learning situation. This response is most strongly determined by the student's representation of the task which is quite distinct from the task itself. Whereas a task can be objectively described, a task representation describes the individuals' appraisal of the task in relation to their own state of readiness for coping with the task. This personal response is the most powerful and pervasive determinant of learning strategy choice.

The task itself was selectively predictive, each task influencing the selection of between one and three strategy groups. *Remembering* strategies were not predicted

by any particular task. This may indicate that these strategies are commonly used for all tasks. Planning, gender and deep motive each influenced the selection of five strategy groups, and age, two strategy groups.

It was not possible to demonstrate any effect, by four of the independent variables, on the choice of learning strategies. These were procrastination (SMS2), study materials (SMS3), a surface motive (SM) and an achieving motive (AM).

**Table 7.5 Standard Multiple Regression of Task Representation, Study Management Skills, Age, Gender, Motive and Task on the Selection of Practice Strategies. N=395**

	CI	TR 1	TR 2	TR 3	TR 4	SMS 1	SMS 2	SMS 3	Age	Gender	DM	AM	SM	D 1	D 2	Beta	T Ratio
TR 1	-.319															-.250**	-3.78
TR 2	.085	.223														.104*	2.24
TR 3	-.243	-.075	-.224													-.149**	-3.057
TR 4	.176	-.025	-.037	-.009												.183**	3.936
SMS 1	.170	.159	.160	-.282	-.042											.115*	2.026
SMS 2	.065	-.097	.071	-.014	.148	-.211										-.027	-.547
SMS 3	.076	.098	.112	-.147	.045	.125	.278									.065	1.36
Age	-.017	.090	.010	-.034	-.146	.332	-.294	-.072								-.002	-.046
Gender	-.043	.166	.005	.047	-.201	.211	.052	.150	.101							.045	.952
DM	.144	.102	.087	-.256	-.036	.492	-.109	-.021	.364	.071						.066	1.22
AM	.103	.246	.169	-.215	.083	.349	.003	.105	.063	.009	.325					.049	.963
SM	.152	.095	.039	-.147	.193	.060	.203	.146	-.247	.031	-.053	.282				.093	1.902
D 1	.322	-.694	-.164	-.065	.009	-.189	.143	-.141	-.208	-.223	-.095	-.151	.037			.264**	3.614
D 2	-.047	.029	-.020	.119	-.148	.207	-.257	-.051	.417	.170	.202	-.040	-.182	-.337		.087	1.548
D 3	-.015	.179	.123	.002	-.049	-.022	.060	.037	-.030	-.004	-.011	-.007	.038	-.243	-.183	.106*	2.221
Mean	2.686	2.909	3.331	2.595	1.957	2.977	3.345	3.247	2.189		3.075	3.121	3.512				
SD	1.054	.884	.601	.762	.649	.690	.713	.453	1.146		.649	.632	.606				
																Intercept=	.456440
																R <sup>2</sup> =	.286
																adj R <sup>2</sup> =	.258
																F=10.113	Sign F= .0000

\*\*  $p < .01$

\*  $p < .05$

CI - Component 1, practice learning strategies  
 TR 1 - Task representation 1, declarative 1 task  
 TR 2 - Task representation 2, investigative  
 TR 3 - Task representation 3, contained  
 TR 4 - Task representation 4, fragmented

SMS 1 - Study management skills 1, planning  
 SMS 2 - Study management skills 2, procrastination  
 SMS 3 - Study management skills 3, complete study notes  
 D1- Dummy variable 1  
 D2 - Dummy variable 2  
 D3- Dummy variable 3

DM - Deep motive  
 AM - Achieving motive  
 SM - Surface motive

**Table 7.6 Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Key Idea Strategies. N=394**

	CII	TR 1	TR 2	TR 3	TR 4	SMS 1	SMS 2	SMS 3	Age	Gender	DM	AM	SM	D 1	D 2	D 3	Beta	T Ratio
TR 1	.173																-.016	-.233
TR 2	.247	.203															.161**	3.326
TR 3	-.230	-.088	-.240														-.137**	-2.683
TR 4	.112	-.048	-.056	-.003													.141**	2.911
SMS 1	.267	.153	.162	-.297	-.061												.084	1.437
SMS 2	.049	-.078	.079	-.009	.144	-.197											.044	.847
SMS 3	.095	.107	.116	-.148	.039	.126	.283										-.026	-.521
Age	.039	.076	.012	-.048	-.153	.323	-.284	-.073									-.068	-1.231
Gender	.149	.182	.008	.042	-.206	.215	.057	.157	.093								.116*	2.326
DM	.230	.112	.080	-.261	-.046	.497	-.103	-.014	.356	.068							.102	1.799
AM	.255	.247	.157	-.220	.067	.354	.014	.108	.063	.027	.343						.097	1.815
SM	.171	.091	.042	-.146	.201	.059	.200	.141	-.247	.027	-.058	.275					.091	1.783
D 1	-.207	-.690	-.156	-.050	.036	-.189	.124	-.145	-.200	-.238	-.108	-.153	.041				-.099	-1.313
D 2	.112	.026	-.024	.118	-.153	.212	-.257	-.053	.427	.177	.209	-.042	-.182	-.338			.133*	2.260
D 3	.087	.176	.133	-.003	-.059	-.030	.065	.034	-.041	-.009	-.012	-.003	.045	-.240	-.181		.073	1.465
Mean	3.606	2.909	3.331	2.595	1.957	2.977	3.345	3.247	2.189		3.075	3.121	3.512					
SD	.812	.884	.601	.762	.649	.690	.713	.453	1.146		.649	.632	.606					
																	Intercept=	.1.2187
																	R <sup>2</sup> =	.227
																	adj R <sup>2</sup> =	.196
																	F=7.4035	Sign F= .0000

\*\*  $p < .01$ \*  $p < .05$ 

CII - Component 2, key ideas learning strategies

TR 1 - Task representation 1, declarative 1 task

TR 2 - Task representation 2, investigative

TR 3 - Task representation 3, contained

TR 4 - Task representation 4, fragmented

SMS 1 - Study management skills 1, planning

SMS 2 - Study management skills 2, procrastination

SMS 3 - Study management skills 3, complete study notes

D1- Dummy variable 1

D2 - Dummy variable 2

D3- Dummy variable 3

DM - Deep motive

AM - Achieving motive

SM - Surface motive

Table 7.7 Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Relating Strategies. N=398

	CIII	TR 1	TR 2	TR 3	TR 4	SMS 1	SMS 2	SMS 3	Age	Gender	DM	AM	SM	D 1	D 2	D 3	Beta	T Ratio
TR 1	.225																-.014	-.236
TR 2	.231	.213															.147**	3.416
TR 3	-.215	-.075	-.232														-.129**	-2.853
TR 4	.031	-.035	-.051	.000													.102*	2.376
SMS 1	.391	.167	.166	-.285	-.053												.108*	2.055
SMS 2	-.156	-.092	.074	-.018	.136	-.204											-.031	-.669
SMS 3	.086	.104	.111	-.147	.038	.126	.280										.041	.925
Age	.361	.090	.010	-.035	-.145	.331	-.293	-.072									.134**	2.739
Gender	-.088	.180	.011	.044	-.208	.216	.059	.156	.102								-.028	-.631
DM	.390	.113	.078	-.255	-.045	.498	-.105	-.018	.362	.085							.186**	3.694
AM	.194	.255	.164	-.214	.074	.354	.007	.107	.063	.019	.334						-.004	-.088
SM	-.033	.086	.041	-.146	.197	.054	.199	.141	-.247	.024	-.060	.273					.012	.279
D 1	-.352	-.695	-.162	-.059	.025	-.201	.136	-.144	-.208	-.237	-.104	-.161	.043				-.211**	-3.132
D 2	.370	.030	-.019	.117	-.150	.211	-.256	-.053	.417	.172	.202	-.037	-.182	-.337			.212**	4.073
D 3	-.010	.179	.123	.001	-.051	-.018	.060	.036	-.030	-.002	-.009	-.005	.038	-.243	-.181		-.025	-.575
Mean	2.789	2.909	3.331	2.595	1.957	2.977	3.345	3.247	2.189		3.075	3.121	3.512					
SD	1.061	.884	.601	.762	.649	.690	.713	.453	1.146		.649	.632	.606					
																	Intercept=	.374070
																	R <sup>2</sup> =	.383
																	adj R <sup>2</sup> =	.359
																	F=15.815	Sign F= .0000

\*\*  $p < .01$ \*  $p < .05$ 

CIII - Component 3, relating learning strategies

TR 1 - Task representation 1, declarative 1 task

TR 2 - Task representation 2, investigative

TR 3 - Task representation 3, contained

TR 4 - Task representation 4, fragmented

SMS 1 - Study management skills 1, planning

SMS 2 - Study management skills 2, procrastination

SMS 3 - Study management skills 3, complete study notes

D1- Dummy variable 1

D2 - Dummy variable 2

D3- Dummy variable 3

DM - Deep motive

AM - Achieving motive

SM - Surface motive

**Table 7.8 Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Remember Strategies. N=392**

	CIV	TR 1	TR 2	TR 3	TR 4	SMS 1	SMS 2	SMS 3	Age	Gender	DM	AM	SM	D 1	D 2	D 3	Beta	T Ratio		
TR 1	.126																-.030	-.425		
TR 2	.133	.195															.074	1.509		
TR 3	-.169	-.061	-.214														-.111*	-2.159		
TR 4	.202	-.033	-.046	-.008													.249**	5.021		
SMS 1	.230	.166	.164	-.298	-.055												.088	1.457		
SMS 2	.040	-.085	.088	-.011	.136	-.202											-.039	.741		
SMS 3	.032	.102	.107	-.145	.039	.126	.283										-.076	-1.492		
Age	.050	.098	.020	-.062	-.161	.335	-.287	-.071									-.032	-.585		
Gender	.179	.183	.016	.021	-.213	.217	.064	.159	.095								.184**	3.614		
DM	.203	.112	.075	-.263	-.038	.499	-.092	-.017	.360	.079							.100	1.709		
AM	.169	.256	.164	-.218	.059	.353	.005	.106	.059	.022	.345						.034	.963		
SM	.140	.081	.031	-.146	.199	.058	.200	.139	-.240	.026	-.056	.277					.073	.634		
D 1	-.172	-.703	-.160	-.048	.030	-.191	.122	-.143	-.197	-.228	-.102	-.158	.045				-.092	-1.180		
D 2	.098	.039	-.007	.099	-.160	.212	-.251	-.052	.401	.165	.200	-.039	-.176	-.335			.099	1.652		
D 3	.076	.179	.125	-.002	-.051	-.019	.061	.036	-.028	-.006	-.006	-.004	.035	-.245	-.182		.080	1.579		
Mean	1.840	2.909	3.331	2.595	1.957	2.977	3.345	3.247	2.189		3.075	3.121	3.512							
SD	.987	.884	.601	.762	.649	.690	.713	.453	1.146		.649	.632	.606							
																	Intercept=	-.31812		
																		R <sup>2</sup> =	.194	
																		adj R <sup>2</sup> =	.162	
																		F=6.0456	Sign F=	.0000

\*\*  $p < .01$ \*  $p < .05$ 

CIV - Component 4, remember learning strategies

TR 1 - Task representation 1, declarative 1 task

TR 2 - Task representation 2, investigative

TR 3 - Task representation 3, contained

TR 4 - Task representation 4, fragmented

SMS 1 - Study management skills 1, planning

SMS 2 - Study management skills 2, procrastination

SMS 3 - Study management skills 3, complete study notes

D1- Dummy variable 1

D2 - Dummy variable 2

D3- Dummy variable 3

DM - Deep motive

AM - Achieving motive

SM - Surface motive

**Table 7.9 Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Background Strategies. N=399**

	CV	TR 1	TR 2	TR 3	TR 4	SMS 1	SMS 2	SMS 3	Age	Gender	DM	AM	SM	D 1	D 2	D 3	Beta	T Ratio
TR 1	.232																.097	1.440
TR 2	.218	.216															.127**	2.667
TR 3	-.230	-.075	-.231														-.091	-1.815
TR 4	-.030	-.034	-.050	.000													-.004	-.097
SMS 1	.370	.166	.164	-.285	-.053												.208**	3.580
SMS 2	-.049	-.090	.075	-.018	.137	-.204											-.019	-.375
SMS 3	.106	.104	.111	-.147	.038	.125	.280										.018	.374
Age	.082	.090	.011	-.035	-.145	.331	-.293	-.072									-.072	-1.336
Gender	.177	.176	.007	.044	-.208	.216	.058	.155	.101								.100*	2.051
DM	.296	.116	.082	-.254	-.044	.495	-.103	-.017	.362	.080							.153**	2.748
AM	.237	.256	.165	-.214	.074	.354	.007	.107	.063	.018	.335						.034	.655
SM	.055	.085	.040	-.146	.196	.055	.199	.141	-.247	.025	-.061	.273					-.002	-.040
D 1	-.183	-.696	-.166	-.059	.024	-.199	.134	-.144	-.208	-.231	-.109	-.162	.04				-.071	-.953
D 2	.056	.031	-.017	.117	-.149	.210	-.256	-.053	.417	.170	.204	-.037	-.182	-.338			-.049	-.846
D 3	-.084	.179	.124	.001	-.050	-.018	.060	.036	-.030	-.003	-.008	-.005	.037	-.244	-.181		-.139**	-2.851
Mean	2.764	2.909	3.331	2.595	1.957	2.977	3.345	3.247	2.189		3.075	3.121	3.512					
SD	1.012	.884	.601	.762	.649	.690	.713	.453	1.146		.649	.632	.606					
																	Intercept=	.167090
																	R <sup>2</sup> =	.239
																	adj R <sup>2</sup> =	.209
																	F=8.0266	Sign F= .0000

\*\*  $p < .01$ \*  $p < .05$ 

CV - Component 5, background learning strategies

TR 1 - Task representation 1, declarative 1 task

TR 2 - Task representation 2, investigative

TR 3 - Task representation 3, contained

TR 4 - Task representation 4, fragmented

SMS 1 - Study management skills 1, planning

SMS 2 - Study management skills 2, procrastination

SMS 3 - Study management skills 3, complete study notes

D1- Dummy variable 1

D2 - Dummy variable 2

D3- Dummy variable 3

DM - Deep motive

AM - Achieving motive

SM - Surface motive

**Table 7.10 Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Project/Predicting Strategies. N=398**

	CVI	TR 1	TR 2	TR 3	TR 4	SMS 1	SMS 2	SMS 3	Age	Gender	DM	AM	SM	D 1	D 2	D 3	Beta	T Ratio
TR 1	-.099																-.076	-1.106
TR 2	.195	.219															.166**	3.436
TR 3	-.290	-.075	-.231														-.171**	-3.364
TR 4	.175	-.030	-.051	.000													.180**	3.719
SMS 1	.215	.166	.164	-.285	-.053												.110	1.874
SMS 2	.004	-.094	.076	-.018	.139	-.204											-.045	-.871
SMS 3	.048	.098	.114	-.147	.043	.126	.278										.023	.481
Age	-.014	.091	.011	-.035	-.146	.331	-.293	-.071									-.076	-1.397
Gender	-.097	.171	.008	.044	-.206	.217	.055	.150	.102								-.044	-.874
DM	.223	.114	.083	-.254	-.042	.495	-.105	-.020	.363	.077							.137*	2.425
AM	.177	.254	.166	-.214	.076	.354	.005	.104	.064	.015	.324						.061	1.154
SM	.106	.089	.039	-.146	.195	.055	.201	.145	-.247	.028	-.059	.275					.025	.493
D 1	.146	-.696	-.167	-.059	.022	-.199	.136	-.141	-.208	-.229	-.108	-.161	.043				.176*	2.323
D 2	-.023	.033	-.018	.117	-.151	.211	-.255	-.051	.417	.172	.205	-.036	-.184	-.339			.083	1.427
D 3	-.012	.181	.123	.001	-.051	-.018	.061	.037	-.030	-.002	-.007	-.004	.037	-.245	-.181		.051	1.025
Mean	2.830	2.909	3.331	2.595	1.957	2.977	3.345	3.247	2.189		3.075	3.121	3.512					
SD	1.036	.884	.601	.762	.649	.690	.713	.453	1.146		.649	.632	.606					
																	Intercept=	.674991
																	R <sup>2</sup> =	.218
																	adj R <sup>2</sup> =	.188
																	F=7.138	Sign F= .0000

\*\*  $p < .01$ \*  $p < .05$ 

CVI - Component 6, projecting learning strategies

TR 1 - Task representation 1, declarative 1 task

TR 2 - Task representation 2, investigative

TR 3 - Task representation 3, contained

TR 4 - Task representation 4, fragmented

SMS 1 - Study management skills 1, planning

SMS 2 - Study management skills 2, procrastination

SMS 3 - Study management skills 3, complete study notes

D1- Dummy variable 1

D2 - Dummy variable 2

D3- Dummy variable 3

DM - Deep motive

AM - Achieving motive

SM - Surface motive

**Table 7.11 Standard Multiple Regression of Task Representation, Study Management Skills and Motive on the Selection of Grouping Strategies. N=397**

	CVII	TR 1	TR 2	TR 3	TR 4	SMS 1	SMS 2	SMS 3	Age	Gender	DM	AM	SM	D 1	D 2	D 3	Beta	T Ratio		
TR 1	.165																	.012		
TR 2	.168	.214																.110*	2.280	
TR 3	-.125	-.079	-.223															-.017	-.348	
TR 4	.053	-.036	-.050	.000														.092	1.916	
SMS 1	.318	.168	.164	-.289	-.053													.145**	2.465	
SMS 2	-.039	-.095	.075	-.018	.136	-.199												-.033	-.646	
SMS 3	.093	.113	.114	-.145	.040	.124	.287											.014	.289	
Age	.038	.087	.009	-.037	-.146	.329	-.292	-.071										-.161**	-2.934	
Gender	.202	.172	.005	.042	-.210	.216	.057	.160	.099									.140**	2.817	
DM	.298	.110	.080	-.258	-.045	.499	-.108	-.011	.362	.076								.222**	3.940	
AM	.189	.252	.163	-.217	.073	.356	.005	.112	.061	.014	.332							.008	.153	
SM	.121	.092	.042	-.143	.198	.057	.201	.138	-.245	.029	-.057	.278						.088	1.744	
D 1	-.214	-.694	-.163	-.05	.026	-.199	.137	-.152	-.205	-.227	-.102	-.157	.037					-.091	-1.211	
D 2	.185	.028	-.019	.115	-.150	.211	-.257	-.051	.416	.168	.202	-.039	-.180	-.337				.149**	2.547	
D 3	.012	.178	.123	.000	-.051	-.019	.060	.037	-.031	-.004	-.010	-.006	.039	-.243	-.182			.007	.139	
Mean	2.981	2.909	3.331	2.595	1.957	2.977	3.345	3.247	2.189		3.075	3.121	3.512							
SD	1.191	.884	.601	.762	.649	.690	.713	.453	1.146		.649	.632	.606							
																		Intercept=	-.71958	
																		R <sup>2</sup> =	.223	
																		adj R <sup>2</sup> =	.193	
																		F=7.2951	Sign F=	.0000

\*\*  $p < .01$ \*  $p < .05$ 

CVII - Component 7, grouping learning strategies

TR 1 - Task representation 1, declarative 1 task

TR 2 - Task representation 2, investigative

TR 3 - Task representation 3, contained

TR 4 - Task representation 4, fragmented

SMS 1 - Study management skills 1, planning

SMS 2 - Study management skills 2, procrastination

SMS 3 - Study management skills 3, complete study notes

D1- Dummy variable 1

D2 - Dummy variable 2

D3- Dummy variable 3

DM - Deep motive

AM - Achieving motive

SM - Surface motive

### 7.2.2 Influences on Learning Outcome

Having determined which variables influenced the selection of learning strategies, the second step was to establish how learning strategies influenced the quality of learning outcome. Learning strategies were not expected to be the only influences on learning outcome. According to Tabanick & Fidell (1989) and Norusis (1988) leaving out significant independent variables from a regression is likely to distort the results. Prior knowledge is well established in the literature as an important determinant of learning outcome (Chi, Feltovich & Glaser, 1981; Chi, Glaser & Rees, 1982; Alexander & Judy, 1988) and was included for this reason. Study management skills were also included because these skills provide the conditions under which the learning process occurs. The presence or absence of these skills impinges on the effectiveness of the whole process and thus is likely to directly affect learning outcome.

The dependent variable (learning outcome) was measured by the assignment mark the student received. All of the independent variables were entered in a single step as recommended by Tabanick & Fidell (1989) as there was no strong theoretical reason for using hierarchical regression.

The regressions were run in five stages. The first was for the total sample as a check on which variables generally might influence learning outcome. However, as it was expected that the association of learning strategies with success would depend on which learning task was being performed, the regression was run again for each of the four tasks.

An evaluation of assumptions made from the frequency distribution and the scatterplot of residuals revealed a slight skewness in the data, which was otherwise characterised by linearity and homoscedasticity. With the use of a  $p < .001$  criterion for Mahalanobis distance no outliers among the cases were found. Listwise deletion of cases with missing data caused some reduction in sample size. One of the tasks has a sample size of only 45 which at 4.5:1, fell below the minimum criteria

---

recommended by Tabanick & Fidell (1989) of five cases to each independent variable. Tables 7.12 to 7.16 display the correlations between variables, the standardised regression coefficient (beta), T ratios, the  $R^2$ , the adjusted  $R^2$ , the F score and its significance.

**Results** Eleven independent variables were regressed on to the assignment mark the student received. One regression equation failed to reach significance, for case study 2 (see table 7.16). In the other equations, the independent variables accounted for between 17.7 and 36.1% of the variance.

Grade point average (GPA), is the variable most consistently associated with learning outcome (mark). When a single regression is run for the total sample, GPA emerges as highly significant. For individual tasks it is an important predictor of learning success for all tasks except the case study 1 group. This anomaly may be explained by the fact that the students included in this group had not been exposed to a prerequisite course in the area under examination in this study in the previous year. These students complete other compulsory first year business studies papers, but do not commence study in their chosen major of Human Resource Management until their second year. None of the results used for determining GPA would include a direct measure of human resource management knowledge.

Study management skills were also significant predictors of learning outcome. Both procrastination and study materials showed negative correlations with assignment marks for the sample as a whole. In the case of procrastination this result seems common sense. If the student delays study they reduce learning opportunity. Why study materials (clear and complete) should correlate negatively is not immediately apparent, unless it reflects behaviour that is overly concerned with the form and appearance of study materials to the neglect of a more substantial involvement.

**Essay Task** Students completing the *essay* task showed a strong negative correlation between *practice* strategies and learning outcome. This is consistent with the result described earlier which showed that students who had a *declarative*

task representation had a strong negative correlation with *practice* strategies. Since *practice* strategies are more appropriate for applied tasks than the declarative task of essay writing, it could be expected that successful students will avoid these strategies. It may be that the use of these strategies by less successful students detracts from their use of more appropriate strategies, thereby diminishing their chances for a successful outcome.

In addition to GPA two groups of strategies had strong positive correlations with learning outcome for these students. These were *relating* and *remembering*. The importance of *relating* strategies for predicting successful learning outcome (significant at the  $p < .01$ ) is particularly interesting when compared to the earlier finding that this essay task was negatively correlated with the selection of *relating* strategies. Students in this class (Accounting for Non-Accountants) were clearly not inclined as a whole to use these strategies, however, those who did were rewarded with a successful learning outcome.

*Remembering* strategies are significant for the essay and case study 1 task, but not the project or case study 2. In both cases remembering strategies are associated with comprehension strategies. Remembering strategies used alone are unlikely to produce a successful learning outcome. Given the earlier results which indicated that students have treated case study 1 as being a declarative rather than a practical task this suggests that being able to remember information is more important for this type of task than for practical or applied tasks.

The essay task group were the only ones for whom *grouping* strategies reached significance. These had a strong negative correlation with learning outcome. *Grouping* strategies are used to organise information. It is possible that these strategies were being used by students as a coping mechanism to avoid the use of more meaningful and demanding comprehension strategies. If this interpretation is correct, it would suggest that students felt comfortable using *grouping* strategies in a way may have seemed to them to be analogous to using comprehension strategies.

GPA, learning strategies and study management skills accounted for 29.4% of the variance.

**Project Task** For the project task group only GPA and planning predicted successful learning. This is very similar to the results for case study 2, though for the latter planning was not significant. No learning strategies predicted learning outcome. This results seems consistent with others such as Entwistle & Ramsden (1983) and Biggs (1970) who found that success in Science and Technology subjects seemed to be more dependent on prior knowledge than on specific learning strategies. It is possible that highly structured procedural tasks such as these have the conditions of applicability (strategies) embedded in the students knowledge structures. High prior knowledge, which includes strategies for using the knowledge, may increase the effectiveness of the strategies. Use of the same strategies, without high prior knowledge, would be less effective, leading to a relatively poor learning outcome. If this interpretation is correct, then the type of learning strategies used would not appear significant as it is the effectiveness with which the same strategies are used that makes the difference.

For the project task the independent variables accounted for 17.7% of the variance.

**Case Study 1** The third task, case study 1, showed some similarities with the essay task group. A negative correlation of *practice* strategies with learning outcome was significant, reinforcing the notion expressed earlier that successful students treat this task as declarative in nature. Further support for this interpretation lies in the finding that for this group of students *key ideas* also predicts a successful learning outcome. *Key ideas* are strategies that build comprehension and are therefore most closely associated with declarative tasks. That such behaviour is reinforced by good marks suggests that this task may also have been treated by the lecturer as a declarative task.

Remembering strategies are also positively associated with learning outcome.

The influence of the study management skill of having complete and clear study materials has a strong negative correlation with learning outcome. As with practice strategies (for this and the essay task) and grouping strategies (essay task) too heavy an emphasis on this skill is dysfunctional, detracting effort and attention from more appropriate learning behaviours.

**Case Study 2** The regression equation for this group failed to reach significance. This may be explained in part by the low numbers in the group.

### 7.2.3 Summary

The results of these regressions suggest that when GPA measures prior knowledge, as it does for the accounting (essay), management (case study 2) and technology (project) class then it is an important predictor of learning success. As a simple measure of academic ability with no prior knowledge, as in the case of case study 1, GPA is not a useful predictor of learning outcome. Successful learning strategies are more readily identifiable for declarative tasks than for practical tasks. This may arise from the students' interpretation of practical tasks in the different contexts of an assignment and "learning" for a test or examination. The project and case study 2 students do select *practice* strategies as seen in the first regression (see table 7.5). Unexpectedly, this use of strategies does not carry through to predicting learning outcome. If students use one set of strategies for an assignment, but some successful students then identify a different set of strategies for "learning", then the expected relationship between *practice* strategies and learning outcome may be muddied.

The conditions of learning created by the use of study management skills do have an overall effect on learning performance. Procrastination and study materials diminish performance, planning is important ingredient for success to the project group.

No learning strategies appeared as always predicting learning outcome. However, in the context of specific tasks some learning strategies are clearly important. Key ideas were significant for case study 1 and relating for the essay group. Both of

these are types of comprehension strategies. Relating may not have emerged as a significant predictor of success for case study 1 because it was used extensively by many students in the group (mean =3.579 compared to the total sample mean of 2.789) not just by the most successful students. These comprehension strategies aid understanding and are appropriate to the declarative nature of these two tasks. Declarative knowledge is generally likely to be a more superficial cognitive structure than procedural knowledge (Glaser, 1988b), as procedural knowledge is declarative knowledge that has undergone further processing. Declarative knowledge then is much more likely to require support for retention than the procedural knowledge of a practical task. Some evidence for this is indicated by the association of remembering strategies with key ideas (case study 1) and relating strategies (essay task).

An interesting aspect of these results is the strong negative correlations between some strategies and skills with learning outcome. This suggests that in specific contexts some behaviours are so inappropriate their use is detrimental to performance. The negative correlation between practice strategies for declarative tasks and learning outcome is a good example of this effect. Why this is so is pursued further in the discussion section.

