A CASE STUDY INVESTIGATING CHANGES IN STUDENTS' APPROACHES TO LEARNING WHEN EXPOSED TO TEACHING STRATEGIES AIMED AT PROMOTING METACOGNITIVE LEARNING.

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Statement of Authorship.

Except where reference is made in the text of the thesis, this contains no material published elsewhere or extracted in whole or in part from a thesis by which I have qualified for or been awarded another degree or diploma.

No other person's work has been used without due acknowledgement in the main text of the research.

This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution.

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ABSTRACT.

The purpose of this study was to investigate, through the use of case study approach, changes in students' approaches to learning when exposed to teaching strategies aimed at promoting metacognitive learning.

The case study approach used in this research to address the research question was characterised by three stages:

1. Identification of the initial learning characteristics of the students.
2. Identification of any changes in these learning characteristics following the exposure to teaching strategies aimed at promoting metacognitive learning.
3. Monitoring the students' perceptions of their own learning during this time using a variety of data sources.

Stages one and two were firstly applied to the class as a group, and provided a framework within which the more detailed investigation of the individual case studies were situated.

The use of the Learning Process Questionnaire (LPQ) as a means of identifying the general learning characteristics of the students was successful. The approach to learning identified by the LPQ for an individual student was very often confirmed by the other data sources. A second application of the LPQ did uncover changes in individual student's approaches to learning, which, through student reflection sheets, semi-structured interviews and teacher reflection, were able to be investigated further.

The results seemed to indicate that in some cases, these changes in approaches were influenced by the teaching strategies used, but the extent to which metacognitive motives and strategies were adopted depended very much on their acceptance by the class and the individual students.

CHAPTER 1.
THE RESEARCH DEFINED.

1.1 Background to the study.

It is clear that knowledge advances, which means that in each generation there are individuals who have learned to go beyond their mentors. How is it that these people have 'learned to learn' better than others? Are enough people reaching this level of learning? Can their numbers be increased? The first of these questions will be investigated later in this paper. The second question, *are enough people learning to learn?* is of a philosophical and sociological nature, as under some social conditions, feudalism and urban slavery of the industrial revolution for example, people were discouraged from being independent thinkers (Baird and White, 1991). However, for the mature industrial democracies of the late twentieth century, whose citizens must be prepared to cope with rapid social and technological change, there is as great a need for independent and skilled learners as there has ever been (White, 1988). Shaping the Future, the recent review of the Queensland school curriculum listed as a key principle that:

> In an era of increasingly unpredictable and accelerating
> change, learning how to learn and how to adapt knowledge
> and skills to novel situations will become critical (Wiltshire
> et al, 1994, p. 4).

Massive and complex schooling systems have been developed in most first-world countries in order to produce people who are capable of meeting society's needs, yet evidence presented by Baird & White (1991) suggests that the number of people learning to learn effectively and attaining high levels of cognitive awareness is insufficient. The third question, *can the numbers of these people be increased?* now assumes additional importance.

Given that a massive educational infrastructure in already in place in this country, and that radical changes to this system would require extensive resources, time and funds, what changes can be made by a conscientious classroom teacher that will enhance the understanding of learning, and encourage students to learn to learn and learn to think more effectively?

The school with which I have been associated with for the past three years is a large day and boarding school for boys and is owned by a religious order. It has a current enrollment of approximately 1300 boys in years 5 to 12. Over 300 of these boys are full-time boarders at the school, with the other students being drawn from the nearby suburbs. The majority of students' backgrounds belong to the middle to upper class socio-economic group, and the school is organized in a traditional manner.

In 1993 inclusions were made to the Junior Science Work Programme which aimed at fostering the development of logical and critical thinking skills as well as learning and problem solving skills. These inclusions took the form of extracts from de Bono's (1986) Cognitive Research Trust (CoRT) Critical Thinking Program. As part of this program, the students practice a limited number of general learning skills in situations which do not require specific content knowledge for success. The CoRT program includes a series of preplanned, sequential lesson cards which are completed at a rate of one per week. The emphasis of this approach is that training in thinking skills is done explicitly, and kept separate from normal learning of classroom content. However, the literature suggests that the overall record of success of this method is poor (Baird & Northfield, 1992; Martin & Ramsden, 1986; Tabberer, 1984; Rowe, 1988). It was my experience that while initial enthusiasm was high, students typically reverted to their original learning habits, finding it difficult to transfer the learned approaches to everyday classroom content and processes.

Baird (1991) recommends a contrasting approach for attempting to improve a person's attitudes to, and competence in learning. Instead of training explicitly, the contrasting approach is to embed the training within the normal classroom learning context. This approach aims to foster student's independent learning through training for enhanced personal metacognition. Metacognition can be described as 'self-knowledge'; that is, knowing whether you have the requisite knowledge, whether you can apply it and whether you are applying it adequately or not. A more formal definition would define metacognitive processes as those that imply self-determination, or autonomy, in learning and problem solving (Biggs and Moore, 1993).

The literature review will include more detailed descriptions of these contrasting means of enhancing thinking and learning, however, it has been my experience that teaching thinking skills explicitly is generally not successful with junior secondary students. Thus, I decided to investigate the impact that the alternative, implicit approach might have on junior secondary students.

1.2 Purpose and significance of the study.

The purpose of this study was to investigate, through the use of case study methodology, changes in students' approach to learning when exposed to teaching strategies aimed at promoting metacognitive learning.

As mentioned previously, evidence exists that indicates current classroom learning is not promoting independent, highly cognitively aware learners, and that major restructuring of the already existing educational system is unrealistic at this point in time. Thus, this study is significant as a means of assessing the impact that one teacher can have on the approaches to learning adopted by group of students in the context of a given curriculum and school environment.

This study is also significant for a number of other reasons; firstly, it incorporates a variety of strategies aimed at promoting metacognition and the effectiveness of these strategies are reported on. The study makes a worthwhile contribution to the literature in the area of metacognitive learning, and the study has played a significant role in the development of myself as a teacher.

1.3 Limitations of the study.

The limitations of this study can be classified into two broad areas; scope and perspective. Scope refers to the breadth of the study, which was limited in that it was conducted by one teacher, and investigated a single class in a single subject area over a time span of a semester and a half. Results obtained by Baird & Mitchell (1987), Baird & Northfield (1992) and others indicate that a longer period of time may be necessary to achieve lasting changes in learning in a majority of students and that this is even more productive if reinforced in several subject areas.

The perspective of the study was limited in the sense that the teacher was also the researcher, and while this does limit the perspective, an attempt was made to overcome this limitation through comparison with the literature, discussion with critical friends and informed colleagues as well as the use of student perspectives.

1.4 Outline of the thesis.

This paper is a case study investigating changes in students' approach to learning when exposed to teaching strategies aimed at promoting metacognitive learning. The paper is divided into five distinct, yet interwoven chapters.

The exploration of the background, purpose, significance and limitations of the study in this, the introductory chapter, leads to the second chapter of the paper, the literature review.

Certain areas of educational literature will be reviewed in this chapter, beginning with an explanation of learning and the identification and formalisation of the approaches to learning. The promotion of learning and knowledge will be explored, with special emphasis on learning in science and the role that metacognition plays in the enhancement of learning skills. Chapter Two concludes with a short review of implicit methods which may be used to foster metacognition.

Chapter Three of this paper is aimed at explaining the design of the study. The use of case study methodology will be discussed and justified, and the methods of determining the students' approach to learning, including the Learning Process Questionnaire will be investigated. The means of data collection and analysis and the teaching strategies aimed at promoting metacognitive learning will also be presented and explained in this chapter.

The discussion of methodology and strategies leads directly into Chapter Four, the presentation and discussion of the results. This chapter begins with a discussion of the data collected from the class and uses this as a framework for the presentation and discussion of each case study.

The final chapter will act as a review and synthesis for the paper. This study will show that the Learning Process Questionnaire is a reliable means of identifying the learning characteristics of junior secondary students, that changes do occur in the approaches to learning adopted by the students and that these changes appear to be influenced by the teaching strategies used.

CHAPTER 2.
LITERATURE REVIEW.

The purpose of this study was to investigate, through the use of case study methodology, changes in students' approaches to learning when exposed to teaching strategies aimed at promoting metacognitive learning.

Certain areas of educational literature, beginning with the topic of learning and the identification and formalisation of the approaches to learning need to firstly be explained. Literature exploring the promotion of learning and knowledge will also be examined, together with some specific approaches which have been used, particularly in science education. The concept and role of metacognition in this endeavour will be included.

2.1 Learning.

Learning is not a simple process The concept of learning can be explored from many perspectives, as an investigation into student learning often involves aspects of a number of different academic disciplines. Fundamentally, learning involves a neurological process whereby the nervous system is transformed by its own activity. Neural activity changes the neurons that are active, and that change is the structural basis of learning (Kolb & Whishaw, 1990). However, this clinical perspective has little to offer to our understanding of learning in the context of a classroom. An investigation into learning develops and extends the theories and techniques of mainstream educational research while at the same time it applies the models and procedures of cognitive psychology to a specific real-life activity (Richardson, 1987).

Much of the early research into learning was carried out by experimental psychologists, in an attempt to uncover general principles of learning from the psychological perspective.

> (Generally,) ..... mainstream cognitive psychology tends to
> be concerned with the study of the processes and
> mechanisms that are responsible for intelligent behaviour
> (Richardson, 1987, p. 4).

The evidence gathered by cognitive psychologists was mainly of a behavioural nature and quantitative in form so that traditional techniques of statistical analysis could be

applied (Richardson, 1987). Most studies were based on animals and followed as closely as possible the well-tried quantitative research procedures from the physical sciences. In these studies, the environment was seen as sets of stimuli and behaviour as responses to those stimuli. Thus, learning was defined an observable change in behaviour when new stimulus-response connections were set up, through a process of called conditioning (Biggs & Moore, 1993). Studies were able to confirm the effects on memory of contiguity (remembering ideas or facts closely related with each other) and of exercise (repetition). It was also noted that learners tend to repeat behaviour which leads to satisfying consequences (law of effect). Teachers, students and researchers have found this view of learning inadequate and object to the image of the teacher as the 'manipulator of learning' (Entwistle, 1984).

> This was of course another manifestation of the age-old
> principle that behaviour could be controlled with reward
> and punishment (Entwistle, 1984, p. 6).

This style of research explained student behaviour from the outside, as a detached, objective observer interested only in those aspects of human cognition that can be conceptualised and quantified in terms of specific experimental procedures. Most psychological research on learning has been carried out in laboratory settings or has made use of artificial or over-simple learning materials. As a result, the researchers have been able to manipulate the learning environments and learning processes. For example, when studying human learning, psychologists such as Ebbinghaus (1913) tried to avoid the 'distorting' effects of previous knowledge by designing tasks based on learning nonsense syllables and random arrays of numbers (Entwistle, 1984). This manipulation of the learning environment through the use of tasks with little or no inherent meaning leads to the learning task itself being drained of meaning. Dahlgren (1984) argues that most human learning depends on meaning and is directed towards it.

> To learn is to strive for meaning, and to have learned
> something is to have grasped its meaning (Dahlgren, 1984,
> p. 24).

> Learning, then, should be regarded as that aspect of human
> life through which the environment - or man himself -
> appears with a higher degree of meaningfulness than before
> (Dahlgren, 1984, p 34).

Attempts at applying the theories derived from this perspective of research in the classroom have not been particularly successful (Entwistle, 1984). Behavioural models are too simple to explain the complexity of human behaviour. Cognitive behaviour, such as problem solving, appeared to some researchers as something like what computers do. The environment provides information, which humans attend to selectively, they then process and store it, to access it later (Biggs & Moore, 1993). This comparison with how computers handle imformation has given rise to the information processing family of learning models.

An alternate approach to the investiagtion of learning would be to seek an empathetic understanding of what is involved in student learning.

> An alternate paradigm exists which involves approaches to research rooted in phenomenology which derive from a direct exploration of students' experiences of learning (Entwistle, 1984, p. 13).

The phenomenological perspective of learning attempts to look at the learning task in context and studies of this nature are based on qualitative 'illuminative evaluation' - research designs which seek to evaluate learning from the students' perspective. Such studies are carried out in naturalistic settings. This change from the traditional behaviourist research style to studying learning from the students' point of view was seen as somewhat radical, as Entwistle points out:

> It involves a shift not just in methodology, but of perspective (Entwistle, 1984, p. 13).

Ramsden (1988) reminds us that after all, teaching is an activity that assumes an understanding of learning and teachers should, in fact, become scholars of their own students' learning.

> In a sense phenomenographic research mirrors what good teachers do. It tries to understand what the students are doing in their learning. It attempts to discover what different approaches students are taking and to understand these in terms of the outcomes of their learning activities (Bowden, 1988, p. 263).

Phenomenographic research into learning indicates that learning is not a unitary process, activated by another unitary process of teaching which proceeds in the same way for all learners (Biggs, 1991). Learning depends very much on the learner's perception of his or her learning context, and students interpret how they will deal with the situation in which they find themselves. Will they decide to get by with minimal effort or will they maximise their chances by playing a competitive game or will some find the situation rewarding, stimulating and challenging? What ever assessment the student makes of the current learning context, he or she will implement an appropriate learning strategy resulting in an identifiable approach to learning. (Biggs, 1991).

There are a variety of conceptualizations of learning in the literature, however the model which suggests that students adopt one of three approaches to learning labelled surface, deep and achieving, not only has sound theoretical basis, but is supported by a substantial body of international research. This model also has the advantage of specifying the particular processes students use and is thus amenable to research which focuses on modification of those processes.

2.2 The identification and formalisation of the approaches to learning.

Much of the pioneering work carried out in the field of approaches to learning was carried out in Gothenburg, Sweden. Marton and Saljo (1976a; 1976b) investigated how students went about the task of reading a complex academic article which was related to the subject they were studying. The researchers had hoped to relate the quality of the learning that took place with the approach adopted. This experiment broke away from the behaviourist tradition of research into learning which was dominant at the time and showed that learning could be investigated qualitatively, yet with a systematic and rigorous analytic procedure (Entwistle & Marton, 1984). The methodology that the study embodied had a profound influence on subsequent studies carried out in this area.

The researchers found that the results could be classified into four categories of learning outcome, each representing qualitatively distinct levels of comprehension (McLaughlin, 1990). A simple ordering of the depth of outcome leads to a hierarchical relationship between the four outcomes. The highest level, included those students who summarised the author's main argument and used supporting evidence with explanations of thoughts and reflections indicating personal understanding of the

argument. The second level, included those students who adequately described the argument but the use of evidence or personal experience to support that argument was not made clear. Students who gave an adequate list of the main points presented in the article, but failed to show how these points were developed into an argument were in the third level, while those that gave a few isolated points, some relevant, others irrelevant and gave the impression of confusion and misunderstanding in their comments were categorised into the fourth level (Entwistle & Ramsden, 1993).

The first two categories represent organized and well structured outcomes, indicating the achievement of some depth of understanding. Members of groups third and fourth levels are merely reproducing parts of the text, often with little understanding. Other research has indicated that students' levels of understanding are generally stable over time (Svensson, 1977).

Given that variables such as prior knowledge and linguistic skills have been accounted for, then it is implicit in the hierarchy of learning outcomes that students who achieve a deeper understanding must be operating differently (McLaughlin, 1990). Marton & Saljo (1984) explained that the differences in learning outcome were a result of differences in the learning processes which led to the outcomes.

Research by Svensson (1977) attempted to provide such a description of the different learning processes. He prompted students to remember how they went about learning tasks through semi structured interviews, and compared the results with the level of outcome obtained by the student. Svenson concluded that when reading a text, the students either focused on the text as a whole or its constituent parts. The recollections of the learning process complemented the performance data and Svensson was able to establish that there was a very close relationship between process and outcome (McLaughlin, 1990).

Marton and Saljo also recognized that there were two apparently dichotomous approaches to learning which reflected different intentions and different levels of processing. Marton initially chose the terms 'surface' and 'deep' to describe the two groups of students. The intention of one of the groups of students was to identify and then memorize what they saw to be the important facts and ideas contained in the text (Newble & Clarke, 1986). These students tended to use rote learning techniques and in doing so, only gained a surface level appreciation for the principles contained in the article. The researchers labelled this the *surface approach* after the levels-of-processing model of Craik & Lockhart (1972). The remainder of the students set out

with the intention of trying to understand what the author had written. This group examined the evidence in relation to the conclusions, related new ideas to old ones and to their own personal experiences (Newble & Clarke, 1986). This group were said to be using a *deep approach* to learning.

While Marton & Saljo's approaches-to-learning concept was formulated within the narrow context of one particular learning task, that of reading an academic article, the importance of this new insight did not go unnoticed. From this experiment came the influential analytical description of learning in terms of *approaches to learning*. The findings and distinctive methodology set a train of research in motion, much of it influenced by the original experiment conducted at Gothenburg.

In 1976, Entwistle & Ramsden initiated a five year study into approaches to learning. The two categories of approach introduced by Marton were validated and interviews with students suggested the need for a third - a 'strategic approach'. Out of this study came the concept of *study orientation* - implying that some students adopted *consistent* approaches across a range of different study tasks (Entwistle & Marton, 1984).

John Biggs, an Australian, was also researching students' approaches to learning at this time. Both of these studies, although conducted independently and in different parts of the world (and in Biggs' case, without knowledge of Marton's work) produced results that were remarkably similar (Newble & Clarke, 1986). Both studies identified three general approaches to learning: surface and deep approaches to leaning, as well as a third approach, where students strive for achieving high grades. This approach has been dubbed the *achievement (or strategic) approach to learning* (Biggs & Moore,1993).

2.3 The approaches to learning.

2.3.1 Introduction.

Essentially then, students produce qualitatively different learning outcomes as a result of the approach to the learning task that each has adopted (Ramsden, 1988). This is because the student's learning outcome depends directly on the strategy adopted by the student for that learning task.

The term strategy was originally a military term that referred to the procedures for implementing the plan of a large scale military operation. Thus, learning strategies are combinations of cognitive skills implemented to accomplish a learning task (Schmeck, 1988). The choice of learning strategies depends on the particular approach to learning adopted by the student.

> .... students usually choose strategies which are congruent
> with their motives. The approach to learning that a
> particular student adopts will be formed by these motives
> and strategies (Biggs & Moore, 1993, p. 310).

Ultimately, the approach adopted is a dictated by the student's personal conception of what learning and knowledge is all about and represents a relationship between the student and the learning he or she is doing (Ramsden, 1984).

Thus, the relationship between learning outcome, strategy and approach to learning can be diagrammatically represented as in Figure 1, on the following page.

Figure 1.

The learner's concept of learning and knowledge

↓

dictates the learner's chosen

↓

Approach to learning

↓

with includes characteristic

↓

Learning strategies

↓

which have a direct impact on the

↓

Learning outcome
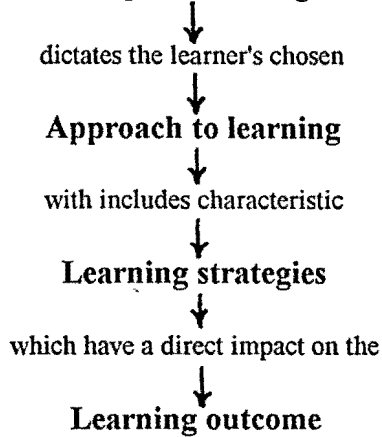
It is important to note that approaches are not a fixed, and are not something a student *has*: rather, they represent what a learning task *is* for the learner. Thus, as the learner's perception of different learning tasks may vary, so too does the adopted approach, as clearly documented by Laurillard (1984). In fact, people are capable of both deep and surface approaches from early childhood onwards (Ramsden, 1984).

As described previously, the results of Marton and Saljo's work into how students went about reading an academic article generated four categories of learning outcome, reflecting qualitatively distinct levels of comprehension. These learning outcomes were a product of two distinct approaches of the learning task, the surface approach to learning and the deep approach to learning.

Figure 1 provides a useful model for investigating the comparative differences between the approaches to learning. In the forthcoming pages, each approach will be described in terms of learning outcome, strategies and the student's concept of learning.

2.3.2 The surface approach to learning.

Learners who adopted the surface approach to learning were characterized by learning outcomes which reflected a surface level only understanding of the learning task. They could reproduce parts of the original text, but rarely in context and without understanding the author's message (Schmeck, 1988). Surface learners associate facts and conceptions unreflectively and are unlikely to relate evidence and conclusions or examine the argument in a critical way (Ramsden, 1984).

These learning outcomes were a product of the main strategy used by the students which was to focus on the separate words and sentences of the text, rather than on the meaning those words and sentences were supposed to convey. This strategy is usually based on rote learning, as students focus on what appears to be the most important topics or elements and try to reproduce them accurately. As a result of their narrow focus, surface learners often do not see interconnections between elements of the task, or meanings and implications of what is learned (Biggs & Moore, 1993).

The main reason that students did not understand the article was that they did not *intend* to understand it (Ramsden, 1992). Students who are predominantly motivated either by a desire simply to complete the course or avoid failure by meeting institutional requirements minimally often adopt the surface approach. These students treat the learning task as an external imposition, an obstacle to be negotiated. These students have a quantitative view of learning, believing that the reproduction of detail is the appropriate way to go and the more that is reproduced, the better the learning (Biggs & Moore, 1993).

Students who adopt the surface approach can vary widely in their level of effort and involvement. At one extreme is the passive surface learner. These students have little or no interest in the subject and make little effort. These students only accumulate a few, unrelated facts and little or no understanding of the material. On the other hand, a surface learner can appear to be very active, expending large amounts of time and effort, often accumulating substantial amount of knowledge, but with only a superficial level of understanding (Newble & Clarke, 1986).

2.3.3 The deep approach to learning

In contrast to the learning outcomes of the surface learners, the remainder of the students in Marton & Saljo's study demonstrated a high level of understanding of the article. These students summarised the author's main argument, showed how evidence is used to support the argument, and explained the thoughts and reflections that were used to reach personal understanding of the argument (Marton & Saljo, 1976).

To reach this comparatively high level of conceptualization, the students using the deep approach to learning adopted strategies to maximize understanding such as discussion and reflection, examining evidence in detail, relating previous knowledge to new knowledge (Newble & Clarke, 1986), relating theoretical knowledge to everyday experience and reorganisation of the content into a coherent whole (Ramsden, 1993).