**Table 7.12 Standard Multiple Regression of Learning Strategies, Study Management Skills and Grade Point Average on Learning Outcome for Whole Sample. N=333**

	Mark	CI	CII	CIII	CIV	CV	CVI	CVII	GPA	SMS1	SMS2	SMS3	Beta	T Ratio
CI	.127												.120	1.750
CII	-.010	.431											-.017	-.265
CIII	-.046	.290	.446										-.050	-.742
CIV	-.014	.418	.513	.460									.007	.121
CV	-.031	.186	.248	.422	.193								.010	.180
CVI	.065	.652	.477	.469	.414	.311							.012	.175
CVII	-.059	.221	.447	.490	.429	.341	.349						-.096	-1.531
GPA	.417	.053	-.023	.008	-.052	-.075	.047	.012					.409**	7.755
SMS1	.125	.165	.223	.349	.204	.382	.219	.325	.223				.102	1.699
SMS2	-.002	.061	.043	-.121	.034	-.040	.003	.031	-.147	-.220			-.112*	2.017
SMS3	-.078	.064	.080	.066	.067	.110	.075	.080	.031	.149	.299		-.137*	-2.555
Mean	70.837	2.686	3.606	2.789	1.840	2.764	2.830	2.981	7.023	2.977	3.345	3.247		
SD	14.667	1.054	.812	1.061	.987	1.012	1.036	1.191	1.942	.690	.713	.453		
													R <sup>2</sup> =	.218
													adj R <sup>2</sup> =	.190
													F=	7.9522
													F Sign	.0000

\* p&lt;.05

\*\* p&lt;.01

CI - Practice strategies  
 CII - Key idea strategies  
 CIII - Relating strategies

CIV - Remembering strategies  
 CV - Background strategies  
 CVI - Projecting/predicting strategies

CVII - Grouping strategies  
 GPA - Grade point average  
 SMS1 - Planning

SMS2 - Procrastination  
 SMS3 - Organised  
 Study Notes

**Table 7.13 Standard Multiple Regression of Learning Strategies, Planning and Grade Point Average on Learning Outcome for the Essay Task N=130**

	Mark	CI	CII	CIII	CIV	CV	CVI	CVII	GPA	SMS1	SMS2	SMS3	Beta	T Ratio
CI	-.121												-.323**	-2.811
CII	-.063	.601											.050	.467
CIII	.180	.529	.466										.288**	2.631
CIV	.129	.604	.519	.455									.330**	3.310
CV	.083	.133	.218	.428	.083								.120	1.328
CVI	-.031	.697	.629	.666	.534	.281							-.018	-.144
CVII	-.145	.429	.542	.471	.418	.415	.519						-.419**	-4.155
GPA	.357	-.040	-.083	.096	-.030	.069	-.020	.127					.378**	4.770
SMS1	.121	.213	.239	.334	.243	.348	.230	.329	.233				.036	.423
SMS2	.072	-.007	.045	-.045	.052	-.137	-.067	.033	-.117	-.214			.134	1.604
SMS3	.122	.151	.150	.155	.203	.067	.150	.198	.125	.166	.331		.030	.369
<b>Mean</b>	67.345	2.339	3.651	2.829	1.895	2.999	2.653	3.029	6.675	2.976	3.379	3.320		
<b>SD</b>	11.964	1.221	.849	1.024	1.088	1.020	1.065	1.231	1.775	.700	.711	.443		
													R <sup>2</sup> =	.355
													R <sup>2</sup> =	.294
													F=	5.9042
													F Sign	.0000

\* p&lt;.05

CI - Practice strategies

CIV - Remembering strategies

CVII - Grouping strategies

SMS2 - Procrastination

\*\*p&lt;.01

CII - Key idea strategies

CV - Background strategies

GPA - Grade point average

SMS3 - Organised

CIII - Relating strategies

CVI - Projecting/predicting strategies

SMS1 - Planning

Study Notes

**Table 7.14 Standard Multiple Regression of Learning Strategies, Planning and Grade Point Average on Learning Outcome for the Project Task. N=102**

	Mark	CI	CII	CIII	CIV	CV	CVI	CVII	GPA	SMS1	SMS2	SMS3	Beta	T Ratio
CI	.116												.175	1.581
CII	.090	.453											.052	.471
CIII	-.086	.358	.384										-.122	-1.048
CIV	-.115	.276	.390	.465									-.131	-1.199
CV	-.046	.317	.188	.284	.157								-.036	-.327
CVI	-.001	.452	.376	.464	.338	.385							-.102	-.880
CVII	.157	.160	.308	.370	.329	.053	.271						.168	1.560
GPA	.365	-.028	.060	-.041	-.052	-.208	.049	.066					.258**	2.523
SMS1	.329	.194	.147	.109	.045	.302	.277	.182	.286				.255*	2.357
SMS2	-.115	.084	.103	.021	.209	.121	-.019	.225	-.254	-.099			-.029	-.283
SMS3	-.065	.138	-.004	.073	.033	.099	.124	-.069	-.022	.200	.232		-.086	-.875
<b>Mean</b>	76.958	3.207	3.367	2.222	1.566	2.476	3.037	2.621	7.602	2.813	3.482	3.166		
<b>SD</b>	17.651	.706	.842	.924	.828	.878	.993	1.222	2.071	.655	.689	.465		
														R <sup>2</sup> = .266
														adj R <sup>2</sup> = .177
													F= 2.96815	F Sign .0021

\* p<.05

\*\*p<.01

CI - Practice strategies

CII - Key idea strategies

CIII - Relating strategies

CIV - Remembering strategies

CV - Background strategies

CVI - Projecting/predicting strategies

CVII - Grouping strategies

GPA - Grade point average

SMS1 - Planning

SMS2 - Procrastination

SMS3 - Organise

Study Notes

**Table 7.15 Standard Multiple Regression of Learning Strategies, Planning and Grade Point Average on Learning Outcome for the Case Study 1 Task. N=56**

	Mark	CI	CII	CIII	CIV	CV	CVI	CVII	GPA	SMS1	SMS2	SMS3	Beta	T Ratio
CI	-.055												-.615*	-2.447
CII	.383	.435											.371*	2.349
CIII	.222	.276	.336										-.083	-.477
CIV	.342	.586	.509	.388									.336*	2.020
CV	.073	.591	.345	.342	.433								.214	1.209
CVI	.045	.793	.567	.319	.520	.401							.100	.443
CVII	.115	.328	.377	.606	.433	.518	.435						-.011	-.058
GPA	.315	-.095	.172	.133	.174	-.052	-.051	-.048					.193	1.509
SMS1	-.063	.329	.118	.455	.197	.536	.262	.547	.028				-.074	-.462
SMS2	-.116	-.081	.093	-.378	-.075	-.088	.007	-.082	.044	-.212			-.014	-.105
SMS3	-.342	-.146	.031	-.285	-.111	.019	-.051	.030	.070	.005	.456		-.434**	-3.127
<b>Mean</b>	70.023	2.557	3.775	3.579	2.084	2.910	2.811	3.434	7.057	3.274	3.000	3.193		
<b>SD</b>	12.538	.975	.683	.790	.955	1.007	.947	..996	1.813	.607	.678	.424		
													R <sup>2</sup> =	.507
													adj R <sup>2</sup> =	.361
										F=	3.46352		F Sign	.002

\* p&lt;.05

CI - Practice strategies

CIV - Remembering strategies

CVII - Grouping strategies

SMS2 - Procrastination

\*\*p&lt;.01

CII - Key idea strategies

CV - Background strategies

GPA - Grade point average

SMS3 - Organised

CIII - Relating strategies

CVI - Projecting/predicting strategies

SMS1 - Planning

Study Note

**Table 7.16 Standard Multiple Regression of Learning Strategies, Planning and Grade Point Average on Learning Outcome for the Case Study 2 Task. N=45**

	Mark	CI	CII	CIII	CIV	CV	CVI	CVII	GPA	SMS1	SMS2	SMS3	Beta	T Ratio
CI	.140												.520	1.826
CII	.089	.680											-.176	-.751
CIII	.003	.603	.479										-.321	-1.327
CIV	.086	.570	.645	.379									-.010	-.048
CV	.059	.487	.298	.642	.227								.175	.814
CVI	.036	.678	.504	.689	.422	.544							-.124	-.521
CVII	.107	.515	.370	.367	.506	.406	.443						-.015	-.083
GPA	.403	-.022	.110	.124	-.024	-.010	.024	.041					.549**	2.772
SMS1	.252	.366	.326	.425	.212	.371	.294	.210	.510				.048	.239
SMS2	-.111	.100	.086	.131	.000	.196	.027	.086	-.406	-.221			.176	.997
SMS3	-.099	.242	.011	.106	-.185	.255	.024	.063	.072	.180	.225		-.319	-1.758
<b>Mean</b>	65.396	2.615	3.802	2.881	1.986	2.573	2.867	3.025	6.661	2.934	3.420	3.326		
<b>SD</b>	9.670	.871	.671	1.037	.948	1.109	1.112	1.013	1.938	.738	.674	.460		
													R <sup>2</sup> =	.304
													adj R <sup>2</sup> =	.065
													F=	1.2731
													F Sign	.2836

\* p&lt;.05

CI - Practice strategies

CIV - Remembering strategies

CVII - Grouping strategies

SMS2 - Procrastination

\*\*p&lt;.01

CII - Key idea strategies

CV - Background strategies

GPA - Grade point average

SMS3 - Organised

CIII - Relating strategies

CVI - Projecting/predicting strategies

SMS1 - Planning

Study Notes

### 7.2.3 Influence of Surface, Achieving and Deep Strategies on Learning Outcome

Throughout this study an important emphasis has been the development of more direct measures of learning strategies and study management skills than those provided by the SPQ. The SPQ combines learning strategies and study management skills into one score, making it difficult to determine the individual contribution made by each. In addition, the limited range of learning strategies measured by the SPQ was thought to give a less representative picture of the students' learning behaviour. To test the strength of this assertion a further set of regressions were run with the three strategy scales of the SPQ and GPA as independent variables on the dependent variable of learning outcome. If the learning strategies and study management skills provide a more accurate measure of student learning than the SPQ strategy scales they should be able to better predict learning outcome.

As previously the regressions were run in five stages. The first was for the total sample, then again for each of the four tasks.

The frequency distribution and the scatterplot of residuals revealed a similarity to the learning strategies, that is slight skewness in the data, but linearity and homoscedasticity. With the use of a  $p < .001$  criterion for Mahalanobis distance no outliers among the cases were found. The sample sizes for case study 1 ( $N=56$ ), and case study 2 ( $N=45$ ) remained the same. Other task groups had small increases; the essay increased by 8 so that  $N=138$ , the project task increased by 12 to 114 and the total group was 345. Tables 7.17 to 7.21 display the correlations between variables, the standardised regression coefficient (beta), T ratios, the  $R^2$ , the adjusted  $R^2$ , the F score and its significance.

**Results** As with the learning strategy results GPA is the most consistent predictor of learning outcome. It is significant for the sample as a whole and for all individual tasks. When the regression equation was run with learning strategies,

GPA did not predict learning outcome for case study 1 students. In the absence of these learning strategies, GPA becomes a predictor at the  $p < .05$  level for this task.

The only SPQ scale to predict learning outcome was the achieving strategy scale. This was significant when the sample was taken as a whole and for the project task. This result is similar to the earlier regression results where planning also predicted learning outcome for the project group. Planning and the SPQ achieving strategy scale are closely related in content.

When the sample is taken as a whole, the amount of variance accounted for is similar for both the learning strategy and SPQ regressions, 19% for the former and 16.2% for the latter. The differences when the sample is broken into tasks are slightly more pronounced.

The SPQ regression was only able to account for 12.2% of the variance for the essay task group, as against 29.4% for learning strategies. The results were reversed for the project task, with the SPQ able to account for 5% more of the variance than the learning strategy equation (17.7% as against 23.6%).

The SPQ regression failed to reach significance for case study 1, but the learning strategy equation was able to account for 36.1% of the variance.

Both regressions failed to reach significance for case study 2, however, the SPQ only just fails with a significance level of .063.

**Summary** For only the project group was the SPQ able to better predict learning outcome and then by a relatively small margin. While the SPQ does predict learning outcome, interpreting the results for individual students is difficult.

**Table 7.17 Influence of Surface, Achieving and Deep Strategies on Learning Outcome for Total Group**

	Mark	Surface Strategy	Achieving Strategy	Deep Strategy	GPA	Beta	T Ratio
Surface Strategy	-.043					.047	.884
Achieving Strategy	.237	-.173				.121*	2.079
Deep Strategy	.190	-.403	.510			.070	1.142
GPA	.384	-.121	.257	.222		.343**	6.676
Mean	70.837	3.233	2.715	3.099	7.023		
S D	14.667	.535	.663	.592	1.942		
						R <sup>2</sup> =	.172
						adj.R <sup>2</sup> =	.162
					F= 17.663	F. Sign	.0000

\* p&lt;.05

\*\*p&lt;.01

**Table 7.18 Influence of Surface, Achieving and Deep Strategies on Learning Outcome for Essay Task**

	Mark	Surface Strategy	Achieving Strategy	Deep Strategy	GPA	Beta	T Ratio
Surface Strategy	-.128					-.032	-.381
Achieving Strategy	.174	-.220				-.002	-.025
Deep Strategy	.243	-.325	.595			.174	1.691
GPA	.339	-.133	.218	.199		.300**	3.647
Mean	67.345	3.254	2.694	3.023	6.675		
S D	11.964	.524	.666	.614	1.775		
						R <sup>2</sup> =	.148
						adj.R <sup>2</sup> =	.122
					F= 5.7850	F Sign	.0003

\* p&lt;.05

\*\*p&lt;.01

**Table 7.19 Influence of Surface, Achieving and Deep Strategies on Learning Outcome for Project Task**

	Mark	Surface Strategy	Achieving Strategy	Deep Strategy	GPA	Beta	T Ratio
Surface Strategy	-.050					.033	.356
Achieving Strategy	.473	-.176				.424**	4.530
Deep Strategy	.165	-.461	.407			-.042	-.422
GPA	.341	-.132	.342	.237		.210*	2.386
Mean	76.958	3.338	2.647	3.051	7.602		
S D	17.651	.516	.630	.541	2.071		
						R <sup>2</sup> =	.263
						adj.R <sup>2</sup> =	.236
					F= 9.7539	F. Sign	.0000

\* p&lt;.05

\*\*p&lt;.01

**Table 7.20 Influence of Surface, Achieving and Deep Strategies on Learning Outcome for Case Study 1.**

	Mark	Surface Strategy	Achieving Strategy	Deep Strategy	GPA	Beta	T Ratio
Surface Strategy	.090					.198	1.254
Achieving Strategy	.055	.030				-.059	-.380
Deep Strategy	.117	-.412	.402			.204	1.188
GPA	.315	-.069	.083	.056		.322*	2.292
Mean	70.023	3.000	2.923	3.379	7.057		
S D	12.538	.527	.634	.524	1.813		
						R <sup>2</sup> =	.140
						adj.R <sup>2</sup> =	.061
					F= 1.7915	F Sign	.1476

\* p&lt;.05

\*\*p&lt;.01

**Table 7.21 Influence of Surface, Achieving and Deep Strategies on Learning Outcome for Case Study 2**

	Mark	Surface Strategy	Achieving Strategy	Deep Strategy	GPA	Beta	T Ratio
Surface Strategy	-.019					.108	.693
Achieving Strategy	.263	-.167				.040	.222
Deep Strategy	.248	-.386	.548			.116	.626
GPA	.425	-.197	.463	.397		.381*	2.310
Mean	65.396	3.265	2.640	3.003	6.661		
S D	9.670	.530	.738	.635	1.938		
						R <sup>2</sup> =	.199
						adj.R <sup>2</sup> =	.117
					F= 2.4298	F Sign	.0638

\* p&lt;.05

\*\*p&lt;.01

### 7.3 Logistical Regressions

In the final stage of analysis differences in characteristics between the most and least successful students were examined. For each of the four tasks, assignments marks were divided into three groups depending on whether they fell above, within or below one standard deviation from the mean. These scores were used to identify a highly successful learning group and the least successful learning group for each task. The assignment mark, which was to be used as the dependent variable was now dichotomous and could be used in a logistic regression to estimate the probability that the most successful and least successful students were defined by different characteristics (Norusis, 1990).

Logistic regression proceeds in two stages. First, the goodness of fit of the overall model is determined. Here the explanatory power of the model is measured by its contribution to the explained variance relative to the total explainable variance. In this case how well the characteristics predict membership in the successful and unsuccessful groups (Dewe, 1993). These characteristics were able to correctly classify between 80 and 100% of students into one of the two success groups.

In the second stage of the regression the logistic coefficients were examined to see how well the characteristics increased the predictability of being in one group or the other. The greater the logistic coefficient for a characteristic, the higher the odds that it associated with a high level of success. The characteristics were entered into the equation by forward stepwise selection as there was no theoretical basis for entering them in a particular order. Norusis (1990) recommends the use of the likelihood-ratio test for determining variables to be removed from the model, rather than the Wald test, whenever the regression coefficient is large. This proved to be the situation for the case study 1 and 2 groups and the likelihood-ratio test was used for these. Table 7.22 reports the logistic coefficients, percentage of correct classifications, total explainable variance, model variance and improvement.

The characteristic of high prior knowledge is clearly the strongest predictor of success for all tasks except case study 1. For this task the measure used for prior knowledge (GPA) was not a good indicator of prior knowledge. Successful students in case study 1 were characterised by low attention to having neat, complete study notes and a high use of key ideas. Low levels of procrastination, in addition to high prior knowledge, described the most successful students in the essay task.

**Table 7.22 Logistic Regression for Characteristics of Most and Least Successful Students**

Learning Tasks		Characteristics	Logistic coefficients
<i>Essay Task (83.33%)<sup>a</sup></i>			
Total explainable variance	58.12	Prior knowledge	1.38**
Model variance	51.33	Procrastination	-1.65*
Improvement	<sup>b</sup> 6.89		
<i>Project Task (80%)</i>			
Total explainable variance	41.58	Prior knowledge	1.59**
Model variance	22.19		
Improvement	19.39		
<i>Case Study 1 (100%)</i>			
Total explainable variance	17.32	Study materials	-73.1**
Model variance	6.85	Key ideas	48.5**
Improvement	10.47		
<i>Case Study 2 (86.4%)</i>			
Total explainable variance	28.84	Prior knowledge	0.80*
Model variance	20.42		
Improvement	8.41		

<sup>a</sup> percentage of individuals classified correctly

<sup>b</sup> All improvements significant beyond 0.01 level.

\* $p < 0.05$ ; \*\* $p < 0.01$



## Chapter 8

### Discussion

#### Introduction

This study set out to examine two major relationships: First, to identify factors which influence the selection of learning strategies and secondly, to determine the influence of learning strategies, in conjunction with prior knowledge and study management skills, on learning outcome. These relationships are illustrated in figure 8.1.

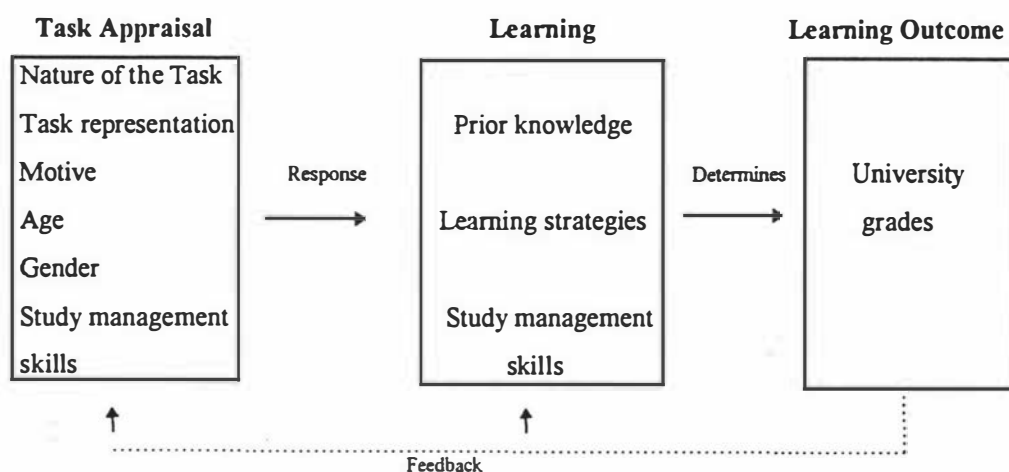


Figure 8.1: Relationship Between Variables in this Study

In the first instance the student undertakes a situation assessment in which the task context is appraised to determine an appropriate learning response. Several variables influence this appraisal process including the nature of the task, the student's representation of the task, motive for studying, the age and gender of the student, and study management skills. Based on the students' assessment specific strategies are used, in conjunction with prior knowledge, to learn the task.

In this second stage, prior knowledge is thought to work by providing a context or framework in which new material can be more readily understood or remembered (Montague, 1972; Wittrock, 1974; 1978; Bellezza, 1981; 1982). Information-to-be-learned is received into the working memory and matched with knowledge structures

held in the long term memory. When a perfect match is found, the new content has been previously learned and no changes are made to the knowledge structures. When no match can be found the learner is unable to comprehend the new material and again no learning is likely to take place. Learning is optimised when a partial match is made with knowledge structures in the long term memory (Biggs, 1969; Siegler & Klahr, 1982).

Learning strategies seem to work by integrating the new content with the existing content, resulting in new knowledge structures that are not just quantitatively increased but are more complex and sophisticated. The type of learning strategy used influences the sophistication of the hybrid knowledge structures (Entwistle & Ramsden, 1983; Biggs, 1987; Jansweijer, Elshout, & Wielinga, 1990). For example, if rote rehearsal strategies are used, the new and existing knowledge are linked relatively superficially. That is, similarities between surface characteristics such as names become the basis for the relationships. Strategies which encourage the student to process the information at a more meaningful level, such as relating strategies, integrate prior knowledge and new information to create a new structure in which the seams between old and new are no longer discernible.

The learning process may be further enhanced or diminished by the student's study management skills or conditions under which it takes place. For example, good planning ensures that students maximise their opportunities for receiving information, have a wider range of learning strategies available to them (some strategies are more time consuming than others) and have the time to effectively use appropriate learning strategies. However, overemphasis on neat, organised study notes may act as a crutch to the student, and detract from his or her ability to understand or remember information.

Learning outcome eventually becomes prior knowledge for the next learning task and this aids new learning (shown in the feedback loop). While it was not specifically tested in this study, logic suggests that this prior knowledge also feeds back to influence the manner in which students interpret and understand (represent)

new learning tasks. The accessibility and usability of the stored knowledge is largely determined by the quality of processing in the previous stage (Weinstein, Underwood, Wicker & Cubberly, 1979; Elshout & Veenman, 1992).

By identifying the strategies students use in a particular context it is possible to evaluate their contribution to learning outcome. Further, if we also understand the appraisal process, that is *why* students select some strategies and not others, we have two opportunities for intervention in the learning process. First we can help students assess the learning context in a manner that leads to better strategy choices, and secondly, we can teach them directly which strategies are more effective for given contexts or tasks. To achieve these aims a number of questions needed to be answered. How do students appraise the learning task, what learning strategies do students use, how does this use vary with context and what contribution do learning strategies, prior knowledge and study management skills make to learning outcome? These were the research questions which now provide the basis for further discussion.

## 8.1 The Appraisal Process

### Finding 1

*Nine context variables influenced the selection and importance of learning strategies. These included: four task representations, planning, deep motive, age, gender and the nature of the task.*

Students appraise the learning task and its context to determine an appropriate response. This appraisal appears to be a *perceptual* process rather than an objective assessment, and is therefore highly individual. The process is shaped by the particular combination of context variables that are important to any given student. These context variables seem to guide the student towards selecting specific learning strategies. For example, if the student sees the task as being highly fragmented, then learning strategies to facilitate an integration of the fragmented

components are likely to be chosen. Similarly, students faced with an essay task respond with extensive background reading.

This appraisal process is similar to the concept of task perception discussed by Laurillard (1984). She defines task perception as encompassing "*a multitude of things: it depends on its form and content, on its relation to other tasks, on the student's previous experience, on the student's perception of the teacher who marked it and of how it will be assessed*" (p. 135). The outcome of these judgements and perceptions is an intention "*either to understand or memorise, and thereby to use either a deep or surface approach*". Laurillard recognised that students reacted to more than just the content of the task. The student's perception of the task context was also an important consideration. For Laurillard, task context involves the student's perception of what the teacher is looking for, how that teacher will assess the work (that is, their personal bias) and the student's own level of commitment to the task. She expressed concern that these considerations could detract from the student's attention to the content of the task itself. As with other researchers in this area Laurillard assumes that students deliberately and intentionally choose a set of strategies for learning to achieve a pre-determined end, that is deep or surface.

The appraisal process described here differs from that of Laurillard's in two important respects. In addition to *answer format* and the *nature of the task* suggested by Laurillard as being important the process described here also includes task representation, study management skills, age and gender as part of the perceptual process. Secondly, this study suggests that the student's task appraisal shapes the student's choice of learning strategies and these are far more significant than a conscious decision by a student to learn at a deep or surface level. In fact it's hard to believe that any university student asked whether they would rather understand material or just be able to memorise it, would answer the latter. When students choose the learning strategies they will use for achieving the task, these are a direct response to their interpretation of the task and its context.

Sections 8.2.1 to 8.2.4 discuss the individual contributions of the nature of the task, task representation, study management skills, age, gender and motive to the selection of learning strategies.

### **8.1.1 Task Representation as an Influence on Learning Strategy Selection**

#### **Finding 2**

*Four types of task representations were identified and these were the generally most powerful predictors of learning strategies selection and importance.*

Task representation describes the manner in which the student represents the task. The student in effect defines the task in light of his or her knowledge or understanding of it. This definition acts as a cognitive framework of the task from which the student determines what must be done to achieve a successful outcome. The student's state of knowledge would seem to play a large part in defining the task. It is likely that a student who is low in prior knowledge would have difficulty accurately representing the task and may see it as a series of unrelated fragmented components. A student who has already achieved some competence in the task is more likely to understand the task parameters, see the interrelationships between components and be clear about the assessment criteria. His or her representation is likely to be a more complete and coherent definition of the task. In this sense task representation is very similar to the concept of problem representation that has been widely used in the field of problem solving. The problem solver represents the problem on the basis of his or her domain-related knowledge, in particular the organisation of that knowledge. The quality of the internal representations determines the effectiveness and efficiency of the solving process (Glaser, 1987b). Novices classify problems on the basis of literal, surface features of the problem, according to the physical properties of the situation. Experts categorise problems in terms of relevant underlying principles.

Task representation differs from problem representation in one significant way. Novice problem solvers represent problems in a manner that generally inhibits successful solution. They tend to be influenced by surface characteristics and irrelevant detail such that they often misrepresent the problem and so fail to reach a solution (Larkin, McDermott, Simon & Simon, 1980; Chi Feltovich & Glaser, 1981). Learners represent tasks in a personal way that defines what they need to do to accomplish the task. For example, novice students may recognise a task as being confusing, fragmented and full of irrelevant detail. This is not a misrepresentation of the task; resolving this state is the first step to achieving the task. When they respond with strategies that reduce the confusion, clarify relationships and identify important information they are in a much better position to successfully complete the whole task. However, should they use inappropriate coping mechanisms such as remember strategies on their own, they are likely to be as unsuccessful as the novice problem solver. The important point seems to be that the student represents the task in a framework that is valid for that particular student. This may mean that students faced with the same objective task, say an essay, in fact may be dealing with quite different tasks according to the representations by which they have defined the task. These differences require different responses to achieve the same final end.

The importance of task representation lies in the influence it exerts on the student's approach to learning as a result of this initial act of definition. Task representation strongly predicts the strategy selection process. These strategies then affect the learning outcome. In this way, the influence of task representation flows through the whole learning process.

Four types of task representations emerged from a principal component analysis: declarative, investigative, contained and fragmented and these were regressed onto learning strategies. These are now described in more detail.

## A Contained Task Representation

### Finding 3

*A contained task representation is one in which the structure and interrelationships between components of the task form a coherent whole, and the manner in which the student is expected to demonstrate competence in the task (assessment requirements) is apparent to the student. The more strongly students represented a task as being contained, the less likely they were to use practice, key ideas, relating, remember and projecting/predicting strategies.*

On first reflection it is easy to be seduced into believing that this representation equates to a deep approach to learning. The student with this representation seems to impose structure and meaning on the task rather like the deep learner who searches for the underlying meaning of a task. However, the nature of the student's response to this representation belies this apparent similarity. A student with this representation does NOT appear to select the type of learning strategy that would be expected from a deep approach student. Deep approach students are thought to use such strategies as the means of finding meaning in the task. It would appear that this task representation is held by students who have already found this meaning and structure and so have no further need of "learning" strategies. They view the task as being completely self-contained. These students may be more akin to the expert problem solver described by Chi, Glaser & Rees (1982) who has a large store of highly organised and integrated knowledge related to the problem (task). When presented with a task they draw upon this internal store of knowledge. The task involves not learning but simply performing. While there may be similarities between the "contained" student and the expert problem solver it should be borne in mind that the student's task representation may not be an accurate representation of reality. It is quite feasible that a contained task representation may mislead a student into believing they do not need to do further study when in fact they do. A student who has a contained task representation that is inappropriate to his or her state of knowledge is probably worse off than the student who knows they do not understand the task. Such a student may well have created a framework referent in which all the task components fit according to some

logic, but this framework is based on a false premise. The student has completely misconstrued the task. Overcoming this misconception may hinder further learning.