In the deep approach to learning, the motive is intrinsic interest in the content learned, a need to satisfy curiosity about a topic and to thoroughly understand the material or subject. These students have a qualitative conception of learning; to learn is to strive for meaning, and to have learned something is to have grasped its meaning. (Dahlgren, 1984). Knowledge is seen as a window through which aspects of reality become visible, and more intelligible (Entwistle & Marton, 1984).

Pask (1976) carried out laboratory studies of how students carried out meaningful learning. In his experiment, students were forced to extract meaning and could not settle for a surface approach. He identified two distinct processes used by the students. Some students still focused their attention narrowly on the facts or details and on logical relationships or procedures. These learners use a logical step-by-step approach with careful analysis of the evidence behind generalisations. The attention to factual and procedural detail may cause this style of deep learner to slip into rote learning when under time pressure. This was described by Pask as a *serialist* strategy, but because this strategy relies on step-by-step concentration on particulars, is more commonly called *operation learning* (Schmeck, 1988). The operation learning style of deep learning is most commonly found in science students. (Entwistle & Ramsden, 1983).

On the other hand, Pask found other students who, right from the beginning tried to see learning in a broader setting and were much more interested in grasping general relationships between ideas. These students were concerned with the broad outline of ideas and their interconnections with other ideas and with previous knowledge. They commonly used analogies, illustrations and anecdotes to bring academic learning closer to their everyday experience. This was described by Pask as a *holist* strategy, but because of the emphasis on interconnections and building up an overview, this strategy is commonly called the *comprehension* style of deep learning and is more characteristic of students of the arts and humanities (Newble & Clarke, 1986).

The most successful students were those who could combine both styles, being flexible enough to choose the appropriate style to suit the task. Pask termed students who achieved this style of learning *versatile learners*.

2.3.4 The achieving approach to learning.

The achievement orientated approach to learning is also commonly called the strategic approach. As these names suggest, the aim of this approach is select learning strategies which will maximize achievement. The level of understanding strategic learners attain is often incomplete and varies, depending on the course requirements and methods of assessment (Newble & Clarke, 1986).

Students using the strategic approach show a great deal of versatility in their strategies but often may not achieve understanding, aiming only to ensure that their marks are sufficiently high (Newble & Clarke, 1986). Students using this approach may aim for maximum engagement in the task by using strategies characteristic of the deep approach, but such engagement is the means, not the end, choice of strategy really depends on which one will earn the most marks (Biggs & Moore, 1993). Thus, these students demonstrate a calculating approach to their study. The degree to which this occurs varies, with the most strategic seeing learning as a game to be played and won (Newble & Clarke, 1986).

Students who regularly adopt this approach to learning have a concept of learning which is based on that of achievement, competition and ego enhancement through obtaining high grades and winning prizes.

Figure 2 is an elegant representation of the key features of the different approaches to learning including associated motivations, strategies and learning outcomes (Newble & Clarke, 1986).

Figure 2.

APPROACH TO LEARNING

STRATEGIC

Intention
- to be successful by using whatever means are necessary

Predominant motivation
- achievement of high grades
- competing with others

PROCESS

Operation learning
Comprehension learning
Rote learning
- uses any or all based on perceptions of what will produce the best grades

OUTCOME
- variable level of understanding depending on what is required by course requirements and methods of assessment

DEEP

Intention
- to reach a personal understanding

Predominant motivation
- interest in the subject matter
- vocational relevance

PROCESS

Comprehension learning
- relates ideas
- particularly 'arts'

Pathology of globetrotting

OUTCOME
- incomplete understanding based on relationships between ideas unsupported by evidence

Versatile learning
- relates evidence to ideas

OUTCOME
- deep level of understanding
- integrates principles with facts
- uses evidence to develop arguments

Operation learning
- examines evidence
- may include elements of rote learning
- particularly 'sciences'

Pathology of improvidence

OUTCOME
- incomplete understanding based on detailed knowledge of relevant facts with little integration with broad principles

SURFACE

Intention
- to fulfill assessment requirements by reproduction

Predominant motivation
- concern with completion of the course
- fear of failure

PROCESS

Rote learning
- focuses on task and pieces of information in isolation
- uses routine procedures and repetition to memorise both facts and ideas

Passive
- little effort
- lack of interest

OUTCOME
- little or no understanding
- able only to mention a few unrelated facts or unimportant details

Active
- Major expenditure of effort

OUTCOME
- superficial level of understanding
- may have substantial knowledge of factual information
- able to provide adequate descriptions

In conclusion, the phenomenological paradigm for research into student learning has provided educators with a new insight into learning, from the perspective of the learner. Researchers have found that students approach learning tasks with one of three main approaches: the surface approach, the deep approach and the strategic approach. Approaches to learning are chosen by the learner in light of the learner's personal conception of what learning and knowledge are. Each approach has its own characteristic strategies which lead to learning outcomes which are qualitatively different.

To effect long term changes in learning outcomes, it therefore seems necessary to change the learner's concept of knowledge and learning or approach to learning. It is therefore important to investigate what factors influence peoples' concept of learning and knowledge.

2.4 The promotion of learning and knowledge.

2.4.1 Introduction.

The assertion that knowledge advances, which means that in each generation there are individuals who have learned to go beyond their mentors was made in the introductory chapter. This statement poses a number of questions, for example, how is it that these people have 'learned to learn' better than others? Are there sufficient people learning to learn? Can their numbers be increased?

The answers to these questions are philosophical and sociological in origin, with epistemology, the theory of knowledge, being one of the most important branches of philosophy. The wealth of philosophical literature investigating the acquisition of knowledge, the extent of our knowledge and the validity of knowledge while very interesting, is beyond the scope of this study. Of more relevance is the effect that social conditions can have on the promotion of knowledge and learning. Throughout history, there have been rulers and dictators who have recognized the threat that educated, independent thinkers may pose, and so have actively discouraged learning. In extreme cases social conditions such as feudalism and urban slavery have been created, and the highly educated persecuted or eradicated.

Public opinion, often grounded in the dogmatic teachings of the church, has in the past been a strong opposition to the progression of knowledge, particularly in the field of science. For example, early Greek philosopher Anaxagoras was exiled from Athens for asserting that the moon was made of stone; Keppler's theories of planetary motion were not accepted until well after his death as they contravened the then accepted earth-centred model of the solar system. Descartes, the great French philosopher and mathematician of the 16th century, came to suspect all accepted views which claimed authority merely because they were ancient and time honoured. As a result, he spent many years living in Holland (Popkin & Stroll, 1986).

The present social conditions in Australia are much more congenial for the promotion of knowledge and learning. The government is actively involved in the facilitation of learning through an enormous educational system catering for preschool, primary, secondary and tertiary sectors. Through the use of political catch cries such as 'building a clever country', the importance of learning has been recognized.

> .... for the mature industrial democracies of the late
> twentieth century, whose citizens must be prepared to cope
> with rapid social and technological change, there is as great
> a need for independent and skilled learners as there has
> ever been (Baird & White, 1991, p. 147).

In addition, in the recent review of the Queensland school curriculum, one of the key principles listed was that in an era of increasingly unpredictable and accelerating change, learning how to learn and how to adapt knowledge and skills to novel situations will become critical (Wiltshire et al, 1994).

In classifying views of the school curriculum, Eisner and Vallance (1974) identified four functions: the promotion of skills which enable people to learn anything, irrespective of content; the development of self, a personal integration achieved through satisfying experiences which relate to life outside school; acceleration of change in the values and procedures of society; and the transmission of knowledge through established disciplines, to enable the recipients to participate fully in their culture.

The formal curriculum, that is what students should learn in Queensland secondary schools, has in the past been guided by the Board of Senior Secondary School Studies (BSSSS) and the former Board of Secondary School Studies (BSSS) and includes an emphasis on established disciplines such as language, mathematics, science, history, geography. This curriculum is instrumental in the development of learning. The next section introduces the rationale for the inclusion of science in the curriculum and its contribution to learning.

2.4.2 Science: its place in the curriculum and contribution to learning.

One justification for the inclusion of science in the curriculum must be that science is capable of making a unique contribution to the aims of the curriculum. The rationale for its inclusion in the in the Queensland curriculum includes the following statements:

> Science is a powerful way of generating and organizing knowledge and a significant contributor to the cultural and intellectual development of our society. It is indirectly responsible, through the application of its findings, for the generation of much material wealth .... and employment. Education in and through science plays a key role in maintaining and enhancing our capacity to enjoy these benefits.
> (Junior Syllabus in Science, Board of Senior Secondary School Studies, 1989, p. 1).

> The study of what (scientists) have done and are doing, and emulating some of their activities, can promote students' personal development and their understanding of the actions of others.
> (Junior Syllabus in Science, Board of Senior Secondary School Studies, 1989, p. 1).

(And) a junior science program must make some contribution to students' life roles as:

a) healthy persons - accepting responsibility for the health and safety of their own bodies and those of others.

b) workers and leisure users

c) users of technology - understanding the increasing growth and sophistication of technology, and its advantages and disadvantages, - making the appropriate 'consumer' choices in the interests of self, society and the future.

d) responsible citizens - contributing to policies and decision making concerning the impact of science on society and the future.

e) scientifically literate individuals - having a continuing desire and the necessary skills to further their understanding of science.

f) parents - contributing to the development of the above life roles in children.

(Junior Syllabus in Science, Board of Senior Secondary School Studies, 1989, p. 2).

While these statements provide some rationale for the inclusion of science in the junior curriculum, and provide some aims for what the learning of science should achieve, there is evidence to suggest that these aims are not being met in all cases.

2.4.3. Learning in science, some other perspectives.

In an age of increasing technological application and advancement, where business and industry have difficulty recruiting employees with the necessary knowledge of science, there is evidence to suggest that there is something of a crisis in science education.

Weiss (1987), Tobin & Gallagher (1987), Gallagher (1989) and Humrich (1988) report that most science curricula emphasize the learning of basic facts and definitions from science textbooks and relatively little emphasis is placed on applications of knowledge to everyday life or on the development of higher-order thinking skills. (Tobin, Kahle & Fraser, 1990).

Additional evidence that higher order thinking skills are not being achieved come from the work of Biggs (1986) and others, who through the application of innovative probes into understanding have revealed that even those students who succeed at examinations often lack acceptable understanding of the major principles of the subject that they have chosen to study in depth.

Thus, even though it seems that many students are achieving quality learning in the Australian schooling system, many students are graduating with a limited concept of learning and knowledge, as Biggs & Moore suggest.

> To young children, learning is fun. To young adults, learning gives power over the world. To school students learning is ... well, what you do in schools. Learning means being taught and passing the test. The higher the mark, the better the learning (Biggs & Moore, 1993, p. 16).

Of the three approaches to learning identified earlier in this chapter, the above concept of learning most closely resonates with the surface approach to learning, which is characterised by rote-learning with little reflection on the part of the learner, and indicates limited concept of knowledge and learning (Newble & Clarke, 1986). Ideally, the majority of learners should be encouraged by the schooling system towards the deep approach to learning, but the evidence suggests that this is not the case.

Instead of developing independence in judgement, problem-solving and analytic skills, the students are obliged to devote their attentions to the narrow requirements of assessment, including the memorisation of ideas and facts (Ramsden, 1984, p. 146).