### **A Fragmented Task Representation**

#### **Finding 4**

*A fragmented task representation is one in which the content is perceived to be made up of isolated, unrelated fragments. This representation predicted the selection and importance of practice, key ideas, relating, remember and projecting/predicting strategies.*

If a contained task representation equates to an expert problem solver, a fragmented representation has much in common with the novice problem solver. Both novice problem solvers and students with a fragmented task representation are faced with a bewildering array of possible task elements, many of which may be irrelevant. This student has no device or mechanism by which important information can be sorted from the unimportant, nor for constructing these elements into a meaningful framework. The inclusion of irrelevant elements clutter up limited cognitive capacity and increases the workload. The task facing a student with this representation would seem to be daunting and he or she would respond by selecting a very broad range of strategies. Whether all students with this representation respond with the same mix of strategies, or sub-groups of students use different mixes of these strategies is not clear from the results. However, it is possible to suggest some alternative explanations which might be pursued in further research.

Remembering strategies are strongly predicted by students with a fragmented task representation (see table 7.8). There are two possible explanations for this. First, there may be a group of students who feel so overwhelmed by the task they resort to remembering strategies above all others as a coping mechanism. Such students may come closest to the *surface* approach student described by Biggs (1987) and others. A second interpretation could reflect the importance of being able to remember information in the early stages of learning any new task. Students need to become familiar with new terminology before they begin to develop understanding.

Learning at least some of the language of the task gives them the tools to think and communicate about the task. Therefore it would not be surprising to see a heavy use of remembering strategies for students with a fragmented task representation. An important consideration is that these students appear to use remembering strategies in conjunction with a variety of other strategies, in particular strategies which seem to aid comprehension such as key ideas. This suggests that a common response of these students is to seek strategies that will overcome the fragmentation of the task.

The strategies of key ideas, and to a lesser extent relating, may be selected by students with a fragmented task representation to provide the structure necessary to make connections between fragments and thus reduce fragmentation. As the most basic of the comprehension groups, key ideas provides the fundamental building blocks for this process. As can be seen in table 7.6 a fragmented task representation is a powerful predictor of the use of key ideas. Relating strategies would seem to be less important for dealing with a fragmented task (see table 7.7) because they require some prior knowledge or understanding of the task to be able to make comparisons with other contexts. It is possible that some students use these after developing a basic comprehension with key ideas.

Students with a fragmented task representation also choose practice and projecting/predicting strategies as being important. It is not clear from the results whether students use these after using comprehension strategies to develop an adequate declarative knowledge base, or use them inappropriately before they have understood the information. If the latter, their behaviour is reminiscent of Spring's (1985) poor readers who used "study" strategies without the prerequisite step of comprehension strategies to gain an understanding of the material.

The learning strategies selected as being important by students with a fragmented task representation are the same strategies which students with a contained task representation rate as unimportant or not applicable. This suggests that these representations are mutually exclusive and describe diametrically opposed views of a

learning task. This apparent relationship between the two task representations bears a strong resemblance to that between expert and novice problem solvers

### **An Investigative Task Representation**

#### **Finding 5**

*An investigative task representation is one in which the student must seek out much of the information for him or herself and is in direct contrast to the task for which all of the information is provided to the student in a neat package. This representation predicted the selection of practice, key ideas, relating, background, projecting/predicting strategies and grouping.*

An investigative task representation is one in which the student must search for much of the relevant information for themselves as opposed to being spoon fed the information in class.

This task representation was a more powerful predictor any other representations of the selection of key ideas, relating, background and grouping. Three of these strategy groups (key ideas, relating and background) function to build comprehension, suggesting that collecting relevant information and organising it into a coherent structure is the primary aim of students with this task representation. This notion is reinforced by the prediction of grouping strategies, used to organise large amounts of information, and much less emphasis on practice and projecting/predicting.

An investigative task representation seems to share some characteristics with the concept of *workload* proposed by Chambers (1992) who identified the extensiveness of additional background reading, in conjunction with the degree of specification of assessment requirements as a measure of workload. However, variables measuring the clarity of the assessment requirements did not appear in this task representation (see table 7.4), being much more closely associated with a contained task representation. It maybe that this task representation, as with fragmented and contained, needs further development, including clarification of the concept of

workload. The investigative task representation may be an indicative measure of workload for some tasks and some students, but not others. For example, more mature students may find being given control over their learning so that they define the objectives, are able to make an assignment more directly relevant to their own work or life needs, and generally define the parameters of the task, less of a workload burden than teacher-determined set pieces. Equally, a technology student given a task that requires a high degree of computation or calculation with a given set of data may feel weighed down by the workload. In the first instance the student would probably have a high investigative task representation score because he or she is required to seek out much of the information, but low workload. A second student may have a lower score on task investigation, but rate his or her workload higher. In both of these instances the investigative task representation may not provide an accurate measure of workload. Until further research provides more information, a cautious interpretation of the investigative task representation as a measure of how much *investigating* the student must do for his or herself and a setting aside of connotations of *workload* is indicated. As workload is known to affect choice of learning strategies, the development of a good measure of workload would be a useful additional to the four task representations already identified.

## **Declarative Task Representation**

### **Finding 6**

*A declarative task representation is one in which the student is required to “know about” something, to be able to describe or explain the information, but not apply or use it in any practical sense. This representation predicted that practice strategies were regarded as unimportant or not applicable.*

Declarative tasks are those in which the student must learn *about* something rather than learning *how to do* something. This type of task covers a large part of learning at our formal educational institutions, even at a tertiary level. While students do learn practical skills, for instance balancing ledgers in accountancy classes, much assessment relies on essay and report writing or short answers in which the student is expected to describe concepts, principals and procedures rather than perform

them. Having said that, it is important to remember that this representation of a task as being declarative is the student's, not an objective description of the task. It may be that some students perceive practical tasks as being declarative. For example, the mathematics student who memorises the steps for solving a particular problem, can explain what those steps are, but never practices solving problems, have treated this task as declarative and will almost certainly struggle to apply this declarative knowledge in any practical assessment situation.

Other than the unimportant or non-applicability of practice strategies this task representation did not predict the use of learning strategies. This may mean that students use a variety of learning strategies to tackle this very common learning task and do not perceive any one set of learning strategies as being more beneficial than another.

Although this task representation component had moderate reliability (see table 7.4) it would benefit from further development. This task representation was partially defined by variables that described what it wasn't, that is a practical task. Variables that defined more clearly what a declarative task representation is, rather than what it isn't may improve the reliability of the scale.

Finally, if some students can recognise a task as being *declarative* it seems likely that some students might also recognise some tasks as being *procedural*, that is practical tasks. Since procedural tasks are expected to elicit different learning strategies to declarative tasks, there would seem to be some value in extending the instrument to include variables that would measure a *procedural* task representation.

**Summary** This is the first study which has identified the role of task representation in the learning process. Four task representations were identified in a principal component analysis. These representations describe different ways in which students define or internally represent learning tasks. They express the task which the student must tackle and this may involve aspects that are not apparent to

the teacher or even other students, for example, integrating a fragmented task. It is clear that students given the same learning task may in fact be faced with tasks that differ in type (investigative versus contained) and size of the task. A student with an investigative representation has a larger task than a student with a contained representation as this student must first find the important information before he or she can begin learning it.

Two of the representations found bear strong similarities to the problem representations used by novices and experts. While these representations are of great interest, the reliabilities of the two scales were quite low (.45 and .43; see table 7.4). The most likely reason for this is that the scales are not fully rounded out. It might be remembered from the methodology chapter that the best estimate of a student's task representation was based on those traditionally used by instructional designers and these notions shaped the items that were used. This approach was given some credence by the emergence of a declarative task representation, which equates to a task measured at Merrill's *remember paraphrase* and Bloom et al's *comprehension* levels, and so was closer in nature to those of instructional designers. The identification of an investigative task representation suggests that students interpret tasks in terms of the amount of research they must do for themselves as opposed to having the material presented in a complete and concise form as part of the lesson.

The findings of the study provide a much better platform for developing further items that accurately describe students' task representations. Four task representations emerged from this study, but it is highly probable that with different contexts, other representations may also be uncovered.

### **8.1.2 The Influence of the Task on the Selection of Learning Strategies**

#### **Finding 7**

*That the type of learning task, that is essay, case study or practical, influences the selection of learning strategies. An essay task predicted the selection and importance of background strategies and the unimportance or non-applicability of*

*relating strategies. The project task predicted the use of practice and projecting/predicting strategies. Case study 1 predicted the selection and importance of key ideas and relating strategies and case study 2 the selection and importance of practice strategies.*

The main emphasis of research which endeavours to understand the role of a task in influencing the manner in which students go about learning has tended to be on differences between Art/Social Science subjects and Science/Technology subjects (Biggs, 1970; 1971; Entwistle & Ramsden, 1983). This study did not try to make a distinction between tasks on the basis of subject. Rather the interest was in the effects of the nature of the task itself, that is essay, practical project and case studies, not the subject matter of these tasks.

The main difference between the task groups was found between the practical project group and the other three. The practical project group rated *practice* and *projecting/predicting* as more important than any of the other task groups and the other learning strategies generally lower than the other task groups (see table 7.5 to 7.11). The distinction between this group and the other three also closely matches the Arts/Social Science-Science/Technology division favoured by other researchers (Biggs, 1970; Entwistle & Ramsden, 1983). The practical project group fits the Technology side of the split, whereas case study 1 (Human Resource Management) and case study 2 (Management) are clearly closer to the Social Sciences. Although the subject area of one of the fourth group was Accounting, normally considered closer to the Science/Technology category because of its mathematical basis, in this case it was probably closer to Arts/Social Science. The learning task of the group was to write an essay on the role of the accountant, a topic more likely found in the Human Resource Management area.

It could be argued, as Entwistle & Ramsden (1983) have, that the nature of the task reflects the different subject areas, so essays and case studies are mainly associated with Arts/Social Science subjects and practical projects are largely found in Science/Technology subjects. This study never sought to make such a distinction,

and while it unwittingly seems to lend some support to such a notion there seem some inherent dangers in endorsing this view too strongly. It implies that Science/Technology tasks require a higher level of cognitive processing because they are mainly application type tasks at the procedural level, whereas Arts/Social Science tasks are primarily declarative tasks and cognitively simpler. This is the perception of many students (Entwistle & Ramsden, 1983). Most Science/Technology subjects have a strong vocational component so it is not surprisingly that many of the learning tasks will have a practical element in which the student is expected to demonstrate applied skills. However, Arts/Social Science students are also required to perform at this level or higher. To use a very simple example, the student who has understood the concept of a sonnet will be able to read a new poem and determine whether or not it is a sonnet. The student is applying the rule that governs the inclusion of instances in this concept, and this is performed cognitively at a procedural level (Reigeluth, 1983). This skill may be demonstrated through the vehicle of an essay, normally considered more closely associated with declarative tasks. This is not to argue that tasks do not vary between subjects, clearly they do, but cognitive complexity is not the exclusive domain of one subject area or another. Rather than discussing differences between subjects it seems much more fruitful to examine the nature of the tasks themselves.

Case studies are simulated practical tasks and fall somewhere between a declarative and procedural task. Which side of the boundary they fall on probably depends on the way the task is perceived by students. In this study the two case studies each fell on opposite sides of the boundary, making an interesting contrast. Case study 1 predicted the use of key ideas and relating strategies, suggesting it was being treated more as a declarative task, while case study 2 predicted practice strategies, which indicated it was closer in nature to the practical project group. Both of the case study groups rated practice and projecting/predicting strategies as more important than the essay group, but less important than the project group (see table 7.5), lending support to the idea that case studies lie somewhere on a continuum between declarative and procedural tasks.

The essay task predicted that relating strategies would be rated as unimportant or not applicable. Relating strategies are very similar in content to the deep strategies used by Biggs in the SPQ (1985) which he found to be strongly related to intrinsic motivation. Given that these students are doing a compulsory paper that is quite different from their chosen major, it is not unexpected to find them avoiding strategies which require them to spend time reflecting on the subject matter. Their rating of background strategies as "more important" compared with other task groups reflects a direct demand of the task. To write an essay one must do extensive background reading to collect relevant information.

In spite of the differences between students in the four task groups, they agreed on two things. They all rated key ideas as the most important learning strategies and, remembering strategies are the least important strategies. The importance of key ideas reinforces the idea suggested earlier that these strategies form a fundamental basic building block in the learning process.

Different types of learning task make different uses of learning strategies. The degree to which those differences are created by subject matter differences requires further study.

**Summary** The clear distinction between the practical project group and the others suggest that some task demands are more easily identified than others. An essay task, which might be described as *explaining ideas in your own words* is clearly distinct from a practical project in which a student must *apply learned knowledge to a new situation*. Case studies, on the other hand, are simulated versions of *apply* type tasks. The student is supposed to put him or herself into a role and complete the task as though it were real. There seems to be room here for a range of interpretations by the student from *explain in your own words*, where the student simply regurgitates textbook answers, to *apply* tasks, where the student actually behaves as though the task were real. The close relationship between the essay group and the two case study groups suggest a strong propensity for students to see case studies as being closer to an *explain* declarative task than its intended

*apply* procedural task. The precise location of a task on the spectrum from declarative to procedural seems to strongly influence which specific learning strategies students choose.

### **8.1.3 The Influence of Study Management Skills on the Selection of Learning Strategies**

#### **Finding 8**

*Planning is the only study management skill to influence the selection of learning strategies. It predicts the importance of practice, relating, background and grouping strategies.*

Study management skills are those behaviours associated with organising and managing learning resources. These behaviours create the conditions under which learning takes place, for example, poor planning reduces time available for learning. While most studies have focused on determining the direct relationship between study management skills and learning performance (Brown & Holtzman, 1955; Biggs, 1970; Entwistle, 1971), this study first questions the role of these skills in creating conditions which may foster, or inhibit the use of particular learning strategies.

Planning would seem to provide three benefits to students. Their attention would be focussed and on target (goal-setting); information would always be close at hand (information accessible); and the time available could be maximised (time management). The conditions created by planning foster the selection of practice, relating, background and grouping learning strategies.

The learning function fulfilled by practice strategies is skill development, which occurs after the declarative knowledge has been acquired (Glaser, 1988a). Skills are refined by repetition and fine tuning. The variables in the practice group of learning strategies imply successive levels of difficulty (see section 8.2 proceduralising strategies) through which the student moves, beginning with the simple tasks. It is

probable that the effective use of these strategies requires time for the student to progress through successive levels of practice. Adequate time is one of the benefits of good planning.

Both background and relating learning strategies involve dealing with information that is additional to the to-be-learnt information. Background building is done by processing a great deal of extra information that is related, but peripheral to the immediate task. Relating strategies require recalling information from other contexts and then finding parallels between the two sets of information. Both of these activities are likely to consume more time than just focussing attention on the to-be-learnt information as might happen with key ideas, and consequently may require planning.

The fourth type of learning strategies predicted by planning was the grouping strategies. While these strategies may be used for memorising, their organisational nature also makes them ideal for using in conjunction with other learning strategies. Choosing to use grouping strategies as a way of organising information ready for processing with a second type of learning strategy probably has an initial time cost, even though, as with most planning, it is likely to save time in the end.

If planning involves timely preparation for an event, procrastination is to delay either planning or the actual commencement of the event until the last possible moment. In that planning seems to facilitate the use of certain learning strategies it seems reasonable to expect that procrastination equally would inhibit the use of some learning strategies. This did not prove to be the case.

**Summary** Students who plan their study programme are more able to take advantage of strategies such as practice strategies which may have a greater need of time. Planning therefore provides the student with a greater range of strategy options and must improve the probability that they will match an appropriate learning strategy with the task. Students who use these learning strategies with inadequate time for carrying out the strategy fully may not get the full benefit from

using the strategy even when it is appropriate to the task. For example, the project task which was strongly associated with practice strategies required good planning skills for a successful learning outcome.

#### **8.1.4 The Influence of Learner Characteristics on the Selection of Learning Strategies**

##### **Age**

##### **Finding 9**

*The age of a student influenced his or her selection of learning strategies. Older students were more likely to use relating strategies, whereas younger students selected grouping strategies.*

Biggs (1987) has argued that as we age we tend to use deeper learning strategies. Whether it is age per se or a kind of intellectual maturation as suggested by Perry (1970) is not completely clear. In either case it is possible that the increase in prior knowledge from studying or life experiences provides a broader context for understanding new content, thus fostering the use of comprehension strategies which relate the new content to existing knowledge. An examination of Biggs' deep strategy scale reveals a considerable overlap between this scale and the relating learning strategy component that emerged from this study. The strong association between age and the selection of relating strategies found in this study lends further support to Biggs' position.

Relating strategies seem a natural choice for older students who have a wealth of life experiences and knowledge that they can use as a context for understanding new information. In this sense these knowledge structures act in a similar manner to prior knowledge. A major difference between the two is that prior knowledge is directly relevant to the to-be-learned information and students extend their understanding of fundamental principles to accommodate incremental changes in their knowledge. Life experiences, by comparison, are more peripheral in nature and probably work

largely by analogy, generating greater potential for applying inappropriate assumptions.

Younger students selected grouping strategies. Given their relative lack of the experience and knowledge that one tends to build as part of the aging process, it may be that this organisational learning strategy helps them to compensate by imposing structure and order into large learning tasks.

## **Gender**

### **Finding 10**

*Being female predicted the selection of key ideas, remembering and grouping strategies.*

The issue of differences in learning behaviour between males and females has been largely overlooked (Richardson, 1993). Typically the small group of studies which has examined these differences has produced results that are statistically reliable, but small in magnitude and inconsistent between studies (Watkins, 1982b; Watkins & Hattie, 1985; Harper & Kember, 1986; Miller Finley & McKinley, 1990).

Gender differences in predicting learning strategy choice were detected in this study. Females were found to be more likely to use key ideas, remembering, background and grouping strategies. These associations were particularly strong for the remember and grouping strategies. The results in this study may be reflecting the uneven gender distribution between task types more than any substantial differences between the sexes.

## **Motive**

### **Finding 11**

*A deep motive predicted the selection of relating, background, projecting/predicting and grouping strategies. Neither a surface nor an achieving motive predicted particular learning strategies.*

Substantial work linking motive to learning behaviour exists (Biggs, 1978; 1985a; 1987; Entwistle & Ramsden, 1983). It is intuitively plausible then to expect that motive would influence the students' choice of learning strategies. The failure of an achieving motive to predict specific learning strategies may be accounted for by Biggs' (1987) explanation that students high in this motive would strategically choose strategies that he or she believed would lead to success. In this case it seems unlikely that this motive would predict specific learning strategies.

Students high on surface motive were predicted by the literature (Biggs, 1978; 1985; 1987; Entwistle & Ramsden, 1983) to prefer rote memorisation strategies. As no rote learning strategy component emerged in this study it was difficult to substantiate these findings. The closest learning strategy group to rote learning was the remember strategies. This component included items measuring rote learning but also other strategies for memorising information such as mnemonics. No influence of a surface motive on strategy choice could be determined. This may have been because this motive predicts only rote learning items and the effect was muddled by the presence of the other items in the component.

Consistent with other studies (Biggs, 1978; 1985; 1987; Entwistle & Ramsden, 1983) a deep motive in this study strongly predicted the selection of relating strategies. The student who is intrinsically interested in a subject will often choose to seek additional information beyond that formally provided by the course and so we find that background building, and projecting/predicting strategies are also associated with a deep motive. For example, Aviation students will voluntarily subscribe to Aviation magazines; Human Resource Management majors will choose to belong to a university Human Resource Management Association for the purpose of meeting and exchanging ideas. These activities build background knowledge. Likewise relating strategies may occur during formal instruction but are also frequently used in spare moments when the student turns the ideas over in his or her head. Such behaviour is indicative of interest in that they require extra effort. The student who has no interest in a subject can be expected to avoid unnecessary interaction with the information and to dismiss the matter from his or her mind at

the earliest possible opportunity. The use of predicting/projecting strategies may arise from the needs of the task but also, because of the effort involved, be associated with students who want to stretch their depth of understanding.

**Summary** As indicated by other research age influences a student's choice of learning strategies. The background knowledge and experiences that the older student brings to the task induces the student to make comparisons between his or her existing knowledge base and the new information. These comparisons are relating strategies. A deep motive has a similar influence. The student actively searches for ways to integrate the new knowledge with existing knowledge, for example, thinking about how the new knowledge could be used in some aspect of the student's life. Strategies predicted by a deep motive all share the characteristic of requiring extra effort, for example building background and predicting/projecting strategies. Grouping strategies may be used by a student with a deep motive as a mechanism for organising the large data bases generated by these strategies.

Although gender differences were found, they do little to clarify the inconsistent picture that has emerged from other studies. The distribution of females between task groups was uneven and the results may be reflecting this anomaly rather than real differences. Further research is indicated.

## 8.2 Learning Strategies

### Finding 12

*By providing students with a broad range of learning strategies to describe the manner in which they undertake learning, a complex pattern of learning responses to a specific task emerges.*

Learning strategy inventories such as the SPQ (Biggs, 1985) are based on the assumption that student learning can be represented by a few key strategies. While these strategies may cohere tidily in factor analysis to produce *surface* and *deep* factors there is no evidence that they *accurately* or completely represent the full

range of strategies a student uses. By selectively choosing strategies for the inventory it has been possible to create a balanced surface/deep dichotomy of learning strategies. Biggs (1987) and others have used this dichotomy as the basis for making generalisations about students learning; some students try to infuse meaning into the to-be-learned information (deep), while others try to memorise with no understanding (surface). When a more complete range of learning strategies is used this simple dichotomy no longer holds true.

The search for learning strategies in this study was rather different from the procedures normally used. Students themselves identified the strategies and these were preserved in the language used by students. Qualitative methods of data collection, similar to those of Marton & Säljö, 1976a; 1976b) were used, including open-ended questions, group and individual discussion. Most of the strategies identified in this manner were later corroborated from the literature.

Sixty learning strategies were suggested for the study. These were supplemented by five open-ended items in which students could provide any additional strategies that had not been included in the original list. Five new strategies were identified by students during the administration of the questionnaire: brain-storming ideas, teaching someone else, recording and listening to audio tapes, comparing one's own work with others to get a different perspective and the use of colour in notes to enhance memory. These were not included in the statistical analysis because they each attracted only one or two responses, but should certainly be included in future questionnaires.

### **Finding 13**

*Seven types of learning strategy emerged from a principal component analysis. These included: practice, key ideas, relating, remembering, background, projecting/predicting and grouping strategies. Each of these serves a specific learning function.*

The notion that learning strategies serve specific learning functions is the logical extension of categorising learning tasks into levels or type of processing. Bloom, Englehart, Furst, Hill & Krathwohl (1956) did this in the development of a taxonomy of objectives (learning tasks) for evaluating different levels of learning. Gagné & Briggs (1979) proposed categories of capabilities, Merrill (1983) different levels of student performance (levels of processing). Others have suggested different levels of complexity in the knowledge structures, namely declarative or procedural, resulting from this processing (Glaser, 1988b; Anderson, 1982; Alexander & Judy, 1988). In common is a description of the types of cognitive processing, and by implications, complexity, that students must use for different learning tasks. The seven groups of learning strategies developed in this study would appear to operationalise these descriptions. If this is so, then these strategies are the specific activities in which the student engages when operating at these levels. A comparison of how the seven types of learning strategies may equate to the levels of processing suggested by others as representative of student learning and the types of learning these strategies may serve is presented in table 8.1.

**Table 8.1 A comparison of processing, learning and knowledge levels**

Bloom et al (1956)	Gagné & Briggs (1979)	D. Merrill (1983)	Learning Strategies	Types of Learning	Knowledge Structures
Knowledge	Verbal knowledge	Remember verbatim	Remember Grouping	Memorise	Declarative
Comprehension		Remember paraphrase	Key ideas Relating Background	Comprehension	
Application	Intellectual skills	Use	Practice	Procedural	Procedural
Analysis Synthesis		Find	Projecting/ predicting	Hypothesise	

It is suggested that these seven types of learning strategy might be thought of as serving four main types of learning: memorising, comprehension, procedural and

hypothesising. The following section describes how each type of learning strategy might contribute to the achievement of the four learning levels.

**Memorising** The simplest type of learning is memorising information and this can be accomplished with either remembering or grouping strategies. This level of learning requires no understanding.

Memorising information has been closely associated with *surface* learning in recent years and has been generally regarded as undesirable (Entwistle & Ramsden, 1983). In fact, memorising is only undesirable when it is used inappropriately, for example, memorising information that needs to be understood. All learning tasks will have some information that needs to be memorised, for example, remembering the names of new concepts. More complex learning is easier if *some* of the information is remembered first. Information that can be represented in working memory by its name, rather than other characteristics is likely to be less demanding on limited capacity. However, demanding that students memorise large amounts of meaningless information before engaging in complex learning is not the answer to more efficient learning. Students are likely find this demotivating and boring. Students probably use memorising strategies most effectively when they intersperse them with more complex learning throughout the learning process.

*Strategies for Memorising* Remembering and grouping strategies are used for remembering information without understanding and equate directly with Bloom et al's *knowledge* and Merrill's *remember verbatim* levels. They form part of Gagné's *verbal knowledge* which also includes a comprehension level. Verbal knowledge is defined as knowing that *something exists* (Gagné & Briggs, 1979) which includes being able to remember and understand information.

These two types of learning strategies come closest to the *surface* approach of Biggs and others in that the focus is on remembering information, not understanding it. A significant difference is that mnemonics make up a large proportion of the strategies in these two groups, whereas surface strategies are defined primarily as

*rote rehearsal* (Biggs, 1987). *Rote rehearsal* is the strategy of repeating information over and over until it can be remembered. Two items within the *remember* strategy group measured this learning strategy. Studies which have attempted to validate the SPQ have found the surface strategy scale to be weak and unstable (O'Neil & Child, 1984). Perhaps one of the reasons for this is the absence of strategies such as mnemonics, which students use with rote rehearsal strategies for remembering.

The label *surface* also has a judgemental connotation, implying a lack of interest or motivation. In fact, almost all learning tasks require an element of *remembering*. At the very least students must be able to remember concept names, and often much more. The high correlation of these strategies with other strategy groups (see table 7.12) suggests these strategies are frequently used in conjunction with other strategies as part of an overall approach to tackling a task, not as a discrete, self contained *surface* approach.

That these two strategies emerged as two rather than one component was interesting. While both sets of strategies improve memorability, grouping seems to have a higher organisational component and works by organising large amounts of information into smaller units for ease of remembering. The rule or criterion for membership in the unit becomes the mechanism for recalling information. This process is enhanced if a name or label that summarises the membership rule is used. For example, information about a system could be categorised as *advantages* or *disadvantages*. The size of the task is reduced into two smaller tasks and information is more easily recalled by focusing on either the advantages or disadvantages. This set of learning strategies is more likely to be associated with tasks which require memorising large amounts of information and have relatively little natural structure to link the ideas. The grouping strategy provides the framework or structure to hold all the separate pieces of information together.

Remembering strategies, in the main, are concerned with making more memorable specific individual pieces of information. These strategies, unlike the grouping strategies, were not task specific (see table 7.8), but correlate with all other strategy

groups (see table 7.12) suggesting they are used in a variety of situations. They have the lowest mean of all the learning strategy groups so students do not rate them as being very important. They seem to be low-level, more generically used strategies than the grouping strategies.

### **Comprehension Learning**

The three groups of learning strategies that would seem to enable students to achieve comprehension are key ideas, relating and background filling. Comprehension requires that the student understand the information to the extent that it can be explained by the student in his or her own words (Merrill, 1983; Pask, 1976). Comprehension learning is cognitively more complex than memorising information and will generally subsume the simpler level as comprehension is rarely achieved without also remembering information.

Memorising and comprehension learning combine to build declarative knowledge structures (Glaser, 1988b). Declarative knowledge is *knowing that* something exists without knowing how to effectively apply the knowledge (Glaser, 1988b; Alexander & Judy, 1988). This knowledge base allows the student to describe, explain and generally *talk about* information but, not apply it in a practical sense. Declarative knowledge becomes a prerequisite for the next level of learning, proceduralising. However, comprehension learning probably continues hand in hand with procedural learning and the declarative knowledge bases also continue to grow.

*Comprehension Strategies* Three components; key ideas, relating and background might be called comprehension strategies. All of these learning strategies contribute to understanding information and equate to Merrill's *remember paraphrase*, Bloom et al's *comprehension* and are part of Gagné's *verbal information*. The three components work in slightly different ways to achieve comprehension. Key ideas involves selecting out the important information. This provides the student with the basic elements of knowledge. At best, the process of separating important information from less important information may clarify the relationships between the critical elements and these elements may be combined into usable declarative knowledge structures. It is possible that not all students make this second leap of

understanding, but remain with the basic unstructured elements. Key ideas were rated as the most important learning strategy by all groups of students (see means in table 7.13 to 7.16).

Relating strategies are widely identified through the literature as *comprehension* strategies (Spring, 1985; Biggs, 1987; Entwistle & Ramsden, 1983). These strategies relate information to another context, for instance to similar or related ideas in another subject. This second context helps to provide a framework for understanding the new information. Relating strategies seem to be a higher order group of strategies than key ideas in that they use other knowledge as the lever for interpreting the new information. This *other knowledge* is thought to play a similar role to *prior knowledge* which, as indicated by the results in the previous chapter, is a powerful aid to effective learning. By using existing knowledge structures (that is, the other context) as a starting framework, relating strategies are probably able to build stronger, more sophisticated knowledge structures than key ideas which seem more appropriate for students trying to build new structures from scratch. Some support for this notion is indicated by the way students in the essay task and case study 1 used these two sets of strategies. Successful students in case study 1 used key ideas. This was the first year these students had taken a paper in this subject, so the main task, seemed to be to develop basic comprehension. Successful students in the essay task, on the other hand, used relating strategies. These students had already completed a first year paper in this subject so should have started with a basic understanding which would increase in sophistication with relating strategies.

The third set of comprehension learning strategies involve developing background knowledge, by reading widely for example. These strategies usually do not have a fast or direct pay-off as background building by nature is peripheral to the task. Over an extended period of time background strategies develop a context which becomes increasingly important for interpreting new information. Because these learning strategies have a slow pay-off and are not directly relevant to the immediate task at hand they are more likely to be done by students with a strong interest in a subject area.

**Procedural Learning** Procedural knowledge structures evolve when declarative knowledge is compiled into functional units (Glaser, 1988b). The propositional form of the structure in its declarative form can only be changed into its procedural form through actual use of the declarative knowledge in some practical task (Anderson, 1982; Glaser, 1988a). The specific strategies students probably use to achieve this result are practice learning strategies. In the first stage of the process the student compares the task, for example a mathematical problem, before and after reaching a solution and from this generates a “production rule”. After repetition several production rules are generated and a process similar to chunking occurs resulting in the amalgamation of these rules into a single generic production rule (Anderson, 1982).

Each time practice strategies are used the proceduralised knowledge structure is refined and the student becomes more skilled at the activity (Fitts & Posner, 1967; Singer, 1978). Using practice strategies these production rules gain strength and lead to parts of the task being automatised, freeing up working memory for processing of new knowledge. The end result of this activity is skilled performance (Glaser, 1988b). Two important considerations need to be noted. First, a declarative knowledge structure is a prerequisite to the development of effective procedural structures. The size of the required knowledge base will vary from task to task, but some prior knowledge is essential (Chi, 1981; 1985; Brown, Burton & de Kleer, 1982; Smith & Good, 1984; Glaser, 1984; 1988a; Rabinowitz & Chi, 1987; Alexander & Judy, 1988). The second point is that procedural knowledge involves skill development, and proficiency requires repetition or practice. Repetition does not necessarily mean drill exercises. A more important type of repetition, described by the items within the practice strategy component, is repeating the performance with different data, different variables or in different situations. By varying the context of the performance a greater understanding of all of the dimensions of performance may be achieved. With repetition, new levels of skill will be achieved and different practice strategies may be used (Owen & Sweller, 1985; Gay, 1986). For example, at the very early stages of learning to solve a mathematical problem a

student might use a number of worked examples to guide him or her through the process. As confidence develops he or she might seek new examples of the problem for which a worked example is not available.

*Proceduralising Strategies* Practice strategies seem to equate to Bloom et al's *application*, Gagné's *intellectual skills* and Merrill's *use level*.

All of the strategies in this group involve the student trying to use the information in some way. Different levels of difficulty are implied. For example, *work through given examples* is likely to be used early in the learning process. *Given examples* have been selected for their instructional properties and may be presented in class by an instructor or in a text. They serve as a blueprint to guide the student through the task (Anthony, 1991). As the student becomes more skilled she or he is able to work through new examples without the guidance provided by the carefully chosen *given examples*. When students reach the stage of finding their own examples they are operating at a higher level of confidence and probably skill. They are able to apply the principles that govern the inclusion of instances of those principles (Merrill, 1983). Progression from simple to more difficult applications is suggested by the inclusion of the learning strategy *practice on simple tasks first* in this component.

**Hypothesis Learning** At a higher level of proceduralising the student develops proficiency in execution and more and more of the learning task becomes automatised, substantially freeing up processing capacity (Glaser, 1988b). Production rules become stronger and more generic, allowing the student to view the task more holistically. The student is able to survey his or her own history of task performance, and likely that of others too. In addition, the student has now built an extensive declarative knowledge base relating to the performance of the task. This enables him or her to determine trends or recognise patterns, to extract meaning that is not totally apparent from the information at hand (Chi & Ceci, 1988). The student working at this level has achieved a considerable degree of expertise. The type of learning engaged in might be called *hypothesising*. The

student develops an hypothesis and then tests it. This process of hypothesising underlies most of the projecting/predicting strategies. These strategies involve *analysing* and *synthesising* information as described by Bloom, Englehart, Furst, Hill & Krathwohl (1956). Bloom also included “evaluation” at this level, but none of the strategies of predicting/projecting group that operationalise this learning really engage in evaluation. This may be because all of the subjects in this study were undergraduates and they are not expected to evaluate the work or ideas of others.

*Hypothesising Strategies* These strategies equate to Merrill’s *find* and to Bloom et al’s *analysis* and *synthesis* levels. Gagné and Briggs (1979) do not have an equivalent component. These strategies would appear to be of a higher order, though similar in nature, to practice strategies. They imply the ability to analyse information, extract key components and synthesise these components to produce new information. A student working at this level would need to be skilled at the practice level.

The two strategies that form part of the predicting/projecting group of strategies, *visualising* and *get an overall picture then fill in the details*, seem to be broader in nature than others in the group and so require comment. Visualising is a form of mental rehearsal in which the student simulates the task. Feedback from this strategy is likely to improve actual performance (Richardson, 1967a; 1967b; Feltz & Landers, 1983; Hall, Rogers & Barr, 1990).

Whereas at the lower level of key ideas the student starts with individual components or ideas that may then be constructed into a framework, at this level the student builds the framework first (*get an overall picture then fill in the details*). To achieve this the student must have a strong understanding of the principles and procedures that govern the subject matter. This is highly suggestive of the notion that as students operate at more complex levels of learning they tend to view tasks more holistically. Holistic learning as a characteristic of *deep* learning is argued in the literature (Svensson, 1977; Entwistle & Ramsden, 1983).

**Summary** The results from the principal components analysis of learning strategies suggest that students have complex patterns of learning strategy use. To reduce these strategies to a representative sample for diagnostic purposes is likely to produce a distorted, oversimplified picture of a student's learning behaviour.

Strategies defined by Biggs (1987) or Entwistle & Ramsden (1983) as *surface* make up a tiny proportion of the total possible range of learning strategies. Surface strategies were measured by only two items which formed part of a larger component (remembering). In itself this implies surface strategies may not be used alone as an approach to learning, but are used in conjunction with other more powerful mnemonic strategies to serve a *remember* function. While *remembering* information is not a high level learning process, it is an inherent part of most learning tasks, even at very high academic levels. To prove the existence of a surface style evidence is not enough to demonstrate that students use rote learning strategies. Evidence must be provided to show that these strategies are used exclusively and inappropriately. This study was unable to detect such a surface style. Students who made a higher than average use of remember strategies also exhibited a higher than average use of all other strategy groups (see table 7.12), suggesting that memorising strategies are used as one component in a more complex learning process than implied by the surface-deep dichotomy.

In this principal component analysis, learning strategies cohered according to function, not a surface or deep approach. The seven functional learning strategy groups that emerged seemed to match the processing levels that instructional psychologists such as Bloom, Englehart, Furst, Hill & Krathwohl (1956), Gagné & Briggs (1979) and Merrill (1983) have widely used to describe learning tasks. This suggests that the seven functions might be ordered hierarchically according to the complexity of the processing required by the student. Students appear to analyse the task demands and respond with learning strategies that are functionally appropriate.

### **8.3 Influences on Learning Outcome**

Once the patterns of learning strategy usage had been determined, the study examined the effect of this usage on the quality of learning outcome. It was recognised that learning strategies work in conjunction with prior knowledge under conditions created by the students' study management skills. Consequently, the effect of the three types of variable, learning strategies, study management skills and prior knowledge, on learning outcome was considered.

In most educational institutions learning outcome is measured from the results of tests, assignments, examinations or some combination of all three. These assessment methods evaluate the quantitative and qualitative knowledge structures and skills the student has acquired. The validity and reliability of these methods have been questioned (Watkins & Morstain, 1980; Watkins, 1982b) and alternative methods such as the SOLO taxonomy have been proposed, particularly for research purposes. However, students are finally judged by formal institutional assessment procedures; this is the system to which their efforts are directed, and if we are to understand their behaviour then the effectiveness of those efforts should be measured against the criteria that the students themselves are using. Consequently the marks that students receive for their learning efforts would seem to have better context validity as a measure of learning outcome than an imposed system such as SOLO to which neither the teacher nor student pay any regard in their efforts to achieve or assess learning outcome.

Both generic and task specific influences on learning outcome were found. Generic variables were found to be important for learning outcome irrespective of learning tasks. Other specific variables emerged as being important when their influence was examined in the context of different tasks. Both generic and specific influences are now discussed in more detail.

### 8.3.1 Generic Influences on Learning Outcome

Three variables affected learning outcome in a generic context.

#### Prior Knowledge

##### Finding 14

*High prior knowledge favourably influences learning outcome.*

When the influences on learning outcome are considered in a generic context, that is without reference to a particular task, then the single most important factor for success is prior knowledge (see table 7.12). This finding is already well documented in the literature (Bellezza, 1981; 1982; Glaser, 1984; Chi, 1985; Alexander & Judy, 1989; Wilson, 1989). Students who already have some background knowledge in a subject area are able to understand and remember content better than those who do not. Prior knowledge provides students with a conceptual framework that facilitates the interpretation and understanding of new information (Siegler, 1986). While the importance of prior knowledge to learning outcome is clear, its relative importance varies from task to task and is dependent upon specific task characteristics. These are discussed in more detail in section 8.3.2.

#### Study Management Skills

##### Finding 15

*The study management skills of procrastination and neat, organised study notes are associated with a low learning outcome.*

Study management skills create the self imposed conditions under which the student engages in learning. Across tasks the high procrastinator tends to perform poorly. This accords with the findings of Entwistle & Ramsden (1983) who found “disorganised study methods” (this scale was closely related to the procrastination component) were associated with a surface approach and a poor learning outcome. This result is not surprising. The student who delays learning until the last possible moment is probably relying on the anxiety generated by an imminent event such as an examination as the motivation to commence work. As Fransson (1977) and others (Naveh-Benjamin, McKeachie, & Lin, 1987) have found, increases in anxiety result in much of the limited capacity in the working memory being distracted by fear of failure and negative self thoughts. The student’s capacity to learn is effectively

reduced. In addition to the problems created by anxiety, the student is faced with a lack of adequate time to complete the learning task. A lower learning outcome usually eventuates.

At first sight, the finding that neat and complete study materials are associated with a poor learning outcome seems contradictory. We would expect that students who have carefully assembled and organised their notes would have improved their chances of a good learning outcome. However, study management skills are only *conditions* which may facilitate effective learning. They are unlikely, in the absence of other effort, to create learning. Students who rate very highly on this skill may be expending too much effort on the form and appearance of study materials and too little effort on the learning itself. This conclusion echoes Spring's (1985) finding that some students rely too heavily on "study" strategies such as underlining ideas instead of strategies that would aid understanding. In both cases students seem to be using these behaviours as a coping mechanism instead of more appropriate strategies. What is not clear from the results is the cause of this dysfunctional behaviour. Does it result from an overemphasis in primary and secondary school on appearance of school work? Do these students have an inadequate repertoire of learning strategies or is this an appropriate response to their representation of the task demands? Further research is indicated before recommendations on appropriate remediation can be made for these students.

## **Learning Strategies**

### **Finding 16**

*No specific learning strategies favourably influence learning outcome irrespective of the task.*

The failure of learning strategies to predict learning outcome *across* tasks was entirely expected. Learning strategies are appropriate to specific tasks. A learning strategy that facilitates learning in one context may hinder effective learning in another. The influence of learning strategies on learning outcome was expected to emerge when they were examined in the context of specific tasks.

### 8.3.2 Task Specific Influences on Learning Outcome

When learning outcome was examined in the context of specific learning tasks a number of influences surfaced that had not been apparent when learning outcome was examined at a more generic level.

#### The Essay Task

##### Finding 17

*For students in the essay task, prior knowledge, relating and remembering strategies predicted a favourable learning outcome. The use of practice and grouping strategies predicted a poor learning outcome (see table 7.13)*

Relating strategies were a key success strategy for the essay task. This is particularly interesting as this task predicted the non-use of relating strategies in the first part of the study, indicating that these students consciously avoided using these strategies. While the students may be averse to the use of these strategies (a reflection of their interest in this subject), their use is associated with a good learning outcome. Marton and Säljö (1976a; 1976b) produced similar results using a phenomenographical approach. Students were given passages from a text to read, and then asked to verbally explain the content. This task might be described as an oral essay. Those students who were classified as having a qualitatively higher learning outcome described their learning behaviour in terms that closely resembled that items used in the relating scale. Likewise Biggs' (1985) "deep scale" shares many similar items with the "relating learning strategies" group and he, along with others (Entwistle & Ramsden, 1983) found a strong relationship between a deep approach and learning outcome.

Remembering strategies were also successful learning strategies for the essay tasks. These strategies also predicted a favourable learning outcome for case study 1, but not for either the practical project group or case study 2. It seems probable that remembering strategies are more important for declarative tasks (essay and report writing) than procedural tasks. When a student has to learn *to do* something (proceduralised learning) and practices performing the task, the need for devices to

help remember information seems to be reduced. Perhaps *using* information makes the information more meaningful and personalised and thus easier to remember. In a declarative task after the initial stages of learning (which again are likely to include remembering specific pieces of information such as concept names), comprehension becomes the focus of effort. Once a student has understood a topic his or her next step in the learning process is to try to *anchor* that information in his or her mind, in other words remember it. In procedural tasks, practice strategies, which allow students to rehearse their performance, seem to serve this *anchoring* function. Spring (1985) called strategies used in a declarative context (reading) to perform this anchoring function, *study strategies* and found that students who used these alone had poor learning outcomes while students who used them in combination with comprehension strategies such as relating were successful.

For the essay task, practice strategies predicted a poor learning outcome. Practice strategies would appear to be inappropriate to this type of declarative task. They imply a minimum level of declarative knowledge as a prerequisite. This knowledge is worked and reworked, using these strategies, into a proceduralised format. Students who use these strategies in a declarative context and have the prerequisite knowledge are wasting effort that might be more effectively applied, because the task does not demand the knowledge in this proceduralised format. Any student trying to apply these strategies without the prerequisite declarative knowledge is likely to end up with fragments of unrelated information because he or she has not developed the comprehension framework to hold the fragments together in a meaningful way. In both of these scenarios, students are wasting effort and their limited learning resources and are consequently unlikely to have a successful learning outcome.

Grouping strategies were also negatively associated with learning outcome for the essay task group. Again the most likely explanation is the context. Grouping strategies perform an organisational function. The student uses them to organise large amounts of information into smaller units, making them more manageable and providing structure to the information. Successful students in the essay group used

relating strategies and these tended to come with an in-built structure created by the prior knowledge (other context) on which the student were modelling their understanding. If students using grouping strategies are doing so because they do not have the benefit of structure associated with relating strategies, it may reflect a lack of the appropriate prior knowledge. Alternatively, they may have made a decision to use grouping strategies with learning strategies that were less useful for this task, such as key ideas, or maybe even on their own. If they are being used in the absence of comprehension strategies they maybe serving as a dysfunctional coping strategy; manipulating the information to satisfy feelings of doing something useful, but in fact not creating understanding.

Prior knowledge is positively associated with a successful learning outcome for the essay task. Students who had been successful in their first year's study appear to have developed a knowledge base that facilitated new learning in their second year.

### **Case Study 1**

#### **Finding 18**

*For students in the case study 1, key ideas and remembering strategies predicted a favourable learning outcome. The use of practice strategies and having neat, organised study notes predicted a negative learning outcome (see table 7.15)*

Case study 1 involved writing a report which was intended to simulate a practical exercise. However, the types of learning strategy that students chose, and were successful with, strongly suggest that students interpreted this task as a declarative rather than practical task.

The *selection* of relating strategies was predicted by the case study 1 task in the first set of regressions (see table 7.7), as were key ideas, but unlike key ideas, relating strategies were not especially associated with a successful learning outcome for students doing this task. This difference may be accounted for by the class context. These students were embarking upon the first paper of their chosen major and were therefore more likely to be intrinsically interested in the subject. Additionally, they

Additionally, they tended to be older (see figure 6.2) than students in the essay group and both age and motivation (interest) contribute strongly to the use of relating strategies (Biggs, 1987).

While the selection of these relating strategies was pervasive for case study 1 students, they did not predict successful learning. The differential effectiveness of relating strategies for producing a good learning outcome in two similar learning tasks (the essay and case study 1) can perhaps be explained by the task context. The essay students had already completed a paper on the same subject in the previous year, so their use of relating strategies presumably included relating back to this very specific and relevant prior knowledge. Case study 1 students had no such prior knowledge. Their relating would necessarily be to life experiences and other subjects which were likely to have been of less relevance than a related subject paper.

Key ideas were the comprehension strategies associated with a positive learning outcome for case study 1 students. For students embarked upon their first course in this subject area, these strategies seem to have been useful in the initial stages of learning this declarative task. These strategies appear to act as the basic building blocks of comprehension.

As with the essay task, practice strategies predicted a poor learning outcome. The argument presented for the essay would also apply to this declarative task.

## **The Practical Project**

### **Finding 19**

*Both prior knowledge and planning predicted a favourable learning outcome for students doing the practical project task. No specific learning strategies predicted learning outcome for this group (see table 7.14).*

Our understanding of the progression of knowledge from declarative to procedural has emerged from studies on expert and novice performance (de Groot, 1965;

Newell & Simon, 1972; Chi, Feltovich & Glaser, 1981; Chi, Glaser & Rees, 1982). In the words of Glaser (1988b) "*Novices can know a principle, or a rule or a specialised vocabulary without knowing the conditions of effective application. In contrast, when experts access knowledge, it is functional or bound to conditions of applicability*" (p.4). Knowledge is first understood in a declarative form, and is used by the student to make an approximation to the skill. Through feedback from these initial performances students create "production rules" which govern future performances. These production rules take an "*if...then...*" form which prescribe sets of conditions that need to be satisfied for an operation. Gradually, feedback and rehearsal eliminates errors and production rules are collapsed into more generic production rules which are more efficient for the task. Anderson (1982) called this process "*knowledge compilation*". Two sets of learning strategies seem to be appropriate for bringing about knowledge compilation; *practice* and *projecting/predicting* strategies. Projecting/predicting strategies are a higher form of practice strategies requiring a high level of declarative knowledge and expertise at the procedural level. A crucial ingredient for the successful use of both sets of strategies is repetition, a necessary component of skill development (Glaser, 1988a).

While the selection of these strategies was predicted by the practical project task, suggesting that they enjoy wide use by students in these task groups, no specific learning strategies were identified with learning outcome. This finding seems to contradict work by others which clearly establishes the link between practice and skill performance (Glaser, 1988a). Two possible explanations can account for this apparent anomaly. The first relates to the importance of prior knowledge to procedural tasks and the second to the qualitative use of learning strategies.

The importance of prior knowledge to successful learning for procedural tasks is clear from the study results. It seems likely, as Entwistle and Ramsden (1983) found, that students performing procedural tasks need relevant prerequisite knowledge. The process of knowledge compilation (proceduralising knowledge) needs a declarative knowledge base to reshape into a procedural format (Anderson,

1982). In the absence of this knowledge the effect of appropriate strategies is seriously compromised.

Procedural tasks can vary from simple to very complex. Whereas practicing on simple tasks such as memorising a check-list may improve performance, practicing on complex ones may not necessarily always produce and improved performance (Schneider, 1985). Complex tasks, for example air traffic control, demand a large knowledge base and a complex set of production rules governing performance (Colley & Beech, 1989). Two factors would seem necessary prerequisites to successful learning of such complex tasks. First, planning skills may be indicated to create a favourable learning environment. It was argued earlier that practice strategies need time to achieve skill development. Also, the practice of complex activities may be hindered if the student lacks focus (goal setting) or cannot access essential information (information available). Each of these, time management, goal setting and having information available make up the study management skill of planning.

Secondly, practice strategies may be ineffective if the student has failed to properly structure the task, for example his or her production rules are based on false assumptions or misunderstandings, he or she may be practicing his or her mistakes rather than detecting errors and correcting them. In this case the quantitative use of practice and projecting/predicting strategies may be the same as for a successful student, however, the qualitative use differs considerably. The mechanisms, that is the learning strategies, underlying the learning behaviour in both cases are the same. The effectiveness of the mechanisms is quite different.

## **Case Study 2**

### **Finding 20**

*Prior knowledge predicted a favourable learning outcome for case study 2 students. No learning strategies predicted learning outcome (see table 7.16).*

As with other groups prior knowledge was a strong predictor of learning success. It is difficult to interpret additional meaning from this result as the regression equation failed to reach significance.

**Summary** Debate has surrounded the issue of measuring learning outcome. Many have questioned the validity of teacher assessment and suggested alternative measures of effective learning. The question is this - should learning research be directed at helping students to perform better in an imperfect educational system, or should it be concerned with defining a learning utopia which will encourage educators to change the educational system, and through a trickle-down theory eventually result in better learning? This study is firmly rooted on the side of students. They pass or fail on the marks given by their teachers. Research effort should be directed at increasing their awareness of the learning process and helping them to develop a strategic approach to their learning. Students should be taught to assess any learning situation so that they understand the "rules of the game" and are able to respond in a manner likely to maximise their probability of passing the course. If some teachers reward memorisation, the sensible student will respond in kind. If educators want more meaningful learning it is up to them to create conditions which will foster it. The same research which helps students to pick their way through the minefields of the education system will demonstrate to educators what changes they need to make in the system to create more meaningful learning. However, research based on artificial methods of learning assessment and strategies for inducing a deep approach to learning (for example see Kember & Gow, 1989) will not help students deal with the realities of their learning environment.

The strongest influence on learning outcome in most contexts is prior knowledge. Study management skills also play a part. Procrastination and a neat, complete study notes seem to be dysfunctional learning behaviours that inhibit good learning performance. In some contexts, depending on the nature of the task, planning is an important ingredient for learning.

No learning strategies were found to be generically important for learning success. The specific context determined which strategies led to a good learning outcome. The use of comprehension strategies of key ideas and relating, and the strategies of remembering predicted a successful learning outcome for declarative tasks. The use of strategies that seem inappropriate to the task, such as practice strategies for a declarative task, leads to a poor learning outcome.

## 8.4 Profiles of Successful Students

Other studies have developed profiles of successful students (Biggs, 1987; Entwistle & Ramsden, 1983). Such a profile would prove to be extremely useful for targeting “at risk” students for early intervention programmes. However, this study found few characteristics which were able to discriminate between good and poor students with a high degree of accuracy. In the main the findings from this section of the study reinforced the findings of the previous section.

### Prior Knowledge

#### Finding 21

*Prior knowledge is a characteristic of successful students for the essay, practical project and case study 2 tasks. The learning strategy of key ideas characterised successful case study 1 students (see tables 7.12 to 7.16).*

Prior knowledge was a success factor in three of the learning tasks. These tasks differ from case study 1 in that the students performing them are in at least their second year of studying the particular subject area with which the tasks are associated. The case study 1 students had only recently commenced study in human resource management. A possible interpretation of this finding is that the more advanced the level of learning being undertaken, the more important is prior knowledge to successful learning.

An alternative interpretation is suggested by Alexander & Judy (1988) who explored the relationship between prior knowledge and strategies. They concluded

that the relative importance of either prior knowledge or strategies to successful task performance was a consequence of the structure of the task. Studies which demonstrated the importance of prior knowledge (for example, Chi, Feltovich & Glaser, 1981; Chi, Glaser & Rees, 1982) were conducted in areas which were procedurally rich or highly structured. Tasks that were ill-structured favoured the use of strategies (Greeno, Magone & Chaiklin, 1979; Lundeberg, 1987; Voss, Blais, Means, Greene & Ahwesh, 1986). An important consideration in this is, as Greeno Magone & Chaiklin (1979) point out, the task representation. A well structured task with a rich knowledge base may appear ill-structured to a student with low prior knowledge. This student is likely to have a fragmented task representation and respond quite differently to the competent learner.

Prior knowledge was not a success indicator for case study 1. It might be argued that compared to the other tasks, case study 1 was ill-structured. The essay task asked students to write a 1500 word essay on "The Role of the Accountant". For most second year university students essay writing is a clearly defined task that has been done many times previously. The topic of the task also implied a structure in which the student worked through a list of functions performed by the accountant. The task of the practical project students was mathematical in nature and as such required the student to follow well-defined procedures. Similarly, case study 2 students had to write a research proposal and were given a particular structure to follow. Case study 1, although a report, was unlikely to have been similar to any previous exercise or assignment encountered by the student. Students were given a set of lecture notes prepared by a trainee teacher and asked to write a report advising the trainee how to improve her lecture design. Given that students would have been unable to draw on previous experience of tackling similar tasks, and because little guidance was presented on the procedure that should be used, it could be assumed that this task appeared ill-structured to students. Students had to pick their way through the task as best they could without the benefit of prior knowledge. Thus the strategies that they chose to aid them in this process became of paramount importance to the success of their efforts.

## Study Management Skills

### Finding 22

*Procrastination was a characteristic of the least successful student doing the essay task. An obsession with neat, organised study notes characterised the least successful students in the case study 1 group.*

For the essay task, procrastination was associated with failure. Procrastination is generally associated with tasks which are disliked. The students in this class were the only group in the study taking a compulsory subject in an area that was quite different to their chosen majors, so it was not surprising to find that procrastination distinguished the most successful students from the least.

For the case study 1 task an obsessive concern with neat study notes predicted failure. Students may use neat study notes as a coping mechanism when they feel overwhelmed by a learning task, and in doing so misdirect learning effort.

## 8.5 Comparisons with the SPQ

The SPQ was developed by Biggs over a period of time until it reached its present form in 1985. At the same time similar inventories measuring the same constructs of deep and surface learning were being constructed and used for research purposes (for example, Entwistle & Ramsden, 1983; Selmes, 1987). The results from these studies have generally been consistent and extremely useful in focussing attention on the active processing role played by the student in the learning process. However, they provide a very general picture of a student's learning behaviour which has considerably less reliability when interpreted in a specific learning context. It is of no value to a teacher or student to know that a student generally has a deep approach when they are specifically concerned about poor performance in a particular course. They need to know exactly what the student is doing in that course, which may be quite different from the student's general approach, why he or she is responding to the task in a particular manner and the likely impact of the student's behaviour on

performance. The study management skills, task representation and learning strategies were developed in this study to provide such information.

Comparisons between the ability of the SPQ and two measures from this study, the Study Management Skills and Learning Strategies, to predict learning outcome in a specific learning context demonstrate the relative strength of the two sets of measures to clarify those aspects of the student's learning behaviour that are the active agents in the learning process.

### **The Essay Task**

#### **Finding 23**

*Neither surface, achieving or deep strategies predicted learning outcome for the essay task (see table 7.18).*

This finding contrasts with finding 16 in which two strategies predicted a favourable learning outcome, and two predicted negative learning outcomes (see table 7.13). Relating strategies predicted learning outcome for the essay task. In spite of the considerable overlap between this scale and the deep scale on the SPQ, no similar relationship between the use of deep strategies and learning outcome could be detected at a significant level. If we accept the similarity in the measures, it suggests that the deep scale of the SPQ is a less accurate indicator of the students' learning behaviour in *this* particular context.