Perhaps, through emphasis on assessment, dividing knowledge into subjects, time constraints, teacher stress, schools are unintentionally indoctrinating learners into the surface approach's concept of knowledge and learning. It could be said that there exists a hidden curriculum, defined at the classroom level by Hewitson (1982) as the verbal and non-verbal messages that students receive from the classroom teacher, as well as what the teacher does not say or do. Hewitson believes the hidden curriculum at the classroom and school level is not communicating self discipline and intrinsic love of learning, rather, external motivation and competition as the norms. Baird & White (1991) question whether our detailed curricula and examinations constitute a facade behind which are encouraged dependence, reception of knowledge without reflection, and conformity rather than creativity.

Given that it would be financially, politically and possibly socially unrealistic to completely disband the present educational system and start over again, that is, to completely change the social implications of schooling for the learner, the question to be asked is: is it possible for a classroom teacher within the normal context of a classroom, to alter students perception of knowledge and learning in such a way as to foster the deep approach to learning? Researchers such as Entwistle (1988), Biggs (1991), Baird & Mitchell (1987) and others suggest that it is possible. By making the students more aware of their own approaches, the implications of adopting them, and creating an awareness of alternate approaches, leads the learner towards a deeper understanding of learning. This process also leads the learner to employ and practice strategies that are characteristic of the deep approach to learning.

This chapter began with an investigation of the term 'learning', which led to a description of the three approaches to learning which can be easily identified. It was found that the approach a learner adopts depends on his or her concept of learning and knowledge and some of the factors which may affect the formation of these concepts have been discussed. Learning within the context of science was also discussed. In the next section, the term metacognition will be defined, and links between metacognition and the deep approach to learning will be explored.

2.4.4 Enhancing learning skills; the role of metacognition.

By making the students reflect upon their own way of approaching a learning task, while at the same time creating an awareness of alternate approaches, a teacher encourages the students to engage in a process called *metacognition*. Metacognition is an aspect of cognition, the broad set of mental capabilities that make possible the intellectual functioning of human beings (Rowe, 1988). While cognition refers to the 'what' of learning, the reflective process, involving the 'how, when, where and why' of learning is referred to as metacognition. The literature contains various definitions of metacognition, but all hold in common that the concept refers to certain cognitive activities including:

> * **knowledge** about learning - eg. the nature of learning, personal learning characteristics, and effective learning techniques.

> * **awareness** of the nature, purpose, and progress of current learning - achieved by asking evaluative questions, and applying techniques for generating answers to these questions.

> * **control** of learning approach, progress, and outcomes through informed, purposeful decision-making.

> Baird & Northfield (1992, p. iii).

Metacognitive skills differ from cognitive skills in a number of ways. Cognitive skills can be regarded as enabling variables, in the sense that they facilitate learning. In contrast, metacognitive skills can be regarded as organising and controlling variables. As organising variables, they contribute to the selection and sequencing of both content and process (Rowe, 1988). Metacognitive variables might include:

> * **Planning,** deciding what my goals are and what
> **strategies** to use to get there.
> * deciding what further **knowledge** or resources I need.
> * **Monitoring** progress along the way, am I going in the
> right direction?
> * **Evaluating** when I have arrived, and
> * **Terminating** when the goals have been met.
> (Biggs and Moore, 1993, p. 307).

Metacognitive skills are of fundamental importance to at least two basic issues in learning. The first of these issues relates to students guiding their own learning processes. The second is related to the first and deals with the transfer of skills and abilities. Metacognition allows individuals to apply, adapt and/or modify what and how they have learnt to new tasks and across different situations (Rowe, 1988).

Effective thinkers and learners integrate metacognition with strategic cognitive behaviours. This dynamic interchange is an important component of general intelligence (Rowe, 1988).

Metacognition is evident when a student matches the task with strategy and motive to produce the desired outcome. The surface approach rarely involves any metacognition, while the achieving and especially the deep learning approaches require high levels of metacognition (Biggs & Moore, 1993). The successful completion of virtually any complex learning task involves some use of metacognition, knowing when you are off the right track, knowing if you have the knowledge or skills or knowing when you are finished (Biggs, 1991).

2.4.5 Fostering metacognition

Baird & Northfield (1992) bring to light two contrasting approaches for attempting to improve a person's attitudes to, and competence in learning. The first approach is prescriptive; thinking is a skill and can be effectively taught. A proponent of this approach is Edward de Bono.

> 'I believe that we should have a specific place in the curriculum that is set aside for the teaching of thinking skills. This formal recognition is essential so that students, teachers and parents all recognize that thinking skills are being taught directly. In time, I would certainly hope that the skills taught in the 'thinking lessons' would find their way in to such subjects as geography, history, social studies, and science. However, the first step is to establish 'thinking' as a subject in its own right.' (de Bono, 1986, p. 5).

de Bono is the founder and director of the Cognitive Research Trust (CoRT) and principal author of the CoRT Critical Thinking Program. As part of this program, the students practice a limited number of general learning skills in situations which do not require specific content knowledge for success. The CoRT program includes a series of preplanned, sequential lesson cards which are progressed through at a rate of one

per week. The emphasis of this approach is that training in thinking skills is done explicitly, and kept separate from normal learning of classroom content. However, Baird & Northfield (1992) state that the overall record of success of this method of general skills training is poor. A typical result is initial enthusiasm, with possibly a temporary improvement in achievement, but students typically revert to their original habits. (Martin & Ramsden, 1986). Such was my own experience using the CoRT program. The students found it difficult to transfer the learned approaches to everyday classroom content and processes. Often, the students rejected the advice, having already formulated methods which they had found to work in the past. This supports the work of Tabberer (1984) and Rowe (1988).

A contrasting approach to this explicit approach is to embed the training within the normal classroom learning context.

> The objective of teaching metacognition should not be viewed as competing with that of teaching content. They should be complementary to one another. The development of one to the neglect of the other will produce less than optimal results (Rowe,1988, p. 229).

An example of this type of approach is the Project for Enhancing Effective Learning (PEEL). This project aims to foster students' independent learning through training for enhanced personal metacognition by encouraging the students to become more willing and able to accept responsibility and control for their own learning. This approach embeds the training in these areas firmly within the normal classroom learning context and includes supporting teachers in their efforts to achieve such learning.

In the recent Review of the Queensland School Curriculum, Fensham (1993) who reviewed the science aspects of the curriculum has this to say of PEEL:

> 'The Project for Enhancing Effective Learning is an example of an idea for innovatory teaching and learning that has enabled more students to be successful learners....... (so) achieving a more inclusive science education. (Fensham, 1993, p. 315).

PEEL had its origins in 1984, when the project was first conceived by John Baird, a lecturer in Biology at Monash University and Ian Mitchell, a science teacher at

Laverton State High School in Melbourne. The project took the form of a two-year group-based action research investigation designed to improve the quality of student learning in everyday classrooms. The project brought together many teachers, tertiary academics and students who acted together to research classroom teaching and learning.

The objectives of the investigation were:

      1. To foster effective, independent learning through
         training for enhanced metacognition.

      2. To change teacher attitudes and behaviours to one
         which promote such learning.

      3. To investigate processes of teacher and student change
         as participants engaged in action research.

      4. To identify factors which influence successful
         implementation of a program which aims to improve the
         quality of students' learning.

      (Baird & Mitchell, 1993, p. 12).

The students were initially dependent and receptive with the teacher being dominant. After twenty-three weeks of the intervention, students came to exert greater control over their learning, made more decisions, understood more often, and at higher levels, why they did particular things (Biggs & Moore, 1993). During the course of the two years progress was made towards each of the four objectives. Baird & Mitchell (1987, p. 215) report that the most significant progress was with the teachers (objective 2), and considerable information was gained about the process of change in teachers and students (objective 3).

Some twenty-two conclusions were drawn from the study. A number of them have been reproduced below.

      1. Students have definite, conservative and restricted views
         about what constitutes learning and what are appropriate
         teacher and student classroom behaviours.

2. Initially, students are unable and unwilling to deal with a broad concept of active learning, they are more able and willing to deal with components of it.

3. Students have very little confidence in their ability to introspect about, monitor or control their learning.

4. Active learning is a tiring and novel experience for students.

5. Personal experience generally precedes changes in attitudes, conceptions and behaviours.

6. Significant student change will begin only after the relevant teacher changes have occurred.

7. Students need to see the personal cost which poor learning behaviours cause.

8. Given the negative effects of imperfectly designed and implemented techniques, the extent of student change indicates that achievement of objective one is possible.

(Baird & Mitchell, 1993, p. 215-220).

These changes did not come about easily, as one teacher's end of year comments show:

> During the year, I felt like I was engaged in a battle which at times was very personal, with my credibility being questioned, my motives doubted and my temper tested. I was amazed at how difficult it was for students to accept that teachers were concerned for them. (Dunne, in Baird & Mitchell, 1993, p. 144).

The project also found that developing and researching an innovation demands a high level of personal commitment from teachers. New techniques need to be practiced before they are effective, and as seen above, training and fostering more active learning can have both positive and negative effects on classroom management (Baird & Mitchell, 1993).

As the project advanced, a number of teaching strategies were introduced, evaluated and found to be in some way effective in the enhancement of learning and metacognition (Baird & White, 1991). Some of these techniques will be explained in the methodology chapter of this study. In concluding the findings of the study and reflecting on the implications for the future, the authors had this to say:

> The project did not provide all the answers, nor even produced a cohesive package of techniques which could be applied elsewhere. However, the project succeeded in revealing some of the inherent complexity of the undertaking, indicated some directions in which to go, and provided some useful lessons for what not to do. It has demonstrated that, for success, the teacher must match high levels of commitment with high standards of sensitivity, introspection and adaptability. Further, it has sheeted home final responsibility for learning quality to the learner. As in good teaching, good learning is a demanding process which, although benefiting from the quality of teaching, is not determined by it (Baird & Mitchell, 1993, p. 221).

What began as a two year project developed a seemingly unstoppable momentum. PEEL continued to grow at Laverton, and has become a permanent part of the school. Its findings have been duplicated and extended in a range of educational contexts, and the project has been adopted in many schools around Australia and interest has been shown from abroad. The problems and difficulties which arise through the use of PEEL are mainly in the area of the way in which the teacher's role is changed. Some teachers find these changes hard to adapt to (Biggs & Moore, 1993).

2.5 Conclusion.

This chapter has investigated certain areas of educational literature which have relevance to this study. The chapter began with a description of learning and the identification and formalisation of the approaches to learning. Literature exploring the promotion of learning and knowledge was also examined, together with some specific approaches which have been used, particularly in science education. The concept and role of metacognition in the development of learning led to a description of the PEEL project as a means of developing metacognition.

The next chapter of this paper will explain the design of the study. The use of case study methodology will be discussed and justified, and the methods of determining the students' approach to learning, including the Learning Process Questionnaire, will be investigated. The means of data collection and analysis and the teaching strategies aimed at promoting metacognitive learning will also be presented and explained in the forthcoming chapter.

CHAPTER 3
RESEARCH METHODOLOGY.

3.1 Introduction.

This paper uses a case study approach to investigate changes in students' approaches to learning when exposed to teaching strategies aimed at promoting metacognitive learning. This chapter includes a description and rationale for the use of the research methods employed in the collection and interpretation of the data for this study.

In the previous chapter it was seen that much of the early research into learning was carried out by experimental psychologists, in an attempt to uncover general principles of learning from the psychological perspective. Learning was defined as an observable change in behaviour as a response to environmental stimuli (Biggs & Moore, 1993). Such research aimed to explain student learning from the outside, through the eyes of a detached, objective observer interested only in those aspects of human cognition that can be conceptualised and quantified in terms of specific experimental procedures using traditional statistical methods.