### **The Practical Project Task**

#### **Finding 24**

*The achieving scale of the SPQ predicted learning outcome for the project task (see table 7.19).*

The SPQ performed slightly better than the learning strategies and study management skills measures for the project task (see table 7.15). The planning scale from the study management skills measures much of the same content as the achieving scale and this commonality is reflected in a similar relationship to learning outcome for the project group. However, it is not as strong a predictor as the

achieving scale. In both instances no learning strategies were associated with learning outcome for the project group and this probably reflects the argument presented earlier that this group performed a highly structured task in which being able to draw on prior knowledge, both declarative content knowledge and the procedural knowledge, were much more significant to successful performance than the specific strategies used. In fact, the high degree of structure may have severely reduced the amount of choice the student had as to the specific strategies to use. If most students are using basically the same strategies then the effect on learning outcome will relate more to the *effectiveness* with which the strategies are used rather than *which* strategies are used. Effective use of strategies is largely a function of prior knowledge (Elshout & Veenman, 1992).

### **Case Study 1**

#### **Finding 24**

*Neither surface, achieving or deep strategies predicted learning outcome for case study 1 (see table 7.20).*

This finding contrast with finding 17. For case study 1, the study management skills and learning strategies provide much more information than the SPQ (see table 4.15). Learning outcome was predicted by three learning strategies (practice, key ideas and remembering) and the study management skill of organised study notes.

### **Case Study 2**

No interpretation of the results could be made as the equation failed to reach significance (see table 7.21).

To summarise, apart from the project task, the learning strategy and study management skill measure demonstrated greater predictive power when learning is examined in task specific contexts. In the case of the project task the SPQ was only marginally stronger. Neither the deep and surface strategy scales of the SPQ predicted learning outcome for individual tasks nor for the group as a whole

In some contexts, the achieving strategy scale of the SPQ seemed to be a more powerful predictor of learning outcome than its study management skill counterpart, planning. This may be because the achieving strategy measures more specifically the organisational or planning elements essential to the successful completion of procedural tasks. A closer examination of the two scales may suggest possible improvements to the planning scale.

The learning strategy measure seemed to have two advantages over the SPQ. First, when examining two tasks that seemed very similar in nature, the essay and case study 1, the instrument was sufficiently sensitive to detect subtle contextual differences as requiring *different sets* of learning strategies (key ideas in one case and relating in the other) for successful learning.

The second advantage is the inclusion of a greater range of learning strategies. Key ideas rated by all students as the most important of all strategies (see table 7.12) do not feature in the SPQ. For both the essay and case study 1 task practice strategies were detrimental to learning outcome. Again the SPQ makes no mention of these types of learning strategies and so misses this important relationship. Similarly mnemonics and projecting/predicting strategies are not represented in the SPQ.

Overall the SPQ provided such a broad macro picture of the student it was unable to detect subtle, but significant, variations of student learning in specific contexts. For diagnosing learning performance and improving learning an understanding of these contextual variations is crucial. It is these contextual adaptations to tasks, for example, using relating strategies rather than key ideas, that can make the difference to a successful learning outcome.

## 8.6 Summary of Discussion

### 8.6.1 Task Appraisal

When faced with learning a task students appraise the task and its context to determine an appropriate response. While different students may all share a similar recognition of the nature of a task, their representation of the task may be quite different. These representations may have more in common with those of students doing different tasks but sharing the same task representation.

Some students represent tasks in quite different ways to teachers and instructional designers. The knowledgeable student with a contained task representation sees the task in terms of the interconnections between task components. This is probably quite close to that of the teacher. The novice student is faced with many unrelated components, rather like a jigsaw before its assembled. This student must make sense of these components before he or she can successfully finish the task. An investigative task representation is similar to a fragmented representation in that the student must tackle a preliminary task, finding the relevant information, before the task can be completed. A declarative task representation identifies the processing level, that is comprehension, at which the task must be performed. Students with these task representations given the same objective learning task may in fact be faced with quite different tasks.

The nature of a task requires a set of responses whose specification is based on an objective understanding of the task and is the same or very similar for all students. For example, practical tasks require practice strategies. Conversely, a student's task representation is a subjective understanding of the task that is influenced by the student's state of knowledge of the task. The nature of the task will tend to generate similarities in responses; task representations will generate diverse responses. To the extent that a task representation is a valid assessment, the student's response will generally be appropriate to the student's learning needs. Students whose task representations misconstrue the learning task may be misled into inappropriate responses. For example, the student who perceives a

mathematical task to be a declarative task will tend to use comprehension strategies but not the practice strategies necessary for proceduralising information.

Of all the variables which shape a student's response to a task appraisal, task representation is the most important. Task representations dominate the appraisal process.

Other contextual variables are considered by the student. Many of these variables are a reflection of the relationship between the task and the student rather than being inherent in the task. For example, older students may see *relevance* in a task that is not apparent to younger students. Older students are able to relate the new task to previous experiences or situations and recognise how they can use the new knowledge or skills in the future. Students who are intrinsically interested in a topic find *value* in completing a task that is not shared by a student who dislikes a subject.

Apart from recognising the nature of the task, which is relatively objective, student appraisal of a task is a highly subjective process. The particular mix of significant variables in any given learning situation will be highly individual. However, the responses to those variables is quite predictable. Intrinsically motivated and older students will have a tendency to use relating strategies; a declarative task requires comprehension strategies. The set of learning strategies any individual student uses for a particular task may be unique to that student but, if the student's task appraisal is known, those strategies can be predicted.

Entwistle & Ramsden (1983), Laurillard (1984) and others have suggested that students make a conscious decision to learn at a memorisation or understanding level. The findings from this study challenge that assumption. A mixture of variables, some inherent in the task, others resulting from the relationship between the task and student, construct a learning context that triggers predictable learning responses from the student. The students' learning response is shaped by their appraisal of the learning task. Learning might be improved if the active agents in the

appraisal process are understood and students' awareness of these agents and the role they play is raised.

### **8.6.2. Learning Response**

Students respond to their task appraisal by activating learning strategies that they believe match the functional needs of the task. The pattern of responses exhibited by students throws some doubt on the claims of other researchers that students' learning behaviour can be categorised as surface or deep. No evidence could be found that students selected strategies on the basis of an intention to learn only by memorising (surface approach). Some support was found for the claim that students who were intrinsically motivated use relating (deep) strategies. However, they also used other strategies depending on the imperatives of the task appraisal. It appears that when students are asked about the full range of learning strategies they use in a particular context, a complex pattern of learning behaviour emerges that transcends the surface/deep dichotomy.

Learning strategies seem to arrange themselves into seven hierarchical functions, from memorising at the simplest level of cognitive complexity to hypothesising at the highest level. These strategy groups appear to operationalise the descriptions of levels of cognitive processing that have been described by others (Bloom, Englehart, Furst, Hill & Krathwohl, 1956; Gagné & Briggs, 1979; Merrill, 1983). Each level subsumes lower levels, but a strict linear progression through the seven levels is not envisaged. As students move to a higher level it is probable that they keep feeding back into lower levels and developing the support foundation that these lower levels provide for more sophisticated levels of learning. So, for example, the student working at skill development (proceduralising) will also continue to build his or her declarative knowledge.

The mechanisms that underlie the learning process are more apparent when they are examined in specific contexts. Context alters students' appraisal of the task, and thus their response, and the relative importance of variables that contribute to successful learning. By studying learning in many different contexts more generic or

macro rules of learning may eventually emerge. In the meantime, studies such as this, which identify subtle variations in the learning process, provide useful information to teachers and students for improving learning.

### **8.6.3 Learning Outcome**

Learning outcome is generally considered the measure of the quality of learning. Some have proposed that taxonomies of learning, such as SOLO, are more valid ways of determining the quality of learning than traditional university or school grades. It is suggested here that the raw marks or grades students receive for their work are contextually more valid than such artificially imposed systems. These marks will determine how students themselves, and the world, judge their success. It is this result that students wish to influence. Students will have no interest in improving their learning if it does not result in better grades.

As indicated in the literature, prior knowledge is the most important predictor of learning outcome. However, its importance varies with context. The more advanced the stage of learning and the more clearly structured the task, the more important prior knowledge appears to be. The study management skills of procrastination and an overly concern with neat, organised study notes predicted a poor learning outcome. No learning strategy predicted learning outcome for all tasks. However, in the context of specific tasks specific learning strategies predicted learning outcome. The type of strategy needed to match the type of task for a favourable learning outcome. Strategies that were important in one context, were associated with a poor learning outcome in another.

## Chapter 9

### Conclusions

The research described in this study does not provide a definitive model of student learning. It does, however, provide insight into some aspects of learning that have been overlooked by researchers keen to develop macro-models that explain an individual's learning behaviour as a constant. Although this study was exploratory in nature, and some of the findings need to be interpreted with caution, a number of conclusions can be drawn from the results with some confidence. These conclusions, some practical applications of the findings, and, finally, some suggested directions for future research are presented.

#### 9.1 Conclusions

1. *Although the trend has been to focus on general, stable patterns of learning behaviour (Entwistle & Ramsden, 1983; Biggs, 1987), the underlying mechanisms of learning are more apparent when learning is studied in very specific task contexts.* When learning was examined in a specific task context more variables emerged as being important than when the same learning was examined in a more macro context in which specific tasks were not considered. Variables that are important for success in one task context may be detrimental to performance in another. Such variations are lost when the focus is too broad.
2. *The qualitative and quantitative methods of data collection used in this study proved an effective way of identifying both the variability between, and the consistency across student learning behaviour.* The 60 learning strategies identified by qualitative methods proved to be a fairly comprehensive list of strategies used by students. Only five new ones were suggested in the main administration of the questionnaire. The high reliability of the learning strategy measure suggested that students were able to recognise in the words of other students reflections of their own learning behaviour. It is possible then to use qualitative data as the basis for

identifying quantitative consistency across large groups of students. Generic measures of student behaviour are not needed to determine consistent patterns that are generalisable.

3. *Students' responses to a learning task are shaped by their appraisal of the task and its context.* The student interprets the learning task according to a number of context variables. This interpretation is highly individualistic and derives from an interaction between the task and the student. The student's interpretation or appraisal determines the nature of the learning strategy response the student makes. There seems to be little room for a deliberate decision to learn at a surface or deep level as suggested by other researchers.
4. *Task representation dominates the appraisal process.* This part of the perceptual process seems to have been completely missed by other researchers, yet proved to be the most important influence in the initial stage of the learning process. The four task representations that emerged in this study are probably less important in themselves than the recognition of this crucial ingredient. The measures designed for the study need further refinement but do provide a blueprint for future development. It seems highly probable that other task representations exist and await the appropriate questions to unveil them.
5. *Seven categories of learning strategy were identified and these could be seen as operating at different levels of cognitive complexity.* These categories appear to represent different types of cognitive function that the student can perform on information. Some categories, such as *remembering*, are clearly cognitively simpler than others. It is suggested that the seven categories can be equated to the levels of cognitive operation identified by instructional psychologists such as Gagné. Learning performance is enhanced when strategies are used that are functionally appropriate to the task.

6. *Students exhibit complex patterns of learning behaviour that are not easily categorised as a deep or surface approach.* These patterns represent the result of an interplay of context variables that are highly individual to the student. Students respond with learning strategies that they perceive to be appropriate to the context. Whether or not such strategies are appropriate depends on the clarity with which the student has appraised the task and its context. More effective patterns of learning may be used by students if they are taught task appraisal strategies. Such an approach may increase the effectiveness of learning strategy training which is often marred by a failure to maintain the learning strategy use after training finishes.
7. *Prior knowledge is the most important determinant of learning success.* Its importance varies from context to context depending on the degree of structure of the task. Its importance is less in the initial stages of learning or when the task is ill-structured.
8. *Study management skills influence what strategies may be used, and the effectiveness of strategy use.* Good planning skills enable students to use effectively learning strategies that are time consuming, such as *background building*. It effectively increases the range of strategies available to the student.
9. *Study management skills influence learning outcome.* Procrastination and a strong emphasis on neat, complete study notes appear to be detrimental to learning performance. In some tasks planning is the key to learning success.
10. *Study management skills and learning strategies should be measured by different scales as they represent different underlying constructs.* Conflating the two measures obscures the different functional roles they each play in the learning process.

## 9.2 Practical Applications

The following recommendations are based on the findings of this study. As this study did not specifically examine the role of instruction in the learning process the recommendations are tentative. This study focussed on the contribution the student can make to his or her own learning. However, in the world of education the teacher also has a role to play. Many of the findings from this study apply to both players in the learning game.

1. *Task representation should be used by both students and teachers.* Task representation showed such a strong influence on learning strategy selection it seems clear that students would benefit from having adequate skills to develop accurate mental representations of the learning task. If, as Glaser (1988b) and others have suggested in the similar area of problem representation, high prior knowledge is a significant advantage in the initial representation of a task, then providing students with either a task representation (from the teacher) or the skills to develop their own representations may lessen the disadvantage of low prior knowledge. Given the dominance of prior knowledge on learning outcome, the overall effect could be quite large. This information could be provided in two ways. First, it is suggested that students should be actively taught these skills. Wherever possible students should be given the tools to control their own learning. Equally, teachers who commence a lesson by providing students with a useful task representation may enhance the learning that ensues. Since the early 1960's instructional objectives have been widely used. It is suggested that the effectiveness of these objectives relates to the extent that they provide students with a representation of the task. However, the findings in this study suggest that it would be appropriate to extend the instructional objective as it is currently used. Objectives have three parts: a performance statement, set of conditions and criteria. To these might be added: the level of processing, the answer format, clear assessment criteria and a representation of the structure of the task. A taxonomy similar to the one used in this study could be used to describe the level of processing required.

The answer format and assessment criteria might be most easily conveyed with sample questions and the structure of the task might be a diagram that synthesises the relationships between the main concepts. Further research on task representation may suggest further refinements or even changes to these suggestions.

2. *Learning strategies should match the type of learning task.* All learning strategies are not equally effective for all tasks. For example, students who used practice strategies for the essay task had poor learning outcomes. Students should be taught how to match task and strategy. This could be done in a learning skills course, but should also be reinforced by teachers of specific subjects.
3. *Students should be taught study management skills.* Students are not necessarily good managers of their learning environment. These skills impact on learning effectiveness and should therefore be taught just as reading and writing skills are.
4. *Students should be taught a range of learning strategies.* There is no systematic attempt to teach learning strategies in the New Zealand education system. The development of these skills seems to depend largely on chance. If students are to learn “*how to do for themselves what teachers typically do for them in the classroom*” (Wendon, 1985: p.7) then they must be given the tools to do the job.

### 9.3 Future Directions

The findings from this study raise a number of issues and questions that would benefit from further study. This last section suggests specific directions for further research into learning strategy use.

1. *The task representation measure (task profile) needs further development.*  
The four scales which measure declarative, investigative, contained and

fragmented task representations need to be refined. Additional task representations should also be sought. The findings from this study provide some guidance for achieving both of these objectives.

2. *Learning strategy selection and use needs to be studied in a wide variety of task contexts.* Four tasks were examined in this study. Identifying strategy use for many different types of task may provide clearer, more generalisable patterns of effective strategy use. From these teachers may be able to teach the appropriate strategies along with the task.

3. *There is a need for a comprehensive framework or model for understanding the appraisal process.* This study identified some of the variables which influence the appraisal process. Undoubtedly there are others. Identifying these and locating them in a framework would facilitate comparisons between studies.

4. *The taxonomy of learning strategies identified in this study needs further verification, in particular that the seven levels identified serve different functional purposes and operate at different levels of cognitive complexity.*

It was proposed that the seven groups of learning strategy were functional in nature and may be used for four types of learning: memorising, comprehension, procedural and hypothesising. Further research needs to verify whether or not this is the case. Although 65 learning strategies were identified, this is unlikely to be a completely comprehensive list. Other learning strategies need to be identified using qualitative methods of data collection so that the strategies may be preserved in the language of the strategy users. Learning strategies used by other cultures would be of particular interest for examining differences in learning between cultures.

---

## References

- Alexander, P.A. & Judy, J.E. (1988) The interaction of domain-specific and strategic knowledge in academic performance. *Review of Educational Research*. 58, 4, 405-437.
- Anderson, J.R. (1982) The architecture of cognition. *Psychological Review*. 89, 369-406.
- Anthony, G. (1991) *Role of assessment in the students' study patterns*. Unpublished Masters Thesis. Massey University, Palmerston North, New Zealand.
- Apps, J. W. (1982) *Study Skills for Adults Returning to School*. New York: McGraw-Hill.
- Baker, L. & Brown, A.L. (1982) Metacognitive skills in reading. In P.D. Pearson (Ed.) *Handbook of reading research*. New York: Longman.
- Baird, J.R. & White, R.T. (1982) Promoting self-control of learning. *Instructional Science*. 11, 227-247.
- Beckwith, J.B. (1991) Approaches to learning, their context and relationship to assessment performance. *Higher Education*. 22, 17-30.
- Bellezza, F.S. (1981) Mnemonic devices: classification, characteristics and criteria. *Review of Educational Research*, 51, 247-275.
- Bellezza, F.S. (1982) Updating memory using mnemonic devices. *Cognitive Psychology*, 14, 301-327.

- Biggs, J.B. (1969) Coding and cognitive behaviour. *British Journal Educational Psychology*. 60, 3, 287-305.
- Biggs, J.B. (1970a) Faculty patterns in study behaviour. *Australian Journal of Psychology*. 22, 161-174.
- Biggs, J.B. (1970b) Personality correlates of certain dimensions of study behaviour. *Australian Journal of Psychology*. 22, 3, 2876-297.
- Biggs, J.B. (1972) Study behaviour and matriculation performance in two school populations. *Australian Journal of Education*. 16, 187-204.
- Biggs, J.B. (1976) Dimensions of study behaviour: Another look at ATI. *British Journal of Educational Psychology*. 46, 68-80.
- Biggs, J.B. (1978) Individual and group differences in study processes. *British Journal Educational Psychology*. 48, 266-279.
- Biggs, J.B. (1985a) The role of metalearning in study processes. *British Journal of Educational Psychology*. 55, 185-212.
- Biggs, J.B. (1985b) *Study Process Questionnaire*. Melbourne: Australian Council for Educational Research.
- Biggs, J.B. (1987) *Student approaches to learning and studying*. Melbourne: Australian Council for Educational Research.
- Biggs, J.B. (1993) What do inventories of students' learning processes really measure? A theoretical review and clarification. *British Journal of Educational Psychology*. 63, 3-19.

- Biggs, J.B. & Collis, K.F. (1982) *Evaluating the quality of learning: The SOLO Taxonomy*. New York: Academic Press.
- Biggs, J.B. & Das, J.P. (1973) Extreme response set, internality-externality and performance. *British Journal of Clinical Psychology*. 12, 199-210.
- Biggs, J.B. & Kirby, J.R. (1984) Differentiation of learning processes within ability groups. *Educational Psychology*. 4, 1,21-39.
- Biggs, J.B. & Telfer, R. (1987) *The process of learning*. Sydney: Prentice-Hall
- Bloom, B.S. & Broder, L.J. (1950) *Problem-solving processes of college students: an exploratory investigation*. Chicago: The University of Chicago Press.
- Bloom, B. S., Englehart, M. D., Furst, E. J., Hill, W. H. & Krathwohl, D. R. (1956) *Taxonomy of educational objectives. Handbook 1: Cognitive domain*. New York: Longmans, Green
- Boekaerts, M. (1987) Situation-specific judgements of a learning task versus overall measures of motivational orientation. In E. de Corts, H. Lodewijks, R. Parmentier & P. Span (Eds.), *Learning and instruction. European research in an international context* Vol 1. Oxford: Lueven University Press & Pergamon Press.
- Bower, G. H. (1970) Analysis of a mnemonic device. *American Psychologist*. 58, 496-510.
- Bracht, G. H. and Glass, G. V. (1968) The external validity of experiments. *American Educational Research Journal*. V, 437-474.

- Brown, A.L., Bransford, J.D., Ferrara, R.A. & Campione, J.C. (1983) Learning, remembering and understanding. In P. Mussen (Series Ed) & J.H. Flavell & E.M. Markman (Vol Eds) *Manual of child psychology: Vol 2. Cognitive development*. New York: Wiley.
- Brown, J.S., Burton, R.R., & deKleer, J. (1982) Pedagogical, natural language and knowledge engineering techniques in SOPHIE I, II, and III. In D. Sleeman & J.S. Brown (Eds) *Intelligent tutoring systems*. London: Academic Press.
- Brown, W. F. & Holtzman, W. H. (1955) A study-attitudes questionnaire for predicting academic success. *Journal of Educational Psychology*. 46, 75-84.
- Brown, W. F. & Holtzman, W. H. (1966) *Manual of the Survey of Study Habits and Attitudes*. New York: The Psychological Corporation.
- Bruner, J. S., Goodnow, J. J. & Austin, G. A. (1956) *A study of thinking*. New York: Wiley.
- Cantwell, R. H. & Moore, P.J. (1991) *The management of learning: The impact of strategy control and approach to learning on final year nursing students*. A paper presented at 1991 Annual Conference of the Australian Association for Research in Education, Gold Coast.
- Cattell, R.B. (1966) The scree test for the number of factors. *Multivariate Behavioural Research*. 1, 245-276.
- Chambers, E. (1992) Work-load and the quality of student learning. *Studies in Higher Education*. 17, 2, 141-153.
- Charles, R. I. & Lester, F. K. Jnr. (1984) An evaluation of a process-oriented instructional program in mathematical problem solving in grades 5 and 7. *Journal for Research in Mathematical Education*. 15, 15-34.

- Chase, W.G. & Simon, H. A. (1973) Perception in chess. *Cognitive Psychology*. 1, 55-81.
- Chi, M.T.H. (1978) Knowledge structures and memory development. In R. Siegler (Ed.) *Children's thinking: What develops* (Vol 1). Hillsdale, NJ: Erlbaum.
- Chi, M.T.H. (1981) Knowledge development and memory performance. In M.P. Friedman, J.P. Das & N. O'Conner (Eds.), *Intelligence and learning*. New York: Plenum.
- Chi, M.T.H. (1985) Interactive roles of knowledge and strategies in the development of organized sorting and recall. In S. F. Chipman, J.W. Segal, & R. Glaser (Eds.), *Thinking and learning skills* (Vol 2). Hillsdale, NJ: Erlbaum.
- Chi, M.T.H. & Ceci, S.J. (1988) Content knowledge: Its role, representation and restructuring in memory development. *Advances in Child Development*. 20, 91-142.
- Chi, M.T.H., Feltovich, P.J. & Glaser, R. (1981) Categorization and representation of physics problems by experts and novices. *Cognitive Science*. 5, 121-152.
- Chi, M.T.H., Glaser, R. & Rees, E. (1982) Expertise in problem solving. In R.J. Sternberg (ed) *Advances in the psychology of human intelligence*. (Vol 1). Hillsdale, NJ: Lawrence Erlbaum.
- Chi, M.T.H. & Koeske, R.D. (1983) Network representation of a child's dinosaur knowledge. *Developmental Psychology*. 19, 29-39.
- Colley, A.M. & Beech, J.R. (1989) Acquiring and performing cognitive skills. In A.M. Colley & J.R. Beech (Eds) *Acquisition and performance of cognitive skills*. New York: John Wiley & Sons.

- Comfrey, A.L. (1973) *A first course in factor analysis*. New York: Academic Press.
- Craik, F.I.M. (1979) Levels of processing: Overview and closing comments. In L.S. Cermak & F.I.M. Craik (Eds), *Levels of processing in human memory*. Hillsdale, NJ: Erlbaum.
- Craik, F.I.M. & Lockhart, R.S. (1972) Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behaviour*. 11, 671-684.
- Craik, F.I.M. & Tulving, E. (1975) Depth of processing and the retention of words in episodic memory. *Journal of Experimental Psychology*. 104, 268-294.
- Cronbach, L.J. (1967). How can instruction be adapted to individual differences? in Robert Gagné (Ed.), *Learning and individual differences*. Columbus, Ohio: Merrill.
- Cronbach, L.J., & Snow, R. (1969). *Individual differences in learning ability as a function of instructional variables*. Stanford University, School of Education.
- Cuff, N.B. (1937) Study habits in grades four to twelve. *Journal of Educational Psychology*. 28, 295-301.
- Dansereau, D. (1978) The development of a learning strategies curriculum. In H. F. O'Neil, Jr. (Ed.), *Learning strategies*. New York: Academic Press.
- Davies, I. K. (1976) *Objectives in Curriculum Design*. Maidenhead: McGraw-Hill

- De Corte, E. & Verschaffel, L. (1981) Children's solution processes in elementary arithmetic problems: Analysis and improvement. *Journal of Mathematical Behaviour*. 4, 3-21.
- de Groot, A.D. (1965) *Thought and choice in chess*. The Hague: Moulton.
- Dewe, P.J. (1993) Coping and the intensity of nursing stressors. *Journal of Community & Applied Social Psychology*. 3, 299-311.
- Duncan, M.J. & Briddle, B.J. (1974) *The study of teaching*. New York: Holt, Rinehart & Winston.
- d'Ydewalle, G. (1984) Motivation and information processing in learning experiments. *Australian Journal of Psychology*. 36, 2, 149-160.
- Elshout, J.J. & Veenman, M.V.J. (1992) Relation between intellectual ability and working method as predictors of learning. *Journal of Educational Research*. 85, 3, 134-143.
- Entwistle, N.J. (1971) Students and their academic performance in different sectors of higher education. In H. Butcher and E. Rudd (Eds) *Higher education in the seventies*. London: McGraw Hill.
- Entwistle, N.J. (1977) Strategies of learning and studying: recent research findings. *British Journal of Educational Studies*. 3, 225-238.
- Entwistle, N.J. (1981) *Styles of learning and teaching* London: Wiley
- Entwistle, N.J. (1982) Study Skills and Independent Learning. *Studies in Higher Education*, 7, 1, 65-73.

- Entwistle, N.J. (1987) A model of the teaching-learning process. In J. T. E. Richardson, M. W. Eysenck & D. W. Piper (Eds.), *Student learning: Research in education and cognitive psychology*. Milton Keynes: SRHE and Open University Press.
- Entwistle, N. J., & Brennan, T. (1971) The academic performance of students: 2 - Types of successful students. *British Journal of Educational Psychology*. 41, 268-276.
- Entwistle, N.J. & Entwistle, D. (1970) The relationships between personality, study methods and academic performance. *British Journal of Educational Psychology*. 40, 132-143.
- Entwistle, N.J., Hanley, M., & Hounsell, D.J. (1979) Identifying distinctive approaches to studying. *Higher Education*, 8, 129-148.
- Entwistle, N. J. & Hounsell, D. J. (1979) Student learning in a natural setting. *Higher Education*. 8, 359-363.
- Entwistle, N. J., Nisbet, J., Entwistle, D. & Cowell, M. D. (1971) The academic performance of students: 1 - Prediction from scales of motivation and study methods. *British Journal of Educational Psychology*. 41, 258-267.
- Entwistle, N.J. & Ramsden, P. (1983) *Understanding student learning*. Beckenham, Kent: Croom Helm.
- Entwistle, N.J. & Robinson, M. (1977) Personality, cognitive style and student learning strategies. In A Bonoir (Ed), *Proceedings of the Second Annual Congress of the European Association for Research and Development in Higher Education*. University of Louvain-la-Neuve.

- 
- Entwistle, N.J. & Tait, H. (1990) Approaches to learning, evaluations of teaching, and preferences for contrasting academic environments. *Higher Education*. 19, 169-194.
- Entwistle, N.J. & Waterston, S. (1988) Approaches to studying and levels of processing in university students. *British Journal of Educational Research*. 58, 258-265.
- Entwistle, N. J. & Welsh, J. (1969) Correlates of school attainment at different ability levels. *British Journal of Educational Psychology*. 39, 57-63.
- Ericsson, K. A., & Simon, H. A. (1984) *Protocol analysis: Verbal reports as data*. Cambridge, MA: MIT Press.
- Feltz, D.L. & Landers, K.M. (1983) The effects of mental practice on motor skill learning and performance: A meta-analysis. *Journal of Sports Psychology*. 5, 25-57.
- Fishman, J. A. (1962) Social-psychological theory for selecting and guiding college students. In N. Stanford (Ed), *The American college*. New York: Wiley.
- Fitts, P.M. & Posner, M. (1967) *Human performance*. Belmont, California: Brooks, Cole.
- Flower, L. (1981) *Problem-solving strategies for writing*. New York: Harcourt Brace Jovanovich.
- Fransson, A. (1977) On qualitative differences in learning: IV - effects of intrinsic motivation and extrinsic test anxiety on process and outcome. *British Journal Educational Psychology*. 47, 244-257.

- Fraser, C., Bellugi, U. & Brown, R. (1963) Control of grammar in imitation, comprehension and production. *Journal of Verbal Learning and Verbal Behaviour*. 2, 121-135.
- Frenkel-Brunswik, E. (1949) Intolerance of ambiguity as an emotional and perceptual variable. *Journal of Personality*. 18, 108-143.
- Gagné, R. M. (1962). The acquisition of knowledge. *Psychological Review*. 69, 355-365.
- Gagné, R. M. (1965) The analysis of instructional objectives for the design of instruction. In R. Glaser (Ed.), *Teaching machines and programmed learning, II: Data and directions*. Washington, D.C.: National Education Association.
- Gagné, R.M. (1967). *Learning and individual differences*. Columbus, Ohio: Charles E. Merrill Books.
- Gagné, R.M. (1970). *The conditions of learning* (2nd ed). New York: Holt, Rinehart & Winston.
- Gagné, R. M. (1980) Learnable aspects of problem solving. *Educational Psychologist*. 15, 84-92.
- Gagné, R. M. (1988) Some reflections on thinking skills. *Instructional Science*. 17, 387-390.
- Gagné, R. M. & Briggs, L. J. (1979) *Principles of instructional design*. New York: Holt, Rinehart and Winston.

- Gagné, E. D., Crutcher, R. J., Anzels, J., Geisman, C., Hoffman, V. D., Schutz, P. & Lizcano, L. (1987) The role of student processing of feedback in classroom achievement. *Cognition and Instruction*. 4, 3, 167-186.
- Gagné, R.M. & Glaser, R.G. (1987) Foundations in learning research. In R. Gagné (Ed), *Instructional technology: Foundations*. Hillsdale, New Jersey: Lawrence Erlbaum.
- Gay, G (1986) Interaction of learner control and prior understanding in computer-assisted video instruction. *Journal of Educational Psychology*. 78, 225-227.
- Glaser, R. (1970). Individual Differences in Learning in K. Allen Neufeld (Ed.) *Individualised curriculum and instruction: Proceedings of the Third Invitational Conference on Elementary Education*. Edmonton, Alberta: University of Alberta.
- Glaser, R. (1984) Education and thinking: the role of knowledge. *American Psychologist*, 39, 93-104.
- Glaser, R. (1987a) Learning theory and theories of knowledge In E. de Corte, H. Lodewijks, R. Parmentier & P. Span (Eds), *Learning and instruction: European research in the international context*: Vol 1. Oxford: Leuven University Press.
- Glaser, R. (1987b) Thoughts on expertise In C. Schooler & W. Schaie (Eds), *Cognitive functioning and social structure over the life course*. Norwood, NJ: Ablex Publishing Corp.
- Glaser, R. (1988a) Intelligence as an expression of acquired knowledge (expertise). Paper presented to a seminar at Massey University, Palmerston North, New Zealand.

- Glaser, R. (1988b) The reemergence of learning theory within instructional research. American Psychology Association's Distinguished Scientific Award for the Applications of Psychology Address. August 15, 1988, Atlanta, Georgia.
- Goldman, R. D. and Warren, R. (1973) Discriminant analysis of study strategies connected with college grade success in different major fields. *Journal of Educational Measurement*. 10, 39-48.
- Gorush, R.L. (1983) *Factor analysis*. Hillsdale, NJ: Lawrence Erlbaum.
- Greeno, J.G., Magone, M.E., & Chaiklin, S. (1979) Theory of constructions and set in problem solving. *Memory & Cognition*. 7, 445-461.
- Hakstian, A.R. (1971) The effects of type of examination anticipated on test preparation and performance. *Journal of Educational Research*. 64, 319-324.
- Hall, C.R., Rodgers, W.M. & Barr, K.A. (1990) The use of imagery by athletes in selected sports. *The Sport Psychologist*. 4, 1-10.
- Haller, E. P., Child, D. A. & Walberg, H. J. (December, 1988) Can comprehension be taught? A quantitative synthesis of "metacognitive" studies. *Educational Researcher*. 5-8.
- Harper, G. & Kember, D. (1986) Approaches to the study of distance education students. *British Journal of Educational Technology*. 17, 212-222.
- Hattie, J. & Watkins, D. (1981) Australian and Filipino investigations of the internal structure of Biggs' new Study Process Questionnaire. *British Journal of Educational Psychology*. 51, 241-244.

- Heinich, R. (1970) Technology and the management of instruction. *Monograph 4 of Association for Educational Communications and Technology*. Washington, D.C.
- Hill, G. L. C. (1981) Through a glass darkly: A naturalistic study of students' understanding of mathematical word problems. *Instructional Science*, 10, 67-93.
- Holtzman, W. H., Brown, W. F. & Farquhar, W. G. (1954) The survey of study habits and attitudes: A new instrument for the prediction of academic success. *Educational and Psychological Measurement*, 14, 726-732.
- Hounsell, D.J. (1984) Learning and essay-writing. In F. Marton et al (Eds), *The experience of learning*. Edinburgh:Scottish Academic Press.
- Hudson, L. (1966) *Frames of mind*. London: Methuen.
- Hunt, G.J.F. (1976). *The interaction of achievement orientations and content familiarity with hierarchically structured programmes*. Unpublished Ph. D. Thesis. Massey University, Palmerston North, New Zealand.
- Hunt, G.J.F. (1986). Needs assessment in adult education: tactical and strategic considerations. *Instructional Science*, 15, 287-296.
- Hunt, L. M. (1991) Information processing in ab initio pilot training. *Proceedings of the Sixth International Symposium on Aviation Psychology*. Ohio: University of Ohio.
- Hunt, L. M. (1992) ALI: Approaches to Learning Inventory. Massey University. Unpublished inventory.

- Hunt, L. M. (1993) New diagnostic tools for measuring learning behaviours in pilot trainees. *Proceedings of the Seventh International Symposium on Aviation Psychology*. Ohio: University of Ohio.
- Jansweijer, W. Elshout, J.J. & Wielinga, B.J. (1990) On the multiplicity of learning to solve problems. In H. Mandl, E. de Corte, N. Bennet, & H.F. Friedrich (Eds), *Learning and instruction. Vol 2: Social and cognitive aspects of learning and instruction*. Oxford: Pergamon Press.
- Jonassen, D. H. (1985) Learning strategies: a new educational technology. *PLET*. 22, 1,26-34.
- Justice, E.M. & Weaver-McDougall, R.G. (1989) Adults' knowledge about memory: Awareness and use of memory strategies across tasks. *Journal of Educational Psychology*. 81, 2, 214-219.
- Kaiser, H.F. (1974) An index of factorial simplicity. *Psychometrika*. 39, 31-36.
- Keisler, E. R. (1960) A descriptive approach to classroom motivation. *The Journal of Teacher Education*. 11, 310-314.
- Kember, D. & Gow, L. (1989) A model of student approaches to learning encompassing ways to influence and change approaches. *Instructional Science*. 18, 263-288.
- Knowles, M (1983) Andragogy: an emerging technology for adult learning. In M. Tight (Ed), *Adult learning and education*. Kent: The Open University.
- Kropp, R. P., Stoker, H. W. & Bashaw, W. L. (1966) The validation of the "Taxonomy of educational objectives". *Journal of Experimental Education*. 34, 69-76.

- Langan, J. & Nadell, J. (1980) *Doing well in college*. New York: McGraw-Hill.
- Larkin, J., McDermott, J., Simon, D.P., & Simon, H.A. (1980) Expert and novice performance in solving physics problems. *Science*. 208, 1335-1342.
- Laurillard, D.M. (1979) The process of student learning. *Higher Education*. 8, 395-409.
- Laurillard, D.M. (1984) Learning from problem solving. In F. Marton, D.J. Hounsell & N.J. Entwistle (Eds), *The experience of learning*. Edinburgh: Scottish Academic Press.
- Locke, N.M. (1940) The student skills inventory: a study habits test. *Journal of Applied Psychology*. 24, 493-504.
- Lockhart, R.S., Craik, F.I.M. & Jacoby, L.L. (1976) Depth of processing in recognition and recall: Some aspects of a general memory system. In J. Brown (Ed.), *Recognition and recall*. London: Wiley.
- Lundeberg, M.A. (1987) Metacognitive aspects of reading comprehension: Studying, understanding in legal case analysis. *Reading Research Quarterly*. 22, 407-432.
- Lundeberg, M. A. & Fox, P. W. (1991) Do laboratory findings on test expectancy generalise to classroom outcomes? *Review of Educational Research*. 61, 1, 94-107.
- Madaus, G. F. Woods, E. M. & Nuttall, R. L. A. (1973) A causal model analysis of Bloom's taxonomy. *Educational Research Journal*. 10, 253-262.
- Maddox, H. (1963) Advice on how-to-study versus the actual practice of university students. *Perceptual and Motor Skills*. 16, 202.

- Mager, R. F. (1962) *Preparing objectives for programmed instruction*. Belmont, California: Fearon.
- Maier, N. R. F. (1949) *Frustration*. New York: McGraw-Hill.
- Marland, P. W. & Edwards, J. (1986) Students' in-class thinking. *Instructional Science*. 15, 75-88.
- Marland, P. W. & Edwards, J. (1986) Students' in-class thinking. *Instructional Science*. 15, 75-88.
- Martin, E & Ramsden, P. (1987) Learning skills or skills in learning? In J.T.E. Richardson, M.W. Eysenck and D. Warren Piper (Eds), *Student learning: Research in education and cognitive psychology*. Milton Keynes: SRHE and Open University Press.
- Marton, F. & Säljö, R. (1976a) On qualitative differences in learning I: Outcome and process. *British Journal of Educational Psychology*. 46, 4-11.
- Marton, F. & Säljö, R. (1976b) On qualitative differences in learning II: Outcome as a function of the learner's conception of the task. *British Journal of Educational Psychology*. 46, 115-127.
- Marton, F., Carlsson, M. A. & Halász, L. (1992) Differences in understanding and the use of reflective variation in reading. *British Journal of Educational Psychology*. 62, 1-16.
- McKay, R. (1978) Effectiveness of learning: The place of study. In D. W. Piper (Ed), *The efficiency and effectiveness of teaching in higher education*. London: University of London, Institute of Education.

- Melton, R. F. (1978) Resolution of conflicting claims concerning the effect of behavioural objectives on student learning. *Review of Educational Research*. 48, 2, 291-302.
- Merril, P. (1987) Job and task analysis. In R. Gagné (Ed), *Instructional technology: Foundations*. Hillsdale, New Jersey: Lawrence Erlbaum.
- Merrill, M.D. (1983) Component display theory. In C.M. Reigeluth's (Ed), *Instructional-design theories and models: An overview of their current status*. Hillsdale, NJ: Lawrence Erlbaum.
- Meyer, G. (1934) An experimental study of the old and new types of examination: I- The effect of the examination set on memory. *Journal of Educational Psychology*. 25, 641-661.
- Meyer, G. (1936) An experimental study of the old and new types of examination: II-Methods of study. *Journal of Educational Psychology*. 26, 30-40.
- Miller, C.D., Finley, J. & McKinley, D.L. (1990) Learning approaches and motives: male and female differences and implications for learning assistance programs. *Journal of College Student Development*. 31, 147-154.
- Miller, R.B. (1962) Analysis and specification of behaviour for training. In R. Glaser (Ed.), *Training research and education*. Pittsburgh: University of Pittsburgh Press.
- Minsky, M. & Papert, S. (1974) *Artificial intelligence*. Condon Lectures, Oregon State System of Higher Education, Eugene OR.
- Montague, W.E. (1972) Elaborative strategies in verbal learning and memory. In G.H. Bower's (Ed), *The psychology of learning and motivation* (Vol 6). New York: Academic Press.

- Moreno, V. & Di Vesta, F.J. (1991) Cross-cultural comparisons of study habits. *Journal of educational psychology*. 83, 2, 231-239.
- Naiman, N., Fröhlich, M., Stern, H. H., Todesco, A. (1978) *The Good Language Learner*. Toronto: Ontario Institute for Studies in Education.
- Naveh-Benjamin, M., McKeachie, W., & Lin, Y. (1987) Two types of test-anxious students: Support for an information processing model. *Journal of Educational Psychology*. 79, 2, 131-136.
- Nevo, B. (1985) *Face validity revisited*. *Journal of Educational Measurement*. 22, 4, 287-293.
- Newell, A. & Simon, H. A. (1972) *Human problem solving*. Englewood Cliffs, New Jersey: Prentice-Hall.
- Newstead, S.E. (1992) A study of two "quick-and-easy" methods of assessing individual differences in student learning. *British Journal of Educational Psychology*. 62, 299-312.
- Norusis, M.J. (1988) *SPSS/PC+ V2 base manual*. Chicago: SPSS Inc.
- Norusis, M.J. (1990) *SPSS/PC+ statistics 4.0*. Chicago: SPSS Inc.
- O'Neil, M.J. & Child, D. (1984) Biggs' SPQ: A British study of its internal structure. *British Journal of Educational Psychology*. 54, 228-234.
- Ornstein, P.A. & Naus, M.J. (1985) Effects of the knowledge base on children's memory strategies. In H.W. Reese (Ed.), *Advances in child development and behaviour*. Vol. 19. New York: Academic Press.

- Owen, E. & Sweller, J. (1985) What do students learn while solving mathematics problems. *Journal of Educational Psychology*. 77, 272-284.
- Pask, G. (1976) Styles and strategies of learning. *British Journal of Educational Psychology*. 46, 128-148.
- Perry, W. G. (1970) *Forms of intellectual and ethical development in the college years: a scheme*. New York: Holt, Rinehart and Winston.
- Peterson, P. L. & Swing, S. R. (1983) Problems in classroom implementation of cognitive strategy instruction. In M. Pressley & J. R. Levin (Eds.), *Cognitive strategy research*. New York: Springer-Verlag.
- Peverly, S.T. (1991) Problems with the knowledge-based explanation of memory and development. *Review of Educational Research*. 61, 1, 71-93.
- Piaget, J. (1950). *The psychology of intelligence*. London:Routledge & Kegan Paul.
- Piaget, J. (1963) *The origins of intelligence in children*. New York: Norton.
- Pines, A. L. and West, L. H. T. (1986) Conceptual understanding and science learning: An interpretation of research within a sources-of-knowledge framework. *Science Education*, 70, 583-604.
- Prawat, R. S. (Spring, 1989) Promoting access to knowledge, strategy, and disposition in students: A research synthesis. *Review of Educational Research*. 59, 1, 1-41.
- Pressley, M., Levin, J. R. & Ghatala, E. S. (1988) Strategy-comparison opportunities promote long-term strategy use. *Contemporary Educational Psychology*. 13, 157-168.

- Prosser, M. (1993) Phenomenography and the principles and practices of learning. *Higher Education, Research and Development*. 12, 1, 21-31.
- Rabinowitz, M. (1988) On teaching cognitive strategies: The influence of accessibility of conceptual knowledge. *Contemporary Educational Psychology*. 13, 229-235.
- Rabinowitz, M., & Chi, M.T.H. (1987) An interactive model of strategy processing. In S.J. Ceci (Ed), *Handbook of cognitive, social, and neuropsychological aspects of learning disabilities*. Hillsdale, NJ: Lawrence Erlbaum.
- Ramsden, P. (1988) Studying learning: Improving teaching. In P. Ramsden (Ed.), *Improving learning: New Perspectives*. London: Kogan Page.
- Ramsden, P., Beswick, D. & Bowden, J. (1987) Learning processes and learning skills. In F. Marton et al (Eds), *The experience of learning*. Edinburgh: Scottish Academic Press.
- Reese, H. W. and Overton, W. F. (1970) Models of development and theories of development. In L. Goulet & P. B. Bates (Eds), *Life span developmental psychology: Theories and research*. New York: Academic Press.
- Reigeluth, C.M (1983) The elaboration theory of instruction. In C.M. Reigeluth (Ed.) *Instructional-design theories and models: An overview of their current status*. Hillsdale, NJ: Lawrence Erlbaum.
- Reiser, R. A. (1987) Instructional technology: A history. In R. M. Gagné (Ed.), *Instructional technology: Foundations*. Hillsdale, New Jersey: Lawrence Erlbaum.
- Richardson, A. (1967a) Mental practice: A review. Part I. *Research Quarterly*. 38, 95-107.

- Richardson, A. (1967b) Mental practice: A review and discussion. Part II. *Research Quarterly*. 38, 263-273.
- Richardson, J.T.E. (1993) Gender differences in responses to the Approaches to Studying Inventory. *Studies in Higher Education*. 18, 1, 3-13.
- Rigney, J. W. (1978) Learning strategies: a theoretical perspective. In H. F. O'Neil, Jr. (Ed), *Learning strategies*. New York: Academic Press.
- Rokeach, M.(1960) *The open and closed mind*. New York: Basic Books
- Rothkopf, E.Z. (1968) Two scientific approaches to the management of instruction. In R. Gagné and W. Gephart (Eds.), *Learning research and school subjects*. Illinois: Peacock.
- Rothkopf, E.Z. (1971) Experiments on mathemagenic behaviour and the technology of written instruction. In E. Z. Rothkopf & P. E. Johnson. *Verbal learning research and the technology of written instruction*. New York: Teachers College.
- Rovegno, I. (1993) Content knowledge acquisition during undergraduate teacher education: Overcoming cultural templates and learning through practice. *American Educational Research Journal*. 30, 3, 611-642.
- Sax, G. (1989) *Principles of educational and psychological measurement and evaluation*. Belmont, CA: Wadsworth
- Schneider, W. (1985) Training high-performance skills: fallacies and guidelines. *Human Factors*. 27, 285-300.

- Schroder, H. Driver, M. and Streufert, S. (1967) *Human information processing*. New York: Holt, Rinehart and Winston.
- Schurr, K.T. & Henriksen, L.W. (1983) Effects of item sequencing and grouping in low-inference types questionnaires. *Journal of Educational Measurement*. 20, 4, 379-391.
- Seddon, G.M. (1978) Properties of Bloom's Taxonomy of Educational Objectives for the cognitive domain. *Review of Educational Research*. 48, 2, 303-323.
- Selmes, I. (1987) *Improving study skills*. London: Hodder & Stoughton.
- Shriffin, R.M. & Dumais, S.T. (1981) The development of automatism. In J.R. Anderson (Ed), *Cognitive skills and their acquisition*. Hillsdale, NJ: Lawrence Erlbaum.
- Shuell, T. J. (1986) Cognitive conceptions of learning. *Review of Educational Research*, 56, 411-436.
- Siegler, R.S. (1985) Encoding and the development of problem solving. In S. F. Chipman, J. W. Segal & R. Glaser (Eds.), *Thinking and learning skills Vol 2 Research and open questions*. Hillsdale, New Jersey: Lawrence Erlbaum Associates.
- Siegler, R.S. (1986) *Children's thinking*. Englewood Cliffs, NJ: Prentice-Hall.
- Siegler, R.S. & Klahr, D. (1982) When do children learn? The relationship between existing knowledge and the acquisition of new knowledge. In R. Glaser (Ed), *Advances in instructional psychology* Vol 2. Hillsdale, NJ: Lawrence Erlbaum.

- Siegler, R.S. & Richards, D.D. (1982) The development of intelligence. In R.J. Sternberg (Ed.). *Handbook of human intelligence*. Cambridge, England: Cambridge University Press.
- Singer, R.N. (1978) Motor skills and learning strategies. In H.F. O'Neil, Jr. (Ed), *Learning strategies*. New York: Academic Press.
- Skinner, B. F. (1953) *Science and human behaviour*. New York: Macmillan.
- Skinner, B. F. (1954) The Science of Learning and the Art of Teaching. *Harvard Educational Review*. 24, 86-97.
- Skinner, B. F. (1968) *The technology of teaching*. New York: Appleton.
- Smith M.U. & Good, R. (1984) Problem solving and classical genetics: Successful versus unsuccessful performance. *Journal of Research in Science Teaching*, 21, 895-912.
- Snow, R. E. & Lohman, D. F. (1984) Toward a theory of cognitive aptitude for learning from instruction. *Journal of Educational Psychology*. 76, 347-376.
- Spring, C. (1985) Comprehension and study strategies reported by university freshmen who are good and poor readers. *Instructional Science*. 14, 157-167.
- Sternberg, R. J. (1984) Toward a triarchic theory of human intelligence. *The Behavioural and Brain Sciences*. 7, 269-315.
- Svensson, L. (1977) On qualitative differences in learning: III - study skill and learning. *British Journal Educational Psychology*. 47, 233-243.

- Sweller, J & Levine, D.M. (1982) Effects of goal specificity on means-end analysis and learning. *Journal of Experimental Psychology: Learning, Memory and Cognition*. 8, 5, 463-474.
- Swing, S., Stoiber, K. & Peterson P.L. (1988) Thinking skills versus learning time: Effects of alternative classroom-based interventions on students' mathematics problem solving. *Cognition and Instruction*. 5, 123-191.
- Tabachnick, B.G. & Fidell, L.S. (1989) *Using multivariate statistics*. New York: HarperCollins.
- Thurstone, L.L. (1947) *Multiple factor analysis*. Chicago: University of Chicago Press.
- Trigwell, K. & Prosser, M. (1991) Improving the quality of student learning: the influence of learning context and student approaches to learning on learning outcomes. *Higher Education*. 22, 251-266.
- Tulving, E. & Donaldson, W. (Eds) (1972) *Organisation of memory*. New York: Academic Press.
- Tulving, E. (1983) *Elements of episodic memory*. New York: Oxford University Press.
- Vallance, T.B. (1947) A comparison of essay and objective examinations as learning experiences. *Journal of Educational Research*. 41, 279-288.
- Volet S. E. & Chalmers, D. (1992) Investigation of qualitative differences in university students' learning goals, based on an unfolding model of stage development. *British Journal of Educational Psychology*. 62, 17-34.

- Voss, J.F., Blais, J., Means, M.L., Greene, T.R. & Ahwash (1986) Informal reasoning and subject matter knowledge in the solving of economic problems by naive and novice individuals. *Cognition and Instruction*. 3, 269-302.
- Wang, M. C., Haertel, G. D. & Walberg, H. J. (1990) What influences learning? A content analysis of review literature. *Journal of Educational Research*. 84, 1, 30-43.
- Watkins, D (1982a) Academic achievement and the congruence of study motivation and strategy. *British Journal of Educational Psychology*. 52, 260-263.
- Watkins, D (1982b) Identifying the study process dimensions of Australian university students. *Australian Journal of Education*. 26, 1, 76-85.
- Watkins, D (1983) *Depth of processing and the quality of learning outcomes*. *Instructional Science*. 12, 49-58.
- Watkins, D & Hattie, J. (1985) A longitudinal study of the approaches to learning to Australian tertiary students. *Human Learning*. 4, 27-141.
- Watkins, D & Morstain, B. (1980) The educational orientations of lecturers and their students: A case study of an Australian university. *Australian Journal of Education*. 24, 155-163.
- Watts, G.H. & Anderson, R.C. (1971) Effects of three types of inserted questions on learning from prose. *Journal of Educational Psychology*. 62, 387-394.
- Weiner, E. L. (1988) Cockpit automation. In E.L. Wiener & D. C. Nagel (Eds), *Human factors in aviation*. San Diego, CA: Academic Press

- Weinstein, C. E., (1978) Elaboration skills as a learning strategy. In H. F. O'Neil, Jr. (Ed), *Learning strategies*. New York: Academic Press.
- Weinstein, C. E., (1987) *LASSI - Learning and Study Strategies: Users' manual*. Clearwater, Florida: H&H Publishing Co.
- Weinstein, C. E., Schulte, A. C. & Palmer, D. R. (1987) *LASSI - Learning and Study Strategies Inventory*. Clearwater, Florida: H&H Publishing Co.
- Weinstein, C.E., Underwood, V.L., Wicker, F.W. & Cubberly, W.E. (1979) Cognitive learning strategies: Verbal and imaginal elaborations. In H.F. O'Neil, Jr., & Spielberger, C.D. (Eds), *Cognitive and affective learning strategies*. New York: Academic Press.
- Weir, M. W. (1964) Developmental changes in problem-solving strategies. *Psychological Review*. 71, 473-490.
- Welford, AT. (1965) Stress and achievement. *Australian Journal of Psychology*. 17,1-11.
- Wendon, A (1985) Learner strategies. *TESOL Quarterly*. 19, 5, 1-7.
- White, C. J. (1993) *Metacognitive, cognitive, social and affective strategy use in foreign language learning: A comparative study*. Unpublished Ph. D. Thesis. Massey University, Palmerston North, New Zealand.
- Wilson, V.L. (1989) Cognitive and developmental effects on item performance in intelligence and achievement tests for young children. *Journal of Educational Measurement*. 26, 2, 103-119.
- Wittrock, M.C. (1974) Learning as a generative process. *Educational Psychology*. 11, 87-95.

- Wittrock, M.C. (1978) The cognitive movement in psychology. *Educational Psychology*. 13, 15-29.
- Wood, G. (1967) Mnemonic systems in recall. *Journal of Educational Psychology*. 58, 6, 1-27.
- Yaney, J. P. (1974) A critical review of the instructional technology mechanism of task analysis. *Improving Human Performance*. 3, 64-70.
- Zhu, X. & Simon, H.A. (1987) Learning mathematics from examples and by doing. *Cognition and Instruction*. 4, 3, 137-166.
- Zimmerman, B.J. (1989) A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*. 81, 3, 329-339.