Attempts at applying the theories derived from this perspective of research directly into practical and everyday activities of the classroom have not been particularly successful (Entwistle, 1984). The previous chapter went on to describe that an alternate paradigm exists which involves approaches to research rooted in phenomenology.

The phenomenological perspective of learning attempts to investigate the learning task in context and studies of this nature are based on qualitative 'illuminative evaluation' research designs which seek to evaluate learning from within, or from the students' perspective. Bowden (1986) supports the use of phenomenographic research because the process of trying to understand how students learn and to discover what different approaches students are taking, mirrors what good teachers do.

In using a phenomenographic approach, and for the purpose of this research, a case study approach appeared appropriate. Case study offers opportunity for the researcher to use direct investigative methods to pheneomenologically explore the world of the participants at particular points in time in their student life (Stenhouse, 1983; Stake, 1983).

3.2 Case study approach.

Case study is an umbrella term for a variety of perspectives which share a common aim - to focus on enquiry around an instance in order to capture those elements of a situation which give it meaning (Alderman, Jenkins and Kemmis, 1976). A case study captures meaning through a process of research which tries to describe and analyse some entity in qualitative, complex, and comprehensive terms not infrequently as it unfolds over a period of time (Wilson, 1979).

The case study approach to research has certain basic qualities:

1. case studies are particularistic. They portray events in one particular situation as it exists in reality.

2. They are holistic. They try to capture as many variables as possible and often include descriptions of history and context. They try to portray the interplay of different features and forces as they bear on the topic of interest. Brandt (1972) suggests they might be the ultimate multivariable study.

3. They are longitudinal. Usually they have a dynamic quality and tell a story which covers a period of time.

4. They are qualitative. Usually case studies use prose and literary technique to describe, elicit image, and analyze situations rather than to summarize quantitative data.
   (Wilson, 1979, p. 448).

Case studies have long been respected as a form of research which is useful because it deals with information in a complex, holistic, process-orientated, particularistic way which mirrors the reality of life in school settings (Wilson, 1979).

The work of Adelman, Jenkins & Kemmis (1976), Verma & Beard (1981) and others underlines the numerous advantages of case study. Case studies tend to:

1. Be strong in reality and thus provide a natural basis for generalisation. They are down to earth and attention holding and readers can respond using ordinary processes of judgement.

2. allow generalisations because of their attention to the subtlety and complexity of the case.

3. recognize the complexity and embeddedness of social truths and therefore can represent the discrepancies and conflicts between viewpoints of participants.

4. produce data which may form an archive of material rich enough for subsequent reinterpretation.

5. be a step to action. They begin in a world of action and contribute to it. Their insights may be directly interpreted and put to use - teacher development, policy making. In this way, case studies may revitalise educational practice.

6. produce data which are more publicly accessible. The language used in less esoteric, less dependent on specialised interpretation and capable of serving multiple audiences. In this way, case studies contribute to the democratisation of knowledge.

7. be more holistic. Case studies endeavour to understand the whole person in relation to their environment.

(McAllister, 1994, p. 7)

The case study approach used in this research to address the research question was characterised by three stages:

1. Identification of the initial learning characteristics of the students.

2. Identification of any changes in these learning characteristics following the exposure to teaching strategies aimed at promoting metacognitive learning.

3. Monitoring the students' perceptions of their own learning during this time using a variety of data sources.

Four sources of data collection were used in this process. The Learning Process Questionnaire (LPQ) was used for stages one and two. Student reflection worksheets, student interviews and teacher reflections were then used to monitor student perceptions of their learning. Sections 3.3, 3.4 and 3.5 of this chapter will offer explanations of the three stages in greater depth, with the first being the initial identification of the students' learning characteristics. The results chapter will be presented in a similar manner consistent with these three stages.

3.3 Stage One: identification of initial learning characteristics.

3.3.1 The Learning Process Questionnaire.

Recent findings published in educational literature, and reviewed earlier in this paper, have concluded that there exist three general identifiable approaches to learning. Each approach to learning is composed of affective components or motives, and accompanying cognitive components or strategies.

Figure 3. Motive and strategy in approaches to learning.

Approach	Motive	Strategy
SA: Surface	Surface motive (SM) is to meet requirements minimally; a balancing act between failing and working more than is necessary.	Surface strategy (SS) is to limit target to bare essentials and reproduce them through rote learning.
DA: Deep	Deep motive (DM) is intrinsic interest in what is being learned; to develop competence in particular academic subjects.	Deep strategy (DS) is to discover meaning by reading widely, inter-relating with previous relevant knowledge, etc.
AA: Achieving	Achieving motive (AM) is to enchance ego and self esteem through competition; to obtain highest grades, whether or not material is interesting.	Achieving strategy (AS) is to organize one's time and working space; to follow up all suggested readings, schedule time, behave as 'model student'. (Biggs, 1987a:3)

The usual method of assessing preferred approaches to learning is by questionnaire. The major questionnaires available are: the Approaches to Study Inventory, developed by Entwistle and Ramsden (1983), the Learning Process Questionnaire (LPQ) and the Study Process Questionnaire (SPQ), both developed by Biggs. The instrument designed by Entwistle & Ramsden was designed for British tertiary students, and as such, is not useful for the proposed study. The LPQ and SPQ were developed by John Biggs in Australia, the SPQ specifically for tertiary students and the LPQ for secondary school students. The LPQ has therefore been used in this study.

The Learning Process Questionnaire is a 36 item, self report questionnaire which allows each student's motives and strategies to be identified through the reduction of the student's responses to the questionnaire into a simple profile indicating the student's general approach to learning.

Each item in the LPQ is a self-report statement of a motive or a strategy. The respondents rate themselves on the item or statement from five (this item is always or almost always true of me) through to one (this item is never or only rarely true of me). The items are cycled through the three basic motives and three strategies in the following order: surface motive, surface strategy, deep motive, deep strategy, achieving motive, achieving strategy.

The coding procedure provides scores for each of the three motives and strategies. Age and sex based norms are provided with the LPQ so that an individual's score can be converted directly to deciles using tables provided.

A quick way of interpreting the numerical data produced by the LPQ has been the development of a shorthand symbolic profile devised by Biggs (1987). The student's profile is a representation of a general orientation towards learning. Biggs designates 'above average' (deciles of 8,9,10) as '+'; average (deciles 4 to 7) as '0'; and below average (deciles 1 to 3) as '-'.

If a student's profile includes a '+' in a subgroup, it indicates that the student has an above average preference for this style of motivation or strategy, alternatively, the student is motivated in this fashion or uses these strategies much of the time. A response in the '0' category of deciles indicates the student has an average preference for this type of motivation or strategy (motivated in this way or uses these strategies some of the time), while '-' indicates the student has a below average preference for this style of motivation or strategy and so would rarely be motivated in this way and would rarely use this style of strategies. It is also possible for individuals to display a strong preference for a combination of motives or strategies, for example, deep-achieving and surface-achieving.

A model student would have a deep-achieving profile which might read

surface motive	surface strategy	deep motive	deep strategy	achieving motive	achieving strategy
below average	*below average*	*above average*	*above average*	*above average*	*above average*
−	−	+	+	+	+

This can be portrayed graphically as illustrated below:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
-	-	+	+	+	+

Thus, this student has a below average surface motivation and preference for surface strategies, but an above average preference for both deep and achieving motives and strategies. Students with this type of approach to learning combine an interested search for meaning and personal relevance with a carefully organized and syllabus-oriented strategy to achieve high marks in the subjects concerned (Biggs, 1987b).

As a method of identifying the learning characteristics of the students, the LPQ lends itself well for use in the first and second stages of this study. Changes that have occurred in the learning characteristics of the students in the interim can be identified. Incorporating what is essentially a quantitative research tool into the research design is not an inconsistency. Parlett (1981) appreciated the value of quantification in this type of research.

> While concentrating on observation and technique....test scores can form merely one section of the data profile. Interest lies not so much in relating different test scores, but in accounting for them using the study's findings as a whole (Parlett and Hamilton, 1976, p. 95).

3.3.2 Identification of the general learning characteristics of the class.

Although the emphasis of this study is on identifying the learning characteristics of *individual* students and investigating any changes which may occur over time, it is useful to situate this within the framework of how the *class* responded to the LPQ at its first and second administration. The LPQ profiles for all the students in the class can be collated and tallied to show the relative distribution of students in each of the three LPQ motive and strategy sub-groups. By doing this, general patterns in the class' preferred approach to learning, motive and strategies may be identified so as to provide some perspective for the more detailed investigations of individual students.

The next chapter will present the results of the study, and will follow the three stages mentioned earlier. Section 4.2 of that chapter will focus on the results of the class group while section 4.3 will focus on specific students in a more detailed manner.

3.4 Stage Two: Identification of any changes in learning characteristics.

A second application of the LPQ and comparison of the learning profiles of the class and individuals in the class allowed the identification of any changes in learning characteristics which occurred.

3.5 Stage three: students' perceptions of their own learning.

The third stage of this study used a variety of data sources to monitor selected students' perceptions of their own learning during this time. The findings from this section of the research will be presented in a section 4.3 of the results chapter and will be in a narrative form, drawing on the information collected from interviews, student reflection sheets and teacher reflections for these students.

3.5.1 Case study data sources.

Good research practice, particularly in qualitative research, involves the use of triangulation, that is, use of multiple methods or data sources to investigate the one event in an effort to enhance the validity of research findings. The research carried out in this study involved the use of methodological triangulation, the use of a number of different methods of data collection. The greater the number of methods used, the

more likely it is that multiple viewpoints will be gained and thus, a more complete and trustworthy picture of the phenomena will be obtained (Cohen & Manion, 1989).

In the case of this study, a number of methods of data collection were used to investigate changes in learning initially identified by the LPQ. These methods included student reflection sheets, interviews, teacher refelctions and teacher observations. In some cases, the methods used to collect data were themselves promoting the development of metacognition.

> Self-reports, obtained by means of interviews, and questionnaires constitute the major direct methods for the assessment of metacognitive activity (Rowe, 1988, p. 233).

The process of making learners reflect on their own way of approaching a task leads the learner towards employing, temporarily at least, strategies which are characteristic of metacognition.

3.5.1.1 Student reflection sheets.

The first source of data was in the form of *Student reflection sheets*. These sheets were a one or two page questionnaire provided by the teacher and aimed at promoting reflection on learning. The reflection sheets were administered at the end of each unit or chapter of work, and themselves went through a process of evolution. Initially the sheets were modelled on weekly review sheets developed by Mitchell as part of PEEL (Baird & Mitchell, 1993, p. 45). Examples of reflection sheets are given in Appendix One. The aim of these sheets was to make the students reflect on their learning, and they were composed of a series of questions relating to the use of strategies, motivation, participation, level of understanding and how different topics link together. As an example, one section on the reflection sheet asked the student to rate his understanding by choosing from four categories: A, B, C or D, which were described as follows:

> A. I felt very confused.
> Not much made sense.
> I couldn't answer any questions.

B. Parts of it made some sense.

I think I could answer questions on these parts, but not on others.

I don't see how it all fits together.

C. It all makes some sense, but it is not easy.

I think I could answer questions on most of it, but only if the

questions were similar to ones in the notes.

I couldn't or wouldn't use the work in any new situation outside the

classroom.

I would find it very hard to explain to someone else.

D. It all seems common sense and fairly obvious.

I think I could explain it to someone else.

I think I could use this in new situations outside the classroom.

The early reflection sheets had each of A, B, C and D labelled as 'Little understanding', 'Partial understanding', 'Mechanical understanding' and 'Real understanding' respectively. In later reflection sheets these labels were not included. I realised that the labels contained judgement statements and may have been influencing the decisions of some students, either their egos would not allow them to admit to 'little understanding', or that 'deep understanding' must be the 'right' answer. When the labels were removed from the reflection sheets, the students had to read each statement fully. However, as a means of referral and comparison, I have used the labels in discussing the results.

3.5.1.2 Semi-structured interview.

The second source of data was a semi-structured interview. The aim of the interview was to draw out information on the following:

a) source of motivation for learning.
b) the meaning of learning.
c) awareness of changes in learning.
d) the nature of these changes in learning.

The planned questioned for the semi-structured interview are included as Appendix Two. The students were interviewed in pairs, as it was hoped that this would reduce

some of the pressure that a one-to-one interview might impose. However, this technique was not particularly successful, and on a whole, while useful, the data collected from the interviews was disappointing. When transcribing the interviews, it is found some that one of the students took a dominate role, with a result that the other student did not contribute as extensively, and in some cases did not verbally answer a number of questions. To overcome this problem, a further reflection sheet was given as a follow up to the interview. This reflection sheet varied from the then standard format and asked specific questions about motivations, concept of learning and perceived changes in learning characteristics. Refer to Appendix Three for an example of this reflection sheet.

3.5.1.3 Teacher reflections.

The third source of data for the investigation into the perceptions of student learning was my own reflections as teacher. Using a process of recall and record sessions at an interval of approximately a week, I endeavoured to reflect regularly on a range of factors affecting the study. This included my own performance and that of the class and individual student, strategies, apparent motivation, level of application and participation in the learning tasks as well as conversations and feedback received from the students about their learning.

The case study for each student presents data from these three sources and aims to show areas of convergence, divergence and contradiction of the data.

3.5.2 Selection of students for case study.

In selecting the individual students for the individual case study section of this paper, it was hoped that a cross sectional representation of the class could be achieved. With this aim in mind, three students were first chosen to give a diversity of academic achievement. This involved selecting an above average student, an average student and a below average student from the Term 1 results for the class. The 'above' and 'below' average students were approximately one standard deviation from the mean for the class.

From the initial LPQ student profiles from the class, an additional three students were chosen whose learning profiles indicated a preference for surface learning, deep learning and achieving learning, and finally, following the second application of the

LPQ, one more student was chosen because of significant changes in his LPQ profile and classroom performances. There are therefore, case studies of seven students.

3.6 Metacognitive teaching strategies.

From the literature review, it was seen that the concept of metacognition refers to certain cognitive activities including:

> * **knowledge** about learning - eg. the nature of learning, personal learning characteristics, and effective learning techniques.

> * **awareness** of the nature, purpose, and progress of current learning - achieved by asking evaluative questions, and applying techniques for generating answers to these questions.

> * **control** of learning approach, progress, and outcomes through informed, purposeful decision-making.

> Baird & Northfield (1992, p. iii).

Thus, some methods of encouraging the development of metacognition in the classroom might include:

> 1. the promotion of knowledge and awareness of metacognitive activity through demonstration and discussion of appropriate metacognitive skills.

> 2. the facilitation of conscious monitoring of cognitive activity by providing opportunities for feedback, by teaching self-questioning techniques, by encouraging students to summarise material, by teaching them to monitor their understanding and to pin-point difficulties.

> 3. the encouragement of deliberate executive control, for example, by assisting students to develop

strategies for dealing with new tasks, perhaps
initially by adapting a suitable model of learning
(Rowe, 1988, p. 230).

Within the context of the normal classroom and syllabus, I attempted to incorporate these three methods into my teaching through the use of PEEL strategies and other activities. The strategies used in ths study were selected from a large number presented by Mitchell & Mitchell in Baird & Northfield (1992). I placed emphasis on comprehension and urged the students to analyse what they were reading, to continually ask themselves 'What is important here?' or 'What is the author really trying to say?' and 'How does this fit in with the bigger picture?' As the students neared their exams, I produced a handout that attempted to consolidate this type of self questioning into a series of 'structured thinking' procedures. The production of the handout was prompted by PEEL (Baird & Northfield, 1992, p. 256) and an example is included as Appendix Five.

I tried to give fewer notes, and encouraged the students to take their own, through a process incorporating the application of the above questions. I also tried to foster a feeling of independence from external guides. This was particularly apparent to the students when they asked how long should their summaries be. Some were shocked when I explained that they had to make that decision themselves. 'Do what is best for your own learning' was an often repeated statement, and meant that the students had to reflect on what was best for them, and a lot of comparisons went on.

I also placed a strong emphasis on the holistic nature of knowledge and learning, with parts of some lessons (particularly ones introducing new topics) being devoted to exploring the historical background to the topic and how it links with other topics in science, other school subjects and knowledge in general.

The use of concept maps as a means of investigating the links between different concepts was encouraged, perhaps a little too energetically at first. Concept maps were used in class and on the student reflection sheets. A concept map aims to show how someone sees the relations between things, ideas, or people. Most often, maps are used with terms that make up the content of a series of lessons. The process of drawing a concept map requires the student to arrange some terms on their page and each is connected by lines to as many others as is sensibly possible. On these connecting lines is written the nature of the link. The students initially accepted the idea and produced

some good examples, but grew tried of them because of over-use in the first Term, so that the quality of the concept maps they produced suffered.

I tried to change the emphasis in my questioning technique from asking simple closed questions requiring a single correct answer to questions which included statements like 'why?' and 'what if?'. Many classes were started with a 'Quick Quiz', composed of about ten questions. This served a number of purposes, it settled the boys quickly, allowed revision of the previous lesson and often sparked discussion which led into the current lesson. Some students composed 'Quick Quiz' questions for the class to attempt.

As part of the Term Three topic 'Energy alternatives', an assignment task was introduced. The task centred around designing and establishing a small, energy self sufficient house on a remote Scottish Island with a fixed amount of money. The assignment was based on Bryan Milner's 'Solving a Current Problem', produced by the National Association for Curriculum Enrichment and Extension. As long as the students were sensible, and their mathematical working correct, there was no right or wrong solution or way of going about the task, my emphasis was that the students should be able to show justification for each decision made.

One possible way to approach the task was firstly to decide what electrical appliances would be necessary in the house, taking into consideration environmental factors such as temperature, rainfall, wind strength and length of day (tables of this information were provided with the assignment). Having decided which appliances were required, the students had to calculate the electrical current needed to run these appliances. Examples of the calculations were discussed in class. The current was then used to choose the storage device. In this case, specifications of a wide variety of batteries were included in the assignment, and finally, the students had to choose a method of keeping the batteries charged. The assignment included information on a range of electricity generating devices such as solar cells and wind turbines, and the choice made could be justified by consulting the tables of hours of sunlight, average wind strength and direction.

As a class, we spent approximately two weeks working on the task, which was significant because it allowed the students executive control over the way they organised and went about the task as well as the decisions they made as part of the task. The process of justifying each decision involved the exercising of metacognitive enriching skills such as comprehension, the construction of tables and diagrams,

information interpretation and selection (including the identification of irrelevant data), structured and critical thinking and the monitoring of personal progress.

At other times during the year, a procedure called 'Predict, Observe, Explain' (POE) was used. This procedure was described by Baird & Northfield (1992) and has three stages. Firstly, the students are shown a situation and asked to make a written prediction (with reasons) as to what they think will happen when some change is made. The change is then made and the students record their observations. Finally, they attempt to make explanations to account for any differences between their predictions and their observations. POE's were applied to many different concepts including motion under gravity, the behaviour of different materials when exposed to liquid nitrogen, electric circuits, heat transfer, the properties of matter and in particular the behaviour of gases.

3.7 Issues of Reliability and Validity.

The results of qualitative ethnographic research are often regarded as unreliable and lacking in validity and generalizability (LeCompte & Goetz, 1981). These issues need to be addressed.

3.7.1 Reliability.

Reliability in ethnographic research addresses the issue of whether the research could be replicated by other researchers under similar conditions.

A case study approach was used in this study as it captures meaning through a process of research which tries to provide understanding of some entity within a particular context as it unfolds over a period of time (Wilson, 1979). Hence, the exact replication is often not possible as the context will change with time. Variables can not be controlled, and in many cases one does not wish to control them. The reliability of a study can be increased through the use of methods of data collection which themselves have been proven to be reliable. Biggs (1987b) has trialled the LPQ extensively and reports satisfactory reliability.

3.7.2 Validity.

While reliability deals with the replicability of the findings, validity in concerned with the accuracy of the findings. Validity also refers to the precision or confidence one has that the method measures what it claims to measure (Kellehear, 1993).

In this study, an attempt to maintain validity was made through the process of corroboration and feedback of information to the participants with the students. The students had access to their LPQ profiles and reflection sheets during the interview phase and were often able to add to or clarify previous resposes.

Bias on the part of the researcher must also be considered as a threat to validity. The researcher employed 'critical friends' or 'confidantes' (Miles & Huberman, 1984) as a means of ensuring the effects of bias were minimized. The acknowledgement of possible bias is a step towards alleviating its effects.

Possible and probable effects of the observer's presence on the nature of the data gathered must also be considered. It is an accepted scientific principle that one can not observe or measure a system without altering the system in some way. This concept holds true for ethnographic research. The process of observing and recording behaviour, and gaining insights into learning practices through interviews and self-reports will to some extent influence the behaviour and reported learning practices in those being studied. The Hawthorne or Halo effect is a well documented form of abnormal behaviour (Argyris, 1952; Cook & Campbell, 1979; Campbell & Stanley, 1963), where the subjects may consciously plan to reveal themselves in the best possible light. This effect may also occur when subjects unconsciously distort the data by providing what the subject believes the researcher wants to see (LeCompte & Goetz, 1981).

3.7.3 Triangulation.

Good research practice, particularly in qualitative research, involves the use of triangulation, that is, use of multiple methods or data sources to investigate the one event in an effort to enhance the validity of research findings. The term triangulation is a reference to the navigator's taking of sightings of celestial bodies and using a set of tables to reduce these sightings to a series of lines on a chart. If three or more cross close together, then the position is triangulated. The closer they cross, the more accurate the position is. In the research carried out in this study, methodological

triangulation was employed through the use of a number of different method of data collection. The greater the number of methods used, the more likely it is that multiple viewpoints will be gained and thus, a more complete and trustworthy picture of the phenomena will be obtained (Cohen & Manion, 1989).

However, Mathison (1988), explains that the process of triangulation can in fact produce three possible outcomes. The first is that which is commonly assumed to be the goal of triangulation, convergence. The data from the different sources provides evidence that will result in a single proposition about some social phenomenon. A second, and frequently occurring outcome from triangulation is inconsistency among the data. In this case, the range of perspectives or data do not confirm a single proposition. The third possible outcome is contradiction. It is possible not only for the data to be inconsistent, but to actually be contradictory (Mathison, 1988, p. 15).

Patton (1980) emphasised the problematic nature of triangulation.

> There is no magic in triangulation. The evaluator using different methods to investigate the same program should not expect that the findings generated by those different methods will automatically come together to produce some nicely integrated whole (Patton, 1980, p. 330).

However, this is not always a bad thing, and Patton goes on to suggest that the point of triangulation is in fact to study and understand when and why there are differences.

Mathison (1988) argues that the value of triangulation is not as a technological solution to a data collection and analysis problem, but rather as a technique which provides a rich and complex picture of some social phenomenon being studied, from which the researcher can construct meaningful propositions about the social world.

3.8 Conclusion.

This paper used a case study approach to investigate changes in students' approach to learning when exposed to teaching strategies aimed at promoting metacognitive learning. This chapter included a description and rationale for the use of the research methods employed in the collection and interpretation of the data for this study, and a description of the teaching strategies used to promote metacognitive learning. In the next chapter, the results of the study will be presented and discussed.

CHAPTER FOUR
RESULTS & DISCUSSION.

4.1. Introduction.

In this chapter, the results and information which have been gathered will be presented and discussed. As explained in the previous chapter, this study has three stages:

1. Identification of the initial learning characteristics of the students.
2. Identification of any changes in these learning characteristics following the exposure to teaching strategies aimed at promoting metacognitive learning.
3. Monitoring the students' perceptions of their own learning during this time using a variety of data sources.

This chapter will begin by reporting the general learning characteristics of the class as identified by the LPQ in stages one and two. Individual case studies of the selected individuals will then be presented. This will include data from three sources student reflection worksheets, student interviews and teacher reflections. The results will be presented in a manner consistent with these three stages, with the first being the identification of the students learning characteristics.

Thus, while the presentation of the results will follow the three phases explained earlier, section 4.2 of this chapter will focus on the class group and section 4.3 focusing on specific students in a more detailed manner.

4.2. General Learning Characteristics of the Class.

4.2.1. The class group.

Science is a compulsory subject and the 198 year 10 students at the College are divided into eight classes. The Science Department does not carry out any streaming of students into classes, however the students are streamed for Mathematics. In an effort make timetabling easier, wherever possible, class groupings are kept consistent for Mathematics, Science, English and Religious Education. Thus, the eight science classes are streamed to some extent.

As a Science Teacher at the College, I was allocated two year 10 classes, 10Sc1 and 10Sc7. This allocation was beyond my control. The identifying numbers are arbitrarily allocated although in this case, 10Sc1 was generally a more academically able class and

was chosen for the study on the basis that I felt the students of this class could express themselves with more fluency.

The LPQ was first administered to the class early in Term One. At the time, the class consisted of 35 students, however during the course of the year the number of students in the class changed due to factors beyond my control. Four students changed classes or left after the initial LPQ was administered, one student was absent on the day of the initial LPQ, while four other students were absent for the second LPQ. Thus, the total number of students who sat for both applications of the LPQ was 26.

## 4.2.2. Identification of the Learning Characteristics of the Class.

To situate changes in learning profiles of individual students within the framework of how the *class* responded to the LPQ at its first and second administration, the each student's LPQ responses were firstly coded in the manner explained in the previous chapter, producing a symbolic learning profile for each student. By tallying the number of students who were coded as '+' , '0' and '-' in each of the six sub-groups, the relative distribution of the class' motive and strategy preferences can be investigated. The general patterns in the class preferred approach to learning, motive and strategies will provide some perspective for the more detailed investigations of individual students.

TABLE 1.

LPQ subgroups	Category	No. of students
Surface Motives (SM)	–	3
	o	14
	+	9
Surface Strategies (SS)	–	9
	o	8
	+	9
Deep Motives (DM)	–	9
	o	11
	+	6
Deep Strategies (DS)	–	10
	o	11
	+	5
Achieving Motives (AM)	–	5
	o	8
	+	13
Achieving Strategies (AS)	–	4
	o	13
	+	9

This data can also be displayed graphically.

FIGURE 4.

Class responses to first LPQ
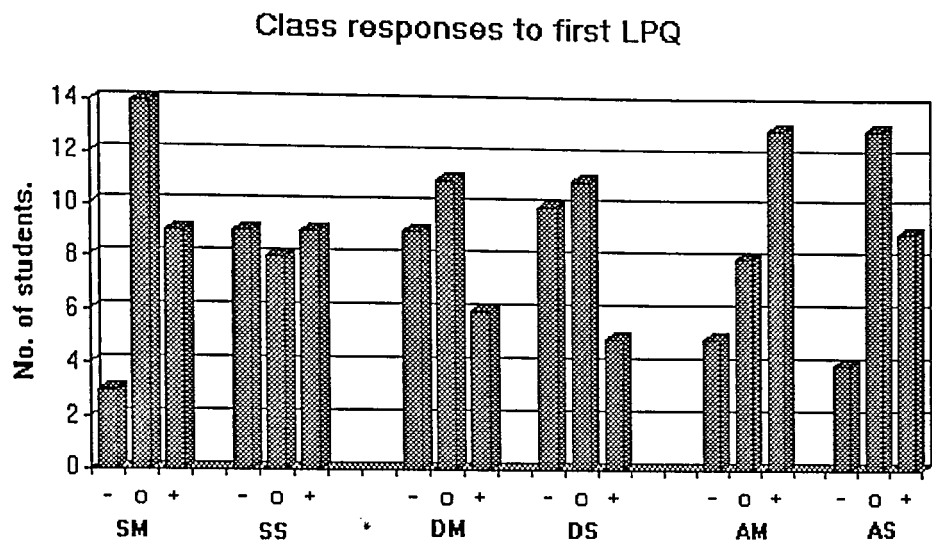
A '+' response in any of the sub-groups indicates an above average preference for this style of motivation or strategy, alternatively, the student is motivated in this fashion or uses these strategies much of the time. A response in the 'o' category indicates the student has an average preference for this type of motivation or strategy (motivated in this way or uses these strategies some of the time), while '-' indicates the student has a below average preference for this style of motivation or strategy and so would rarely be motivated in this way and would rarely use this style of strategies.

### 4.2.3. Identification and investigation of changes in Learning Characteristics of the Class.

A form of comparison is required to identify any changes in the general learning characteristics of the class. This comparison is readily supplied through a second application of the LPQ, which was carried out at the end of Term 3. The results were once again tallied and are displayed in Table 2 and in graphical form as Figure 5.

TABLE 2.

LPQ subgroups	Category	No. of students
Surface Motives (SM)	–	4
	o	11
	+	11
Surface Strategies (SS)	–	8
	o	10
	+	8
Deep Motives (DM)	–	10
	o	5
	+	11
Deep Strategies (DS)	–	9
	o	12
	+	5
Achieving Motives (AM)	–	5
	o	10
	+	11
Achieving Strategies (AS)	–	4
	o	13
	+	9

FIGURE 5.

Class responses to second LPQ
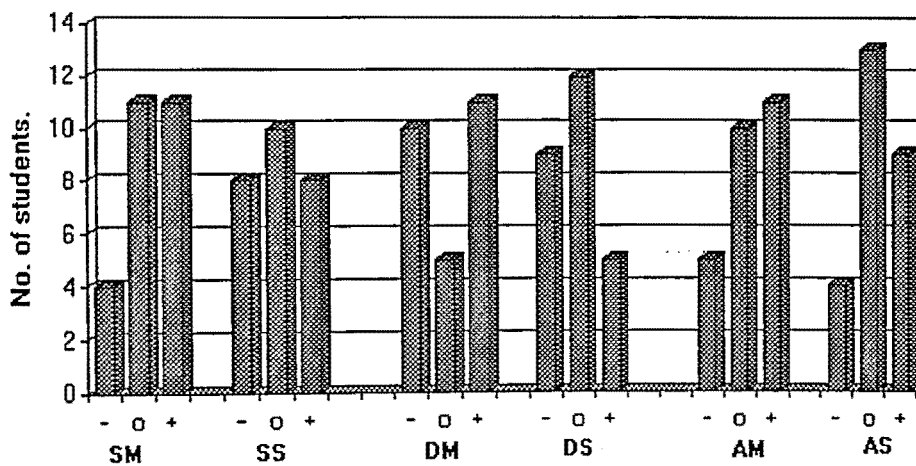
Using the data from Figures 4 and 5 as a starting point, it is possible to compare the relative distributions of student motivation and strategies as indicated by the LPQ at the start of Term 1 and at the end of Term 3. Let us begin by looking more closely at the motive responses. To make the data clearer, Figures 6 and 7 are reproductions of Figures 4 and 5, showing only the motive subgroups.

FIGURE 6.

First LPQ: motive responses.

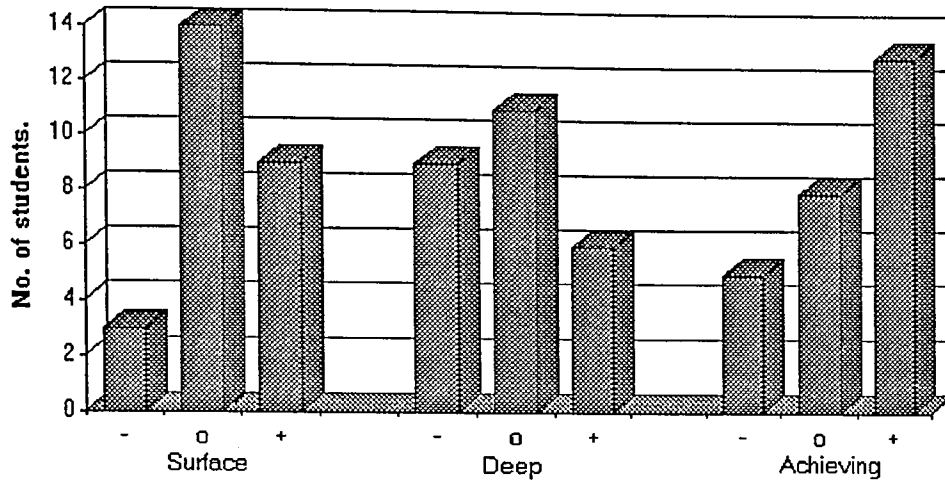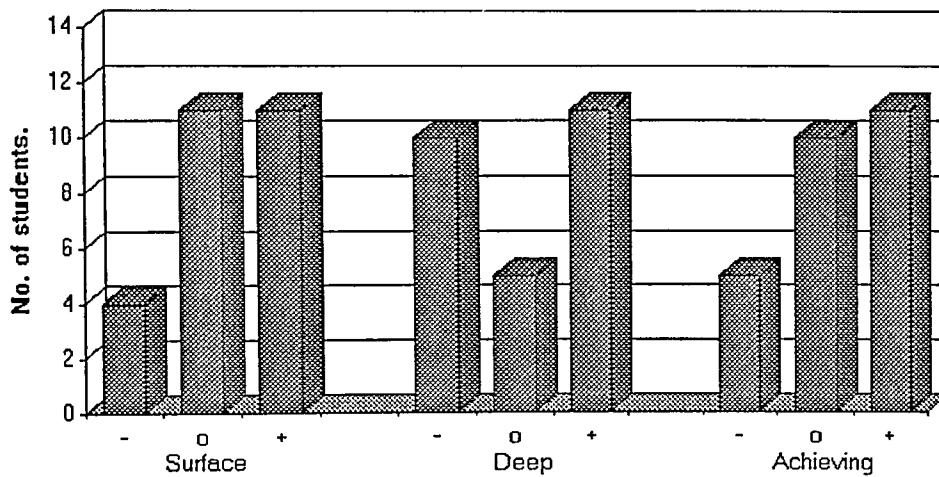FIGURE 7.

Second LPQ: motive responses.

With reference to Figure 6, it can be seen that, at the beginning of Term one, 13 students (half the sample group) indicated a strong preference for the achieving motive. Over half the respondents (14 students) indicated that they had an average preference for surface motivation and 9 students indicated that had a strong preference for surface motivation.

The second application of the LPQ (Figure 7) indicated that the distribution of responses in the achieving subgroup has remained relatively constant while the distribution in the other two subgroups has changed in a number of interesting ways:

Firstly, the number of students indicating a strong preference for surface motivation has increased. This might be an indication that these students have rejected the metacognitive interventions and have resorted to a predominantly surface approach.

Secondly, the distribution of responses for the first LPQ deep motive subgroup was a bell curve shape, while the responses for the second LPQ have been polarized towards the above and below average categories. This indicates that some students have developed deep motives while others have rejected them. Certain students were quite opposed to some of the metacognitive teaching strategies and this will be explored through individual case studies later in the chapter. Another factor which may have affected this result is the fact that most students start the year with good learning intentions. As the initial LPQ was at the start of the year, these non-enduring learning intentions may have been recorded.

In contrast, the strategy responses for both LPQ's display remarkable consistency. Figures 8 and 9 are once again reproductions of Figures 4 and 5, showing only the responses to the strategy subgroups.

FIGURE 8.

First LPQ: strategy responses

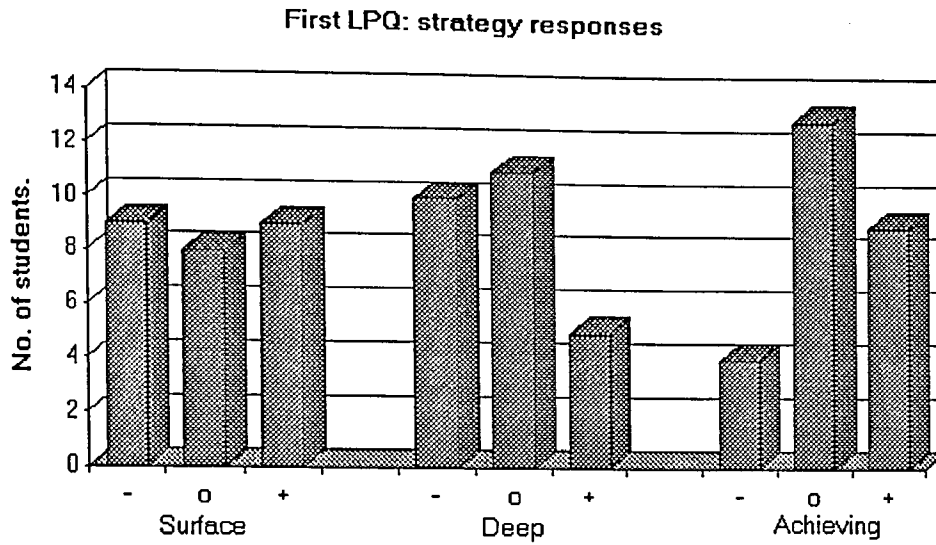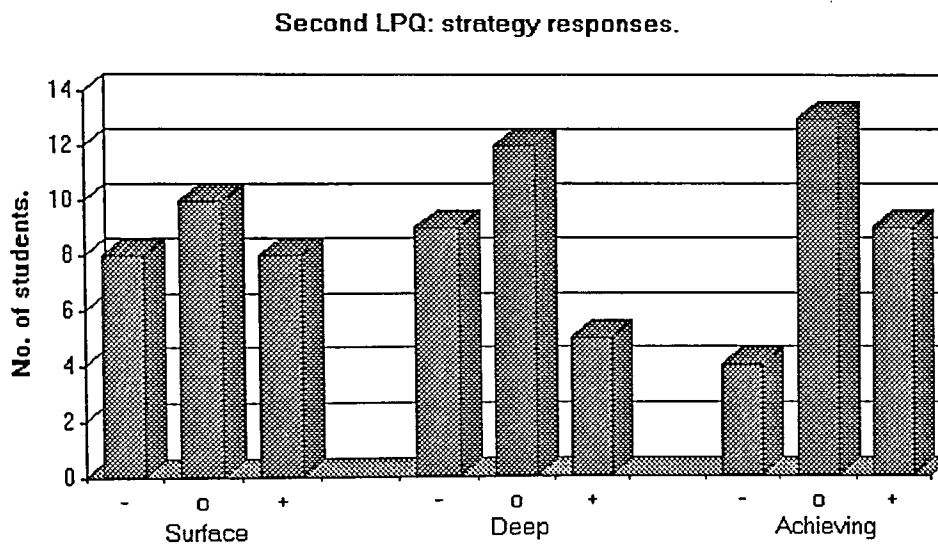## FIGURE 9.

Second LPQ: strategy responses.

There is only one slight change to note which lies in the small increase in the number of students who indicated an average preference for surface strategies. This consistency may indicate that there was not enough time for the changes in motives to flow through into changes in strategy, or that the students were not aware of other strategies.

This investigation into how the class responded to the first and second administration of the LPQ and the identification of some changes in learning preferences at the class level, provides a stepping stone to the investigation of certain individuals in the class.

4.3 Investigation of Individual Students.

In this section, the learning characteristics of a number of individuals in the class will be identified. Changes that occur in these learning characteristics will then be identified and investigated.

Three students were initially chosen on the basis of academic merit: one below average student, one average student and one above average student. The average was taken from the first term's science exam. From the initial LPQ student profiles from the class, an additional three students were chosen whose learning profiles indicated a preference for surface learning, deep learning and an achieving learning, and finally, following the second application of the LPQ, one more student was chosen because of significant changes in his LPQ profiles and classroom performances.

The introduction and description of each student is a composite description based on interview, student reflection sheets and teacher reflections.

4.3.1 Case study 1. Liam.

Introduction to the student.

Liam was included in the study as a below average student (9% below average in term 1). As his teacher, my impression was that Liam seems to have a casual attitude towards his work, he was very often restless in class and looked for excuses to avoid engaging the task at hand. Liam was the student who was most often mentioned in my reflections.

> 'I had another confrontation with Liam today. After twenty
> minutes he did not have his book open. He said he was
> about to open it and I interrupted him!' (Teacher reflection,
> 5/8/94).

> 'Liam arrived very late to class on Thursday. I am
> beginning to think this is a planned exercise. He often
> makes a point of keeping his cap on until told personally to
> take it off.' (Teacher reflection, 26/8/94).

This practice increased as the year went on, to a point where he was doing very little work in class or at home. Any advice offered seemed to fall on deaf ears and, if challenged over his lack of work, he would try and laugh it off, often saying 'you're kidding...... I was just about to start', or 'it'll be alright.' I found this student to be very frustrating to deal with.

In the interview, Liam stated that he likes some subjects, mainly the ones involving hands-on components. There are subjects that he doesn't like. 'Some subjects I try and do well, but others I get annoyed and I couldn't be bothered. I think I can learn pretty well, but sometimes I don't want to learn.'

Identification of learning characteristics.

Liam's initial LPQ profile indicated a preference for deep motives, but combined with surface strategies.

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
-	+	+	O	O	O

This combination of preferences seems to be mutually exclusive. Biggs (1987a) states that it is difficult to see how one could simultaneously rote learn and seek meaning.

Identification of changes in learning characteristics.

By the end of term 3, Liam's profile had changed to:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
O	O	O	O	O	-

There are four changes to Liam's learning profile:
a) an increase in surface motive, from '-' to 'O',
b) a decrease in surface strategies, from '+' to 'O',
c) a decrease in deep motive, from '+' to 'O' and
d) a decrease in surface strategy from 'O' to '-'.

Liam's final learning profile is characteristic of the low-achieving pattern (Biggs, 1987b).

> These students are not necessarily of low intelligence, but are highly defensive when their competence is being publicly evaluated, especially in a competitive situation. Consequently these students are skilled task avoiders, which they do by 'forgetting' crucial assignments, setting impossibly high or trivially low goals (either way they are off the hook) (Biggs, 1987b, p. 16).

Investigation of changes.

My own reflections on Liam's progress during the year support the shift towards this low-achieving pattern of learning behaviour. I felt very frustrated trying to encourage him to learn during the year, as I felt he had talent but was squandering it. By the end of Term 3 and beginning of Term 4, my impressions were that Liam was so poorly motivated that he did literally nothing in class, while remaining very defensive and argumentative when challenged about his work.

> 'I pulled Liam aside again after Tuesday's lesson. He had only four lines of work to show for the whole period. I cannot seem to be able to reason with him. He does no work, but he won't accept or admit it himself that he does nothing. Talking to him is so frustrating! Nothing was achieved or resolved.' (Teacher reflection, 9/9/94).

In contrast, Liam thought that his work habits improved during the year.

> In the first part of the year I didn't do any homework for any subject, never got around to it , I would just go into my bed room and sleep, then at the end of first term, my report was alright, I got a couple of A's but then in second term I got a few D's so I studied a little bit, I used to hate study, but now that I am doing a bit of work, I don't find it so bad.

Liam was erratic with the completion of his reflection sheets, sometimes returning them unanswered or with some parts or questions incomplete. In the interview, Liam said that he rarely thought about his own learning, although the reflection sheets

sometimes forced him think and reflect. One section of the reflection sheets asked the students to rate themselves from low to high on certain aspects such as how hard they had to think, what was their level of motivation, how hard did they try, how actively did they participate and so on. On one of these sheets, Liam responded with 'low' for every aspect except one, a 'medium' for how interesting was the work. Liam remembered this sheet in the interview.

> 'The one I did the other day asked how much effort did I
> put in etc, it got low, low, low, low... and that made me
> think a little bit. I had to choose my subjects for next year,
> and I want to get into the non-OP thing, but I've got to
> show an improvement in my work and then I did that sheet
> where I marked all the questions as low, low, low, low etc
> and that made me think.'

Liam stated in the interview that he found the 'Solving a Current Problem' task difficult.

> It wasn't the sort of assignment you could do on the last
> night. There was a lot of calculations involved in doing it.

During class time which was devoted to the task, Liam constantly asked 'what do we have to do?', 'what do you want?' and finally, on the student reflection sheet for the asked, 'what was the point?' However, he did admit in the interview that he probably learnt more about the use of alternative energy sources by doing the task than by normal methods of teaching.

Conclusion.

Liam's LPQ results that his motivation for learning in science declined through the year to a point where his learning profile was that of a low-achiever. Teacher observations showed that he displayed many of the characteristics of this type of learner including task avoidance and defensiveness. It seems that the teaching strategies aimed at promoting metacognition have had no impact, or that he has rejected them. In contrast, his interview indicated that reflection sheets were remembered as causing him to reflect on his learning. Other interview comments contradicted the LPQ results, with Liam considering that his approach to work had improved. Enough evidence was gathered to describe Liam as a low achiever, yet capable of some reflective ability which may enable him to progress, particularly in his preferred subject areas.

4.3.2 Case study 2. Steven

Introduction to the student.

Steven lives in the local area and is a day boy at the school. He was included in this study as an average student (3% above average in term 1). From my own observations, Steven is a very quiet, reliable student, so quiet in fact, that he said very little in the interview! Steven reported in a reflection sheet that his motivation for learning was to 'get really good report cards'. This motivation was confirmed in the interview: 'You have to get good marks to get a good job.'

Identification