## APPENDIX A

## Learning Strategies from LASSI

Scale	Item	Learning Strategy
Information Processing	12. I try to think through a topic and decide what I'm suppose to learn from it rather than just read it over when studying.	Identify main or significant points
	15. I learn new words or ideas by visualising a situation in which they occur.	visualising/applying to real world situations.
	23. I translate what I am studying into my own words.	explain ideas to yourself
	32. When I am studying a topic I try to make everything fit together logically.	work out how ideas are related to each other
	40. I try to find relationships between what I am learning and what I already know.	relate ideas to own knowledge or experience of a problem or situation
	47. I try to relate what I am studying to my own experiences.	relate ideas to own knowledge or experience of a problem or situation
	67. I try to see how what I am studying would apply to my everyday living.	think how you might use the information in some aspect of your life
	76. I try to interrelate themes in what I am studying.	relate ideas to other subjects/work out how ideas are related to each other
Selecting main idea	2. I am able to distinguish between more important information and less important information during a lecture.	identify main or significant points
	8. I try to identify the main points when I listen to lectures	identify main or significant points
	60. It is hard for me to decide what is important to underline in a text.	underline or high-light points/identify key words and phrases
	72. Often when I am studying I seem to get lost in details and "can't see the forest for the trees".	get basic overall picture overall picture then fill in details/take notes point by point and learn each
	77. I have difficulty identifying the important points in my reading	identify main or significant points

Study aids	7. I use special study helps, such as italics and headings, that are in my textbook.	use headings and sub-headings
	19. My underlining is helpful when I review text material.	underline or high-light points
	44. I key in on the first and/or last sentences of most paragraphs when reading my text.	identify key words and phrases/identify main or significant points
	50. I make drawings or sketches to help me understand what I am studying.	change notes into diagrams
	53. I make simple charts, diagrams, or tables to summarise material in my courses.	change notes into diagrams
	62. I use chapter headings as a guide to identify important points in my reading.	identify main or significant points
Self testing	4. After class, I review my notes to help me understand the information.	read over notes
	17. When preparing for an exam, I create questions that I think might be included.	ask yourself questions to test understanding
	21. I try to identify potential test questions when reviewing my class material.	ask yourself questions to test understanding
	26. I review my notes before the next class.	read over notes
	30. I stop periodically while reading and mentally go over or review what was said.	summarise information/explain ideas to yourself
	65. I test myself to be sure I know the material I have been studying.	ask yourself questions to test understanding
	70. I go over homework assignments when reviewing class materials.	complete set exercises/assignments
Test strategies	27. I am unable to summarise what I have just heard in a lecture or read in a textbook.	summarise information
	64. I memorise grammatical rules, technical terms, formulas, etc. without understanding them.	memorise until you can recall without error

## APPENDIX B

## Learning Strategies from the SPQ

Scale	Item	Learning strategy
Surface strategy	4. I think browsing around is a waste of time, so I only study seriously what's given out in class or in the course outline.	read more widely on the subject
	10. I learn some things by rote, going over and over them until I know them by heart.	memorise until you can recall without error/copy out notes, diagrams, words/ reciting
	22. I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra.	get more background information to help understanding/ read more widely on the subject/ find out more about the context in which the ideas were developed/ talk to other people about the topic or subject/ collect extra information from a variety of sources.
	34. I find it best to accept the statements and ideas of my lecturers and question them only under special circumstances.	relate ideas to own knowledge or experience of the problem or situation/ relate ideas to other subjects/ relate ideas to own views, beliefs, or emotional reactions
	40. I am very aware that lecturers know a lot more than I do and so I concentrate on what they say is important rather than rely on my own judgement.	relate ideas to own knowledge or experience of the problem or situation/ relate ideas to other subjects/ relate ideas to own views, beliefs, or emotional reactions

Scale	Item	Learning Strategy
Deep strategies	5. While I am studying I often think of real life situations to which the material that I am learning would be useful.	apply to real world situations/ think how you might use the information in some aspect of your life
	11. In reading new material I often find that I'm continually reminded of material I already know and see the latter in a new light.	relate ideas to other subjects
	17. I find that I have to do enough work on a topic so that I can form my own point of view before I am satisfied.	relate to own views, beliefs or emotional reactions
	23. I try to relate what I have learned in one subject to that in another.	relate to ideas in other subjects
	29. I find most new topics interesting and often spend extra time trying to obtain more information about them.	get more background information to help understanding/ read more widely on the subject/ find out more about the context in which the ideas were developed/ talk to other people about the topic or subject/ collect extra information from a variety of sources.
	35. I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.	get more background information to help understanding/ read more widely on the subject/ find out more about the context in which the ideas were developed/ talk to other people about the topic or subject/ collect extra information from a variety of sources.
	41. I try to relate new material, as I am reading it, to what I already know on that topic.	relate to own knowledge or experience of a problem or situation

## APPENDIX C

## Learning Strategies from SASI

Scale	Item	Learning Strategy
Deep Approach	4. In written work I try to put over my own view whenever possible	relate ideas to own views, beliefs or emotional reactions
	9. I try to identify the underlying meaning in what I read	identify main or significant points
	13. When revising I try to summarise the material.	summarise information
	18. I piece together notes from a variety of sources.	collect extra information from a variety of sources
	22. I try to discuss with others a topic that I am trying to revise.	talk to other people about topic or subject
	27. When writing I consider how the various aspects link together.	work out how ideas are related to each other
	32. I try to include my own view whenever possible, in making notes.	relate ideas to own views, beliefs or emotional reactions
	37. I try to summarise the material when I make notes	summarise information
	42. When reading I try to work out the connections between different aspects I come across.	work out how ideas are related to each other
	47. When revising I consider how the various aspects link together.	work out how ideas are related to each other
	51. I try to summarise the material in my written work	summarise information
	55. Often I ask myself questions about the things I hear in lessons or read in books.	ask yourself questions to check understanding

Surface Approach	2. I try to memorise everything when I revise	memorise until you can recall without error
	16. I make notes only about the points I shall have to learn.	get more background information to help understanding/ read more widely on subject/ collect extra information from a variety of sources
	20. When reading I try to memorise everything.	memorise until you can recall without error
	40. When I read I concentrate on the facts.	identify key words and phrases
	45. I try to memorise my written work.	memorise until you can recall without error
	54. I concentrate on the facts when revising.	identify key words and phrases

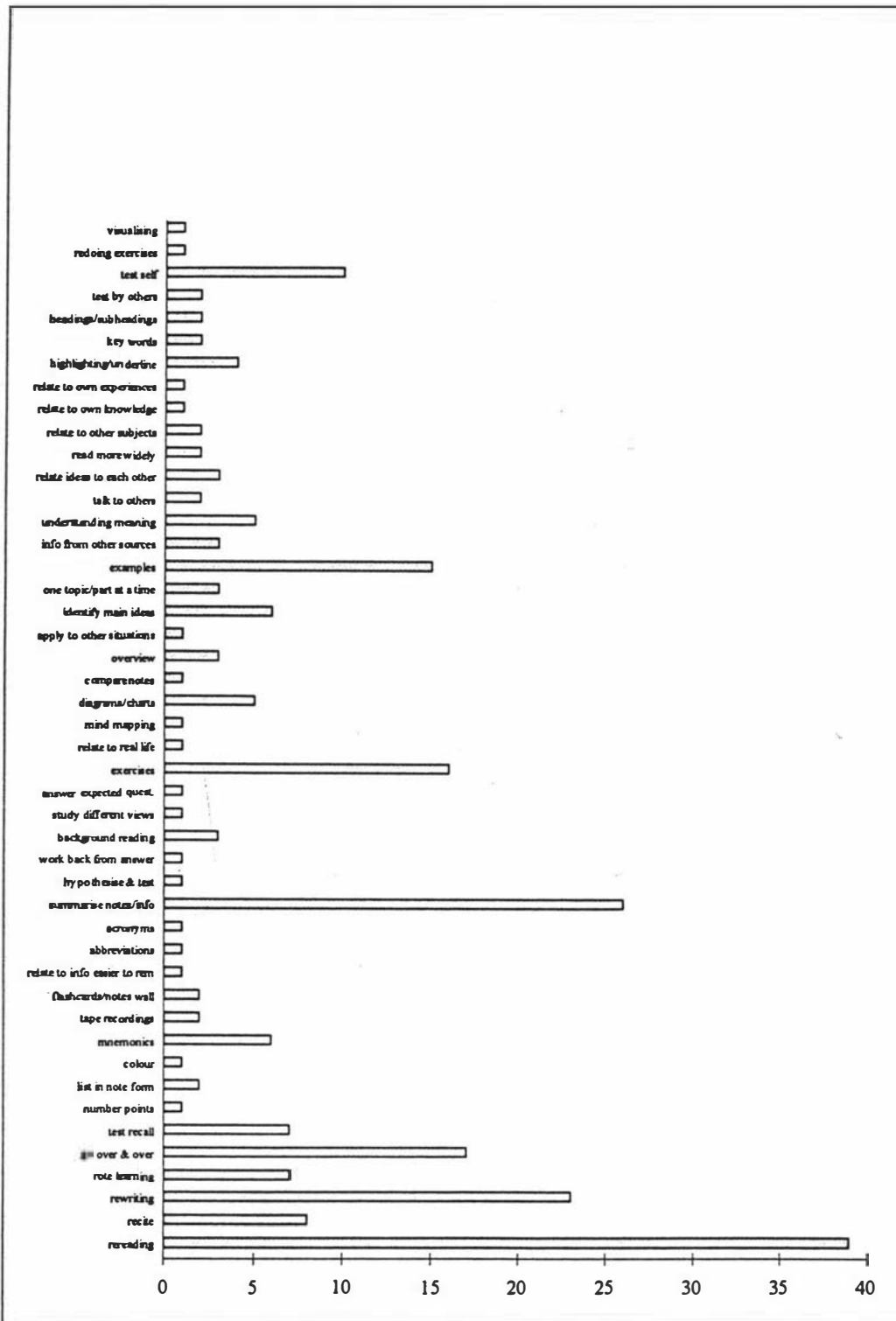
## APPENDIX D

### Learning Strategies from Spring

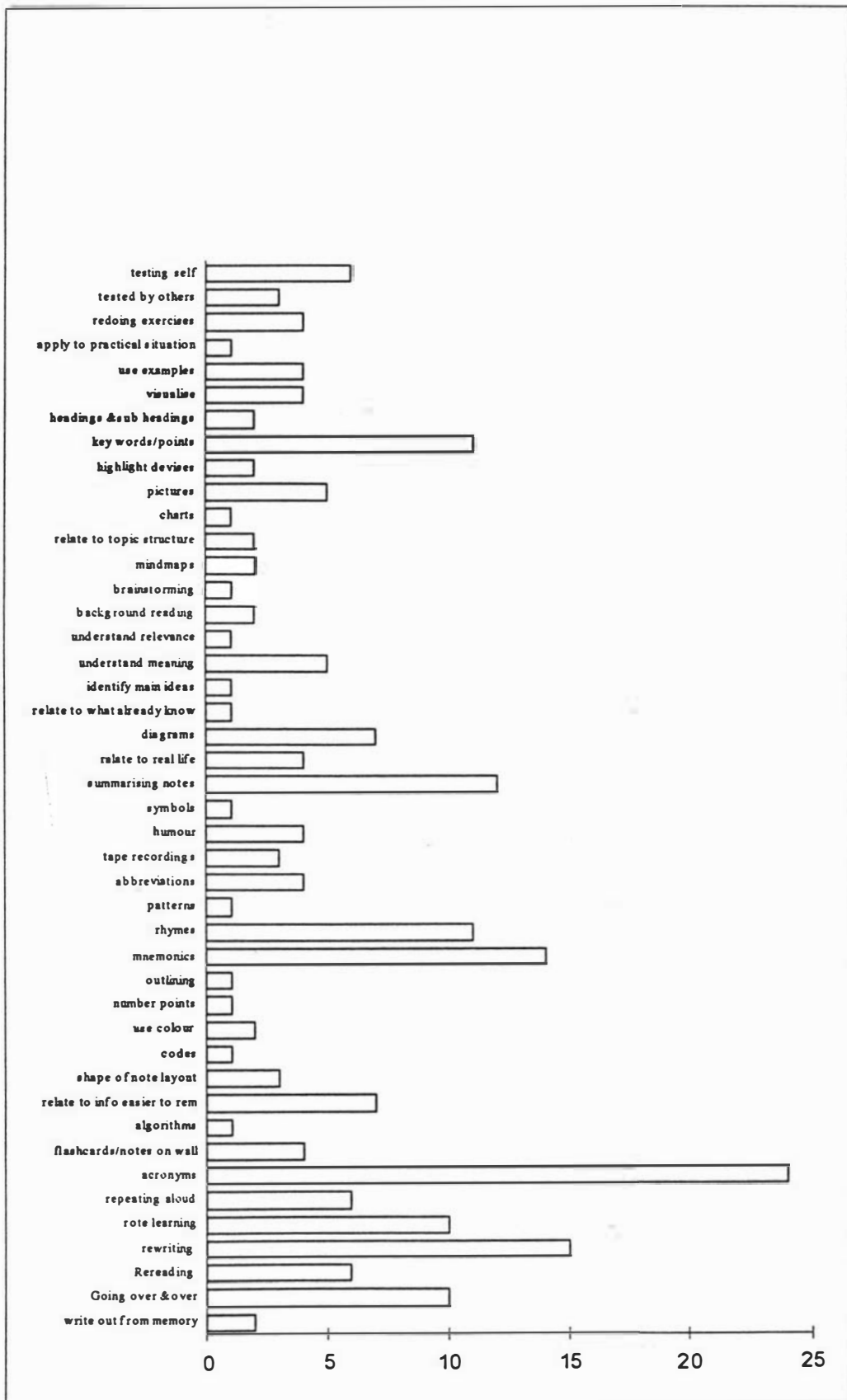
Scale	Learning Strategy
Comprehension	relate material to own beliefs and attitudes
	think about how material could be used
	relate material to own experience
	think about emotional or critical reaction to the material
	underline or high-light the main ideas
	relate the material to what I already know
	look for logical relationships within the material
	mentally identify the most important points
	Study strategies
ask myself questions to test my understanding or memory of the material	
restate the material in my own words	
takes notes	
make an outline of the material	
summarise the material	
draw diagrams or pictures related to the material.	

## APPENDIX E

## Instrument Study 1: Strategies for Understanding

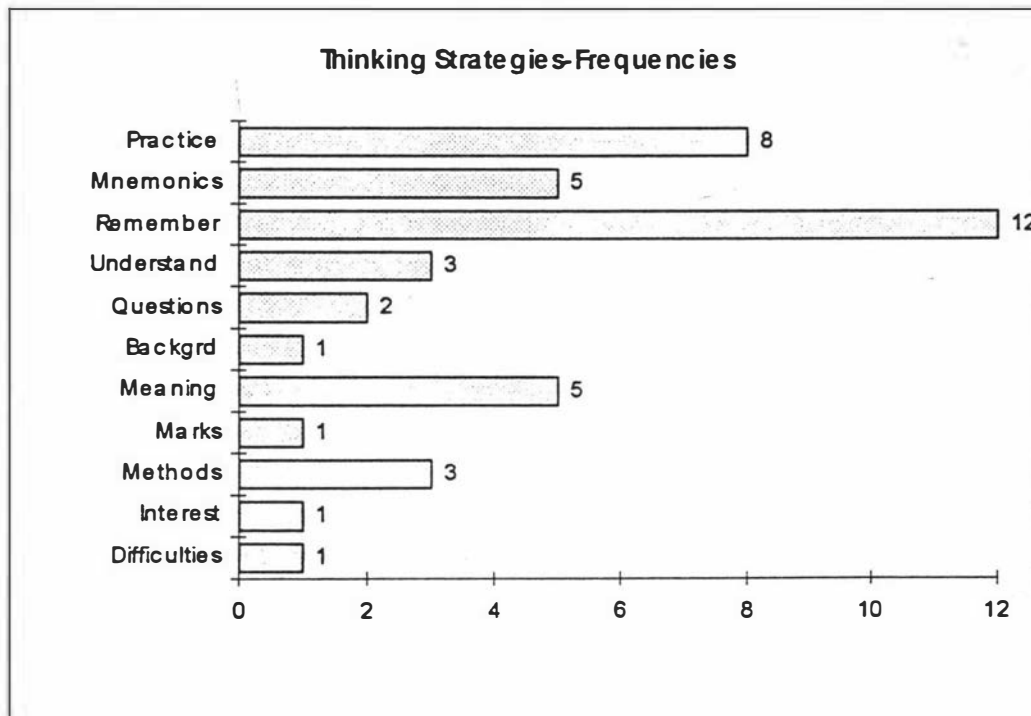
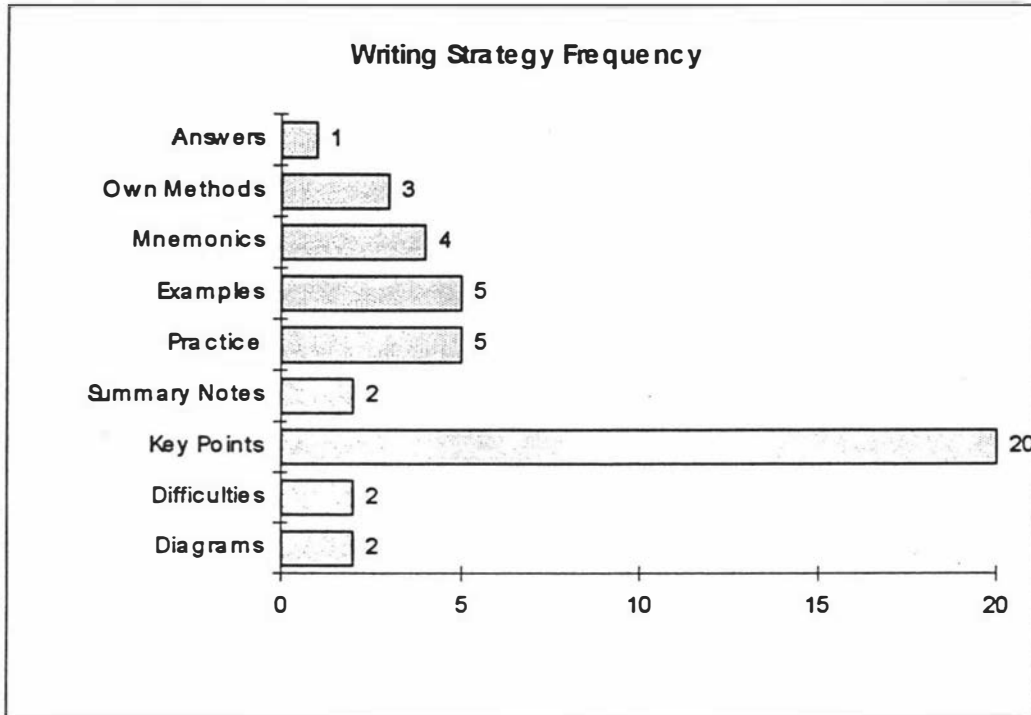


## Instrument Study 1: Strategies for Remembering



## APPENDIX F

### Instrument Study 2: Frequencies for Learning Strategies



## APPENDIX G

### Instrument Study 3:

#### Content - Part One

#### 1. Content

Shutting down a computer

1. Save file being worked on.
2. Type "SHUTDOWN" and press ENTER.
3. Turn off monitor.
4. Turn off CPU.
5. Turn off printer.

#### Question

State the steps for shutting down a computer.

#### 2. Content

$$A = \pi r^2$$

#### Question

Make  $r$  the subject of the formula.

#### 3. Content

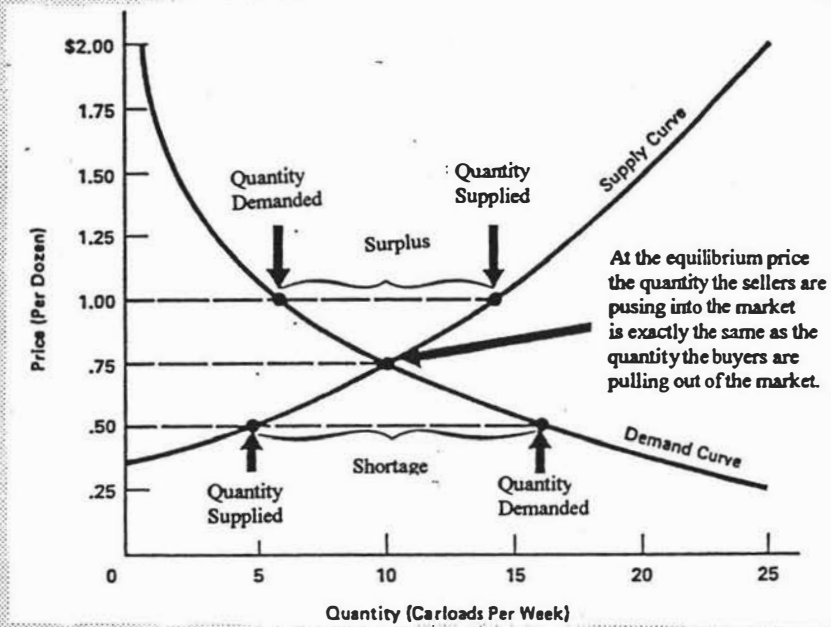
Newton's gravitation formula

$$F = \frac{GM_1M_2}{r^2}$$

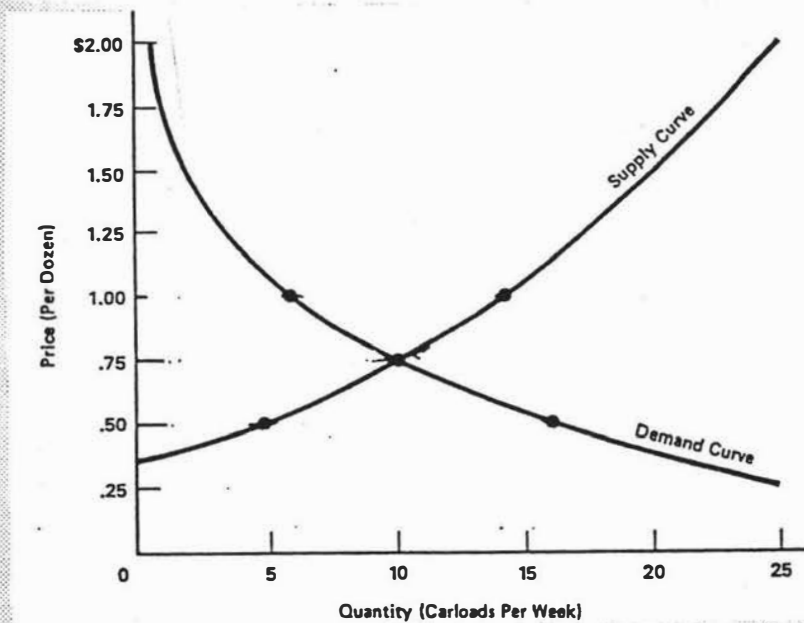
#### Question

Use Newton's gravitational formula to calculate.

## 4. Content



## Question



At the equilibrium price, what is the quantity being supplied?



**7. Content**

The changing political and social background of Maori Society.

**1870-1920** - Extremely small numbers of Maoris. Survival became all important.

**1920's** - A turning point was reached. Birthrate began to exceed that of Pakehas.

**1928** - Sir Apirana Ngata launched his solution to Maori problems - land development.

**Question**

When did the Maori birthrate overtake that of the Pakehas?

**8. Content**

Cumulus clouds

These form in convective currents resulting from the heating of the earth's surface. They usually have flat bottoms and dome-shaped tops. Widely spaced cumulus clouds that form in fairly clear skies are called fair weather cumulus and indicate a shallow layer of instability. You can expect turbulence, but little icing and precipitation.

**Question**

Is this a cumulus cloud? If it is say why, if not, why not?.

9. **Content**

Assets				=	Liabilities + Owners equity	
Cash	Accounts receivable	Furniture	Office equipment		Accounts payable	Roy Bell
\$6,000	+ \$1,000	+ \$3,000	+ \$8,000	=	\$4,000	+ \$14,000
\$18,000				=	\$18,000	

**Concept:** There is always a relationship between assets and the claims against those assets. This relationship is expressed by the accounting equation: assets = liabilities + owner's equity.

**Question:** Ronald Ramos, a dentist, has assets and liabilities given below. List the assets (beginning with cash) in one column and the liabilities in another; then determine the owner's equity.

Cash	\$ 4,000	Dental Equipment	\$ 9,500
Notes Payable	\$ 400	Land	\$12,000
Accounts Receivable	\$ 700	Office Equipment	\$ 300
Building	\$30,000	Mortgage Payable	\$28,000
Accounts Payable	\$ 500	Supplies	\$ 200

Assets \$ \_\_\_\_\_ = Liabilities \$ \_\_\_\_\_ + Owner's Equity \$ \_\_\_\_\_

10. **Content**

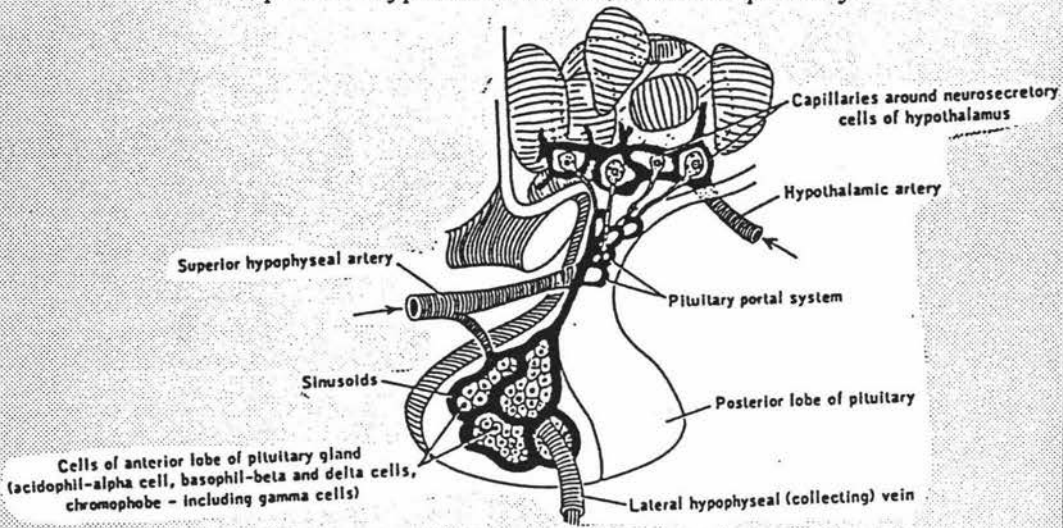
The four schedules of reinforcement summarised here represent different ways of systematically administering reinforcements intermittently (ie according to a partial reinforcement schedule).

Schedule of	Description	Example
Fixed Interval	Rewards given after a constant amount of time has passed.	Pay check given the same time each week.
Variable Interval	Rewards given after a variable amount of time has passed.	Bank auditor visits branch offices an average of once every eight weeks, but not on a fixed schedule
Fixed ratio	Rewards given after a constant number of actions performed	Pay of \$1.00 is given for every boxes of fruit picked and packed
Variable ratio	Rewards given after a variable number of actions performed.	A slot machine pays a jackpot, on average, one time per million plays

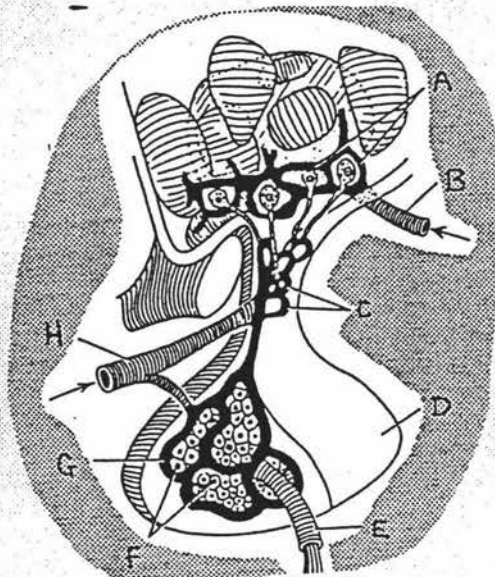
**Question** Develop a reinforcement schedule to change the behaviour of a disruptive and easily distracted 5th form student.

11. **Content**

The Relationship of the hypothalamus to the anterior pituitary.



**Question**



Beside each letter write the missing label.

12. **Content**

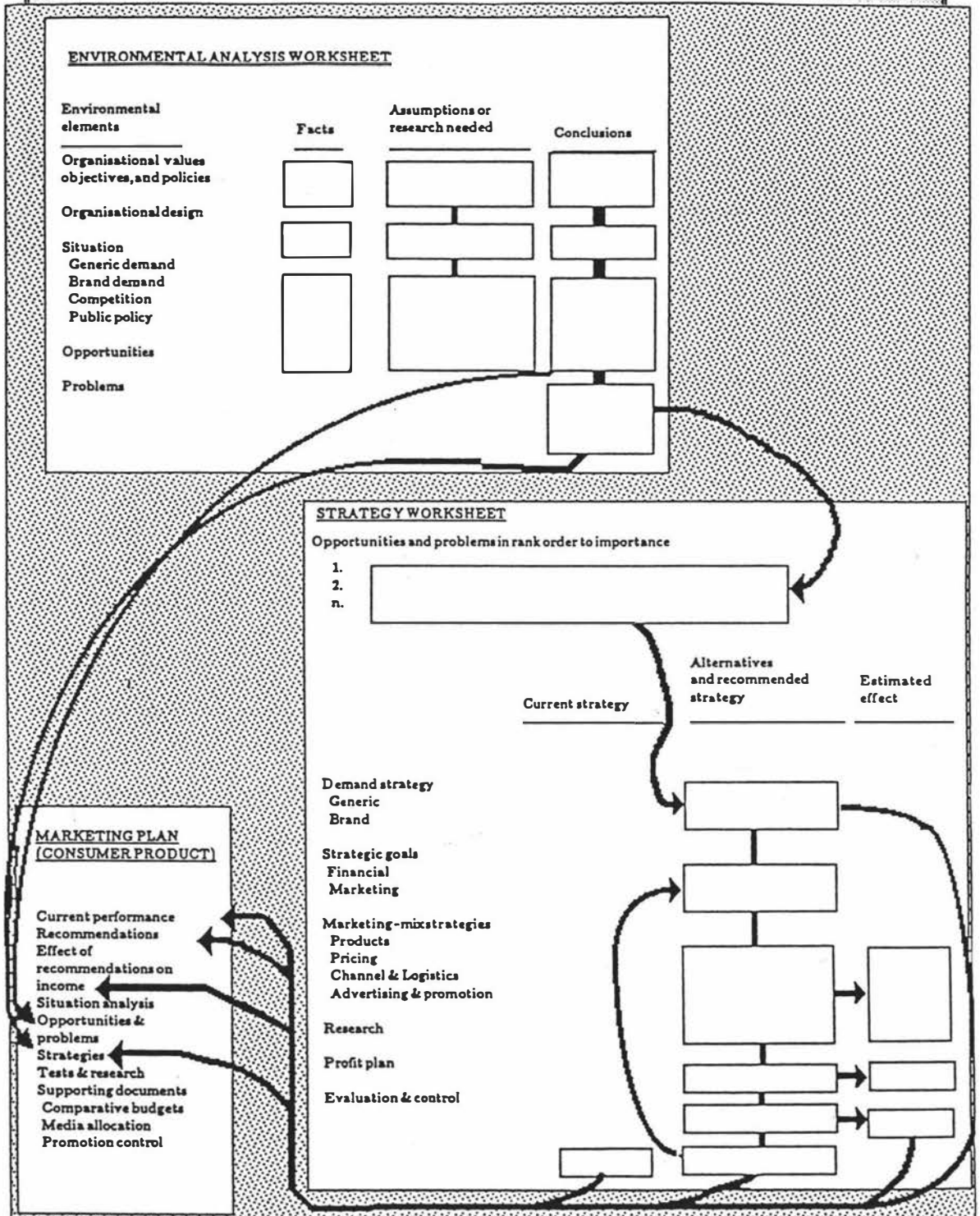
Wagners work includes:

1. Ride of the Valkyries
2. Death March
3. Dance of the Apprentices
4. Dawn and Siegfried's

**Question**

Who wrote the Death March?

13. Content



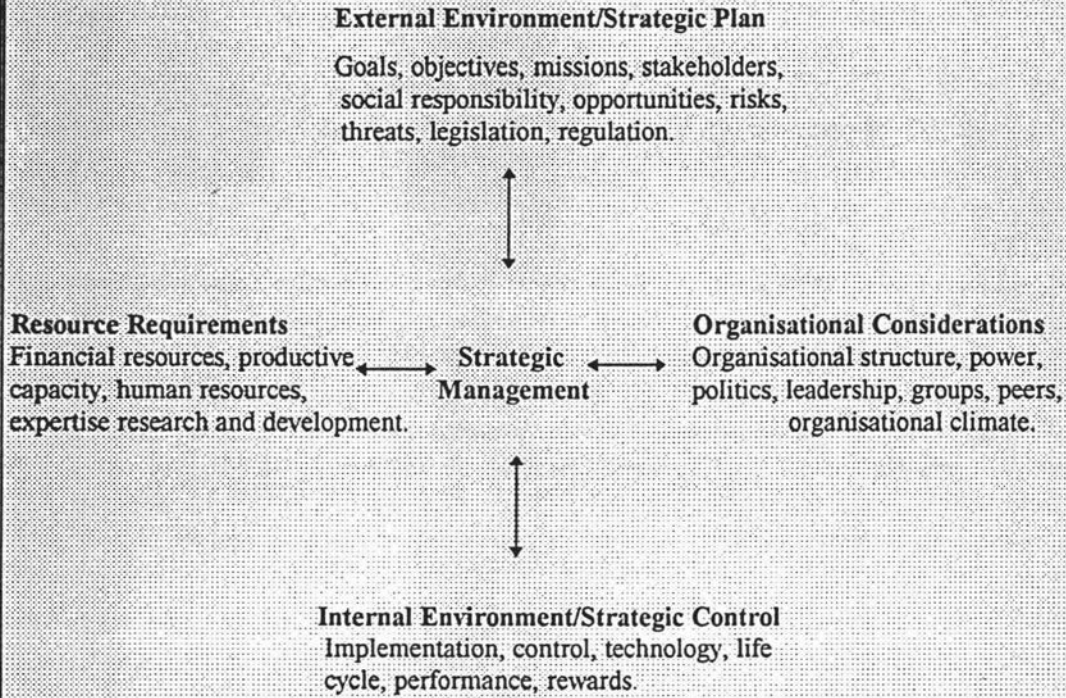
Question

Explain how to develop a marketing plan for a small business.

## Content: Part Two

### 1. Content

The Strategic four-factor analysis is used as a tool for planning corporate strategies



### 2. Content

Periodic time of a pendulum

$$T = 2\pi \sqrt{\frac{I}{g}}$$

### 3. Content

All

Double, double, toil and trouble;  
Fire burn, and cauldron bubble.

Second Witch

Fillet of a fenny snake  
In the cauldron boil and bake;  
Eye of newt, and toe of frog,  
Wool of bat, and tongue of dog,  
Adder's fork, and blind-worm's sting,  
Lizard's leg and howlet's wing,  
For a charm of powerful trouble,  
Like a hell-broth, boil and bubble.

All

Double, double, toil and trouble;  
Fire burn, and cauldron bubble.

Third Witch

Scale of dragon, tooth of wolf,  
Witch's mummy, maw and gulf  
Of the ravined salt sea shark,  
Root of hemlock digged i'the dark  
Liver of blaspheming Jew,  
Gall of goat, and slips of yew  
Slivered in the moon's eclipse,  
Nose of Turk, and Tartar's lips,  
Finger of birth-strangled babe,  
Ditch-delivered by a drab,  
Make the gruel thick and slab.  
Add thereto a tiger's caudron.

All

Double, double, toil and trouble;  
Fire burn, and cauldron bubble.

Second Witch

Cool it with a baboon's blood;  
Then the charm is firm and good  
*[Enter Hecat and the other three Witches]*

Hecat

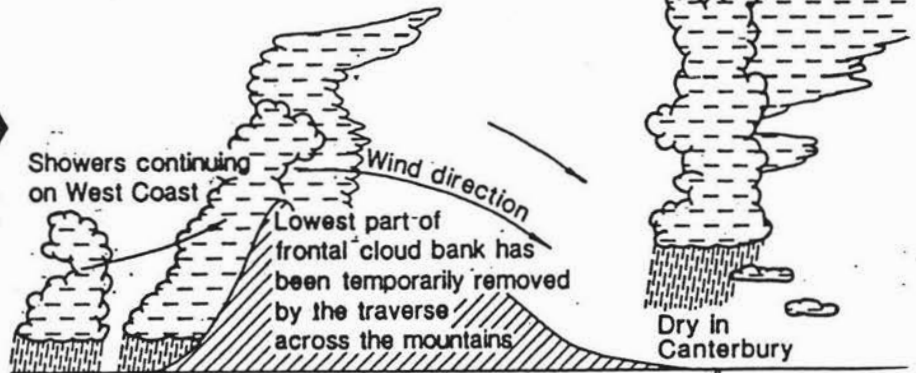
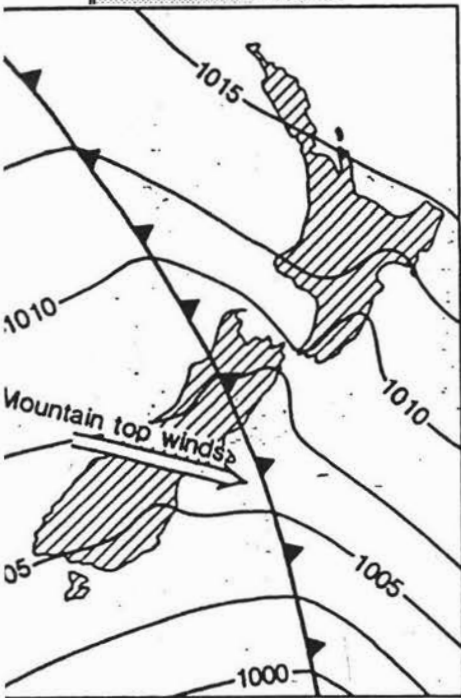
O well done! I commend your pains;  
And everyone shall share i'the gains.  
And now about the cauldron sing  
Like elves and fairies in a ring,  
Enchanting all that you put in.

*William Shakespeare*

4. Content

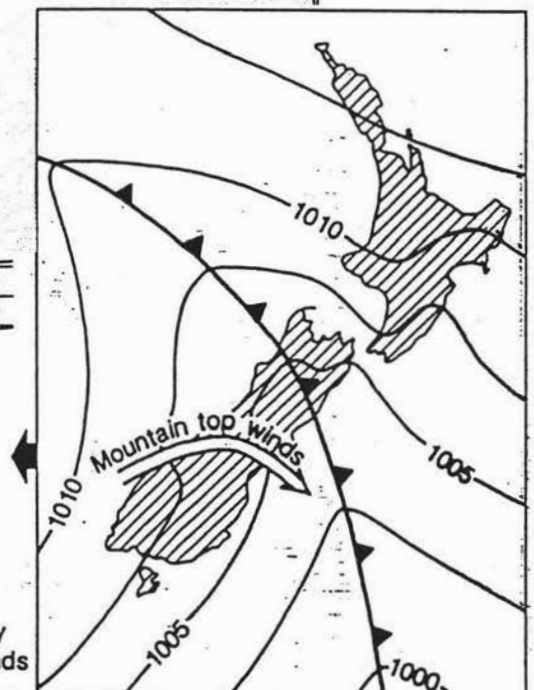
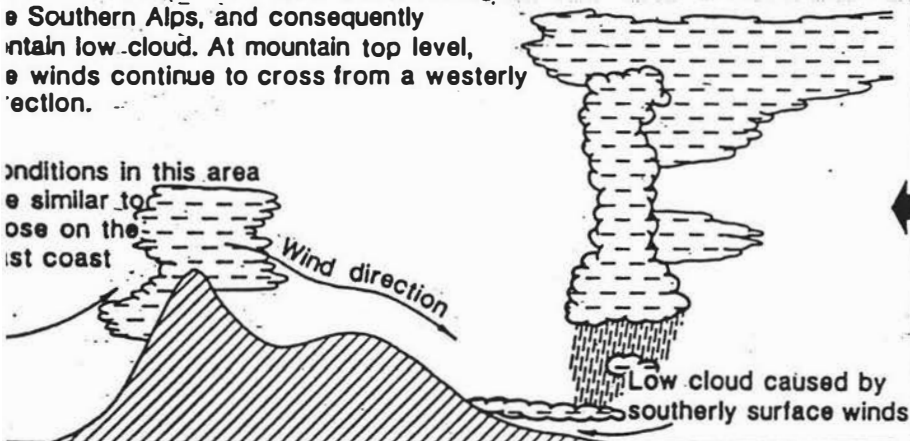
The effect of a mountain range - the Southern Alps - on weather conditions. Cross-sections show what happens when the surface wind behind a cold front reaches the east coast from across the ranges (*top*) and from across the sea (*bottom*).

The surface winds behind the cold front are blowing over the Southern Alps from a westerly direction. Meanwhile, it is normal for the winds at mountain top level to do the same.



The surface winds behind the cold front reach the east coast without first crossing the Southern Alps, and consequently maintain low cloud. At mountain top level, the winds continue to cross from a westerly direction.

Conditions in this area are similar to those on the west coast



## 5. Content

The following list summarises some of the more common programming mistakes made in C. They are not arranged in any particular order. Knowledge of these mistakes will hopefully help to prevent you from making them in your own programs.

### 1. Misplacing a semicolon.

Example:

```
if ( j == 100 ) ;
    j = 0;
```

In the above statements, the value of `j` will always be set to 0 due to the misplaced semicolon after the closed parenthesis. Remember, this semicolon is syntactically valid (it represents the null statement) and therefore no error is produced by the compiler. This same type of mistake is frequently made in while and for loops.

### 2. Confusing the operator `=` with the operator `==`.

This mistake is usually made inside an if, while, or do statement.

Example:

```
if ( a = 2 )
    printf ("Your turn. \n");
```

The above statement is perfectly valid, and has the effect of assigning 2 to `a` and then executing the `printf` call. The `printf` function will always be called since the value of the expression contained in the if statement will always be nonzero (its value will be 2).

### 3. Omitting return type declarations.

Example:

```
result = square_root (value);
```

If the `square_root` is defined later in the program, or in another file, and is not explicitly declared otherwise, then the computer will assume that this function returns a value of type `int`.

### 4. Passing the wrong argument type to a function

Example:

```
result = square_root (2);
```

If the `square_root` function is expecting a floating point argument, then the above statement will produce erroneous results, since an integer value is being passed. Remember that the type cast operator can be used to explicitly force conversion of a value that is passed to a function.

## APPENDIX H

### ALI

## Approaches to Learning Inventory

### What the ALI is About

On the following pages there is a series of questions about your attitudes, style and methods of learning and studying.

There is no one right way of learning or studying. People adopt styles and methods that they feel comfortable with and which suit the requirements of the course. The following questions have been selected to develop a learning profile that reflects your individual approach to learning. After the questionnaires have been analysed you will be given a copy of your profile and a booklet of alternative approaches and strategies that you could use for learning.

### How these results will be Used

The intention of this research is to develop a self administered questionnaire that students can use to increase their knowledge about the way they approach learning. Students will be able to use this information to change their style or add other strategies and techniques to their range of approaches. The results of the questionnaire will be used only to provide you with information on your own learning approach and to verify and improve the questionnaire.

All responses are CONFIDENTIAL and will be made available only to you and the researcher.

### How to Answer

Each set of questions has a four or five-point scale, shown at the top of the page. The scales mean slightly different things for each set of questions so please read these carefully before answering.

Beside each question are the numbers in the scale. Indicate your response by circling the number that most closely reflects you.

For example:

5 - always or almost always true	2 - not so often true
4 - generally true	1 - rarely or never true
3 - true about half the time	

After a lecture I check over my notes..... 1 2 3 **4** 5

## Study Habits

**Directions:** Below are a number of statements which describe study behaviour. Read each statement then circle the number to the right which indicates how closely it reflects your own study habits.

1 - rarely or never true	4 - generally true
2 - not so often true	5 - always or almost always true
3 - true about half the time	

1. My lecture/study notes are complete and well organised..... 1 2 3 4 5
2. I often find myself working late the night before a test or assignment..... 1 2 3 4 5
3. I start each study session with the aim of getting through as much material as possible ..... 1 2 3 4 5
4. I always have the text available to check references in lectures or when studying..... 1 2 3 4 5
5. I set aside regular periods for study and stick to them..... 1 2 3 4 5
6. I find it difficult to sort my notes into logical units for studying ..... 1 2 3 4 5
7. When I set myself a study timetable I often find other things crop up and ruin it ..... 1 2 3 4 5
8. I set specific goals for myself every time I study ..... 1 2 3 4 5
9. I am usually good at taking notes at lectures ..... 1 2 3 4 5
10. When faced with an assignment or study I find it hard to know where to begin ..... 1 2 3 4 5
11. I complete assignments comfortably before the due date..... 1 2 3 4 5
12. I work out exactly how much I will cover in a study session ..... 1 2 3 4 5
13. I make it a priority to get all the information I can on how the course will be assessed ..... 1 2 3 4 5
14. I add notes from additional readings to my lecture notes ..... 1 2 3 4 5
15. I plan a study timetable well in advance of examinations ..... 1 2 3 4 5
16. When they are available I attend tutorial/lecture review sessions..... 1 2 3 4 5
17. I can usually get down the main ideas clearly at lectures ..... 1 2 3 4 5
18. I usually leave assignments or study until the last minute..... 1 2 3 4 5
19. I find out all the assignment and examination dates early in the course ..... 1 2 3 4 5

## Study Process Questionnaire

**Directions:** Below are a number of questions about your attitudes towards your studies and your usual way of studying.

There is not right way of studying. It all depends on what suits your own style and the courses you are studying. If your answer depends on the subject being studied, give the answer that would apply to the subject(s) most important to you.

Read each statement then circle the number to the right which most closely reflects how true of you that statement is.

1 - rarely or never true	4 - generally true
2 - not so often true	5 - always or almost always true
3 - true about half the time	

1. I chose my present courses largely with a view to the job situation when I graduate rather than out of intrinsic interest to me ..... 1 2 3 4 5
2. I find that at times studying gives me a feeling of deep personal satisfaction ..... 1 2 3 4 5
3. I want top grades in most or all of my courses so that I will be able to select from among the best positions available when I graduate ..... 1 2 3 4 5
4. I think browsing around is a waste of time, so I only study seriously what is given out in class or in the course outline..... 1 2 3 4 5
5. While I am studying I often think of real life situations to which the material I am learning would be useful ..... 1 2 3 4 5
6. I summarise suggested readings and include these as part of my notes on a topic ..... 1 2 3 4 5
7. I am discouraged by a poor mark on a test and worry about how I will do on the next test ..... 1 2 3 4 5
8. While I realise that truth is forever changing as knowledge is increasing, I feel compelled to discover what appears to me to be the truth at this time..... 1 2 3 4 5
9. I have a strong desire to excel in all my studies ..... 1 2 3 4 5
10. I learn some things by rote, going over and over them until I know them by heart ..... 1 2 3 4 5
11. In reading new material I often find that I am continually reminded of material I already know and see the latter in a new light..... 1 2 3 4 5
12. I try to work consistently throughout the term and review regularly when the exams are close..... 1 2 3 4 5
13. Whether I like it or not, I can see that further education is for me a good way to get a well paid or secure job ..... 1 2 3 4 5

1 - rarely or never true	4 - generally true
2 - not so often true	5 - always or almost always true
3 - true about half the time	

14. I feel that virtually any topic can be highly interesting once I get into it..... 1 2 3 4 5
15. I would see myself basically as an ambitious person and want to get to the top, whatever I do..... 1 2 3 4 5
16. I tend to choose subjects with a lot of factual content rather than theoretical kinds of subjects ..... 1 2 3 4 5
17. I find that I have to do enough work on a topic so that I can form my own point of view before I am satisfied..... 1 2 3 4 5
18. I try to do all of my assignments as soon as possible after they are given out..... 1 2 3 4 5
19. Even when I have studied hard for a test, I worry I may not be able to do well in it..... 1 2 3 4 5
20. I find that studying academic topics can at times be as exciting as a good novel or movie..... 1 2 3 4 5
21. If it came to the point, I would be prepared to sacrifice immediate popularity with my fellow students for success in my studies and subsequent career..... 1 2 3 4 5
22. I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra..... 1 2 3 4 5
23. I try to relate what I have learnt in one subject to that in another..... 1 2 3 4 5
24. After a lecture or lab I reread my notes to make sure they are legible and that I understand them..... 1 2 3 4 5
25. Lecturers should not expect students to spend significant amounts of time studying material everyone knows will not be examined..... 1 2 3 4 5
26. I usually become increasingly absorbed in my work the more I do..... 1 2 3 4 5
27. One of the most important considerations in choosing a course is whether or not I will be able to get top marks in it..... 1 2 3 4 5
28. I learn best from lecturers who work from carefully prepared notes and outline major points neatly on the blackboard..... 1 2 3 4 5
29. I find most new topics interesting and often spend extra time trying to obtain more information about them ..... 1 2 3 4 5
30. I test myself on important topics until I understand them completely ..... 1 2 3 4 5

1 - rarely or never true	4 - generally true
2 - not so often true	5 - always or almost always true
3 - true about half the time	

31. I almost resent having to spend a further three or four years studying after leaving school, but feel that the end results will make it all worthwhile..... 1 2 3 4 5
32. I believe strongly that my main aim in life is to discover my own philosophy and belief system and to act strictly in accordance with it ..... 1 2 3 4 5
33. I see getting high grades as a kind of competitive game, and I play to win ..... 1 2 3 4 5
34. I find it best to accept the statements and ideas of my lecturers and question them only under special circumstances ..... 1 2 3 4 5
35. I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes..... 1 2 3 4 5
36. I make a point of looking at most of the suggested readings that go with the lecturers..... 1 2 3 4 5
37. I am at university mainly because I feel that I will be able to obtain a better job if I have a tertiary qualification ..... 1 2 3 4 5
38. My studies have changed my views about such things as politics, my religion, and my philosophy of life..... 1 2 3 4 5
39. I believe that society is based on competition and schools and universities should reflect this ..... 1 2 3 4 5
40. I am very aware that lecturers know a lot more than I do and so I concentrate on what they say is important rather than rely on my own judgement ..... 1 2 3 4 5
41. I try to relate new material, as I am reading it, to what I already know on that topic..... 1 2 3 4 5
42. I keep neat, well-organised notes for most subjects ..... 1 2 3 4 5

## Learning Strategies

Paper Number: \_\_\_\_\_

Paper Name: \_\_\_\_\_

**Directions:** Included with this questionnaire is a copy of an assignment you have recently done. If you were studying for a test or exam in which you expected the questions to be of a **similar type and content** as in this assignment, which of the following strategies would be important in helping you to learn. For each strategy circle the number which indicates how important that strategy is to you when learning this type of material. If you think a strategy is inappropriate for this type of material circle NA.

NA - Not applicable	3 - Quite important
1 - Not important	4 - Important
2 - Slightly important	5 - Very important

1. copy out notes/diagrams/words.....NA 1 2 3 4 5
2. recite notes out aloud .....NA 1 2 3 4 5
3. read over my notes and texts .....NA 1 2 3 4 5
4. memorise until I can recall without error .....NA 1 2 3 4 5
5. put ideas into a pattern that is easy to remember .....NA 1 2 3 4 5
6. associate new idea with something easy to remember, for  
example: Skinner - skinny man.....NA 1 2 3 4 5
7. mentally picture what is described.....NA 1 2 3 4 5
8. take first letter from a phrase to make a word (Acronyms) .....NA 1 2 3 4 5
9. expand a word or group of letters into a sentence .....NA 1 2 3 4 5
10. number each item in a list.....NA 1 2 3 4 5
11. put information into lists.....NA 1 2 3 4 5
12. put information into groups.....NA 1 2 3 4 5
13. label groups of information .....NA 1 2 3 4 5
14. make up rhymes or rhythms.....NA 1 2 3 4 5
15. summarise information .....NA 1 2 3 4 5
16. rewrite notes into a more concise form.....NA 1 2 3 4 5
17. identify main or significant points.....NA 1 2 3 4 5
18. identify points of confusion/difficulty/misunderstanding .....NA 1 2 3 4 5
19. read notes/text and make general statements .....NA 1 2 3 4 5
20. get more background information to help understanding.....NA 1 2 3 4 5
21. read more widely on the subject .....NA 1 2 3 4 5

NA - Not applicable	3 - Quite important
1 - Not important	4 - Important
2 - Slightly important	5 - Very important

22. find out more about the context in which the ideas were developed ..... NA 1 2 3 4 5
23. talk to other people about topic/subject ..... NA 1 2 3 4 5
24. collect extra information from a variety of sources..... NA 1 2 3 4 5
25. relate ideas to my own experience/knowledge of a problem or situation ..... NA 1 2 3 4 5
26. relate ideas to other subjects ..... NA 1 2 3 4 5
27. relate ideas to my own views/beliefs/emotional reactions ..... NA 1 2 3 4 5
28. think how I might use the information in some aspect of my life..... NA 1 2 3 4 5
29. ask myself questions to check understanding ..... NA 1 2 3 4 5
30. work out how ideas are related to each other..... NA 1 2 3 4 5
31. put learned parts back together to see how they fit ..... NA 1 2 3 4 5
32. reduce notes to get a skeleton structure of main ideas ..... NA 1 2 3 4 5
33. work through given examples..... NA 1 2 3 4 5
34. put notes/information into a different order ..... NA 1 2 3 4 5
35. underline or high-light points..... NA 1 2 3 4 5
36. change notes into diagrams ..... NA 1 2 3 4 5
37. change formulas into words..... NA 1 2 3 4 5
38. change diagrams into words ..... NA 1 2 3 4 5
39. explain ideas to myself to test understanding ..... NA 1 2 3 4 5
40. use headings and sub-headings..... NA 1 2 3 4 5
41. identify key words and phrases ..... NA 1 2 3 4 5
42. work through new examples ..... NA 1 2 3 4 5
43. find my own or new examples ..... NA 1 2 3 4 5
44. try using information in new situations..... NA 1 2 3 4 5
45. apply to real world situations..... NA 1 2 3 4 5
46. try doing something the wrong way to see what happens ..... NA 1 2 3 4 5
47. complete set exercises/assignments..... NA 1 2 3 4 5

NA - Not applicable	3 - Quite important
1 - Not important	4 - Important
2 - Slightly important	5 - Very important

48. complete extra exercises/assignments.....NA 1 2 3 4 5
49. use principles with different data .....NA 1 2 3 4 5
50. determine trends or patterns.....NA 1 2 3 4 5
51. practice predicting outcomes/results.....NA 1 2 3 4 5
52. identify or simulate consequences or results of doing something  
a certain way.....NA 1 2 3 4 5
53. do something and try to explain to yourself why it happens.....NA 1 2 3 4 5
54. practice on simple tasks first .....NA 1 2 3 4 5
55. get basic overall picture then fill in details .....NA 1 2 3 4 5
56. learn information to a higher level of understanding than  
required .....NA 1 2 3 4 5
57. study examples first, then theory .....NA 1 2 3 4 5
58. theory first, then examples .....NA 1 2 3 4 5
59. break task into parts and learn each separately.....NA 1 2 3 4 5
60. take notes point by point and learn each.....NA 1 2 3 4 5

If there are other strategies, tricks or techniques you use please include them below with a brief description.

61. Other .....NA 1 2 3 4 5
62. Other .....NA 1 2 3 4 5
63. Other .....NA 1 2 3 4 5
64. Other .....NA 1 2 3 4 5
65. Other .....NA 1 2 3 4 5
66. Other .....NA 1 2 3 4 5

## Learning Task Profile

**Directions:** Using the same assignment as in the last set of questions, choose the level of thinking you believe is required to learn this type of material for a test or exam. You may choose only one, in which case you should put 100% in the box beside that choice, or divide the percentage between the four different levels. A brief definition of each level is given below with some examples of questions at that level.

Levels of Thinking	
<b>Memorisation</b>	- To remember without necessarily having to understand.
<b>Explain</b>	- To explain ideas in your own words.
<b>Use</b>	- To actually do, perform or carry out something.
<b>Analyse</b>	- To interpret information/data.

1. **Memorise** - to be able to remember or recall without any depth of understanding.

Examples of questions that require only memorisation are:

Who invented the telephone?

On what date did the Resource Management Bill have its first reading?

Label the components on the accompanying diagram.

Give Gagne's definition of "instructional psychology".

State the law of diminishing returns.

List the steps to shutdown a computer.

MEMORISE

%

2. **Explain** - to explain or describe ideas or how things work in your own words.

Examples of questions that require you to be able to explain are:

Describe what accounting procedures you would use in a small business.

Explain what the term "stress management" means.

Explain the law of supply and demand.

EXPLAIN

%

3. **Use** - to do something or to apply knowledge to a problem or situation to get a solution as opposed to just talking about it as in the "explain" category above.

Examples of questions that require you to use information are:

Design a lesson to teach communication skills using good principles of instruction design.

Develop a marketing plan for the organisation described below.

Calculate the fuel needed to get to Napier from Palmerston North in a Piper Warrior given the weather conditions below.

USE

%

4. **Analyse information** - to extract information or meaning from data or use it to predict future trends or events.

Examples of questions that require you to analyse information are:

Use the information in the graph below to decide which instructional strategies can be matched with which students.

From the information collected in the questionnaire what recommendations would you make.

Conduct a literature search of all the significant theorists in this area and determine the major themes or schools of thought in the 1970's.

ANALYSE

%

### Learning Task Characteristics

**Directions:** Rate the same assignment as previously used on the following features according to how strongly they describe the work you are required to do.

- |                |                 |
|----------------|-----------------|
| 1 - Not at all | 4 - Quite a lot |
| 2 - A little   | 5 - Strongly    |
| 3 - Some       |                 |

- |  |           |
|--|-----------|
| 5. Essay/report writing.....   | 1 2 3 4 5 |
| 6. Short answers .....   | 1 2 3 4 5 |
| 7. Practical exercises (including written).....                                    | 1 2 3 4 5 |
| 8. Many discrete or unrelated parts .....  | 1 2 3 4 5 |
| 9. Each new section depends on understanding previous sections.....                | 1 2 3 4 5 |
| 10. Includes lots of background material.....                                      | 1 2 3 4 5 |
| 11. Need to learn only selected aspects.....                                       | 1 2 3 4 5 |
| 12. Clear, well defined assessment requirements.....                               | 1 2 3 4 5 |
| 13. Ideas which build on related ideas.....  | 1 2 3 4 5 |
| 14. Students must find much information for themselves .....                       | 1 2 3 4 5 |
| 15. All required information given in lectures, study guides and course texts..... | 1 2 3 4 5 |

### Biographical Information

Name \_\_\_\_\_

Age    Under 20     20-24     25-29     30-35     Over 35

Gender        Male                       Female

Ethnicity (please specify) \_\_\_\_\_

University/Institution \_\_\_\_\_

Degree/Diploma sought (eg BBS) \_\_\_\_\_

Major subject area in qualification (actual or proposed, eg Marketing)

\_\_\_\_\_

Favourite academic subject \_\_\_\_\_

#### Last Year's Academic Results

<i>Paper Number</i>	<i>Grade</i>
14.252	C

Thank you for your help and co-operation with this questionnaire.

1. Study Processes Questionnaire: From J B Biggs.
2. Study Habits, Learning Strategies and Learning Task Profile: From Lynn Hunt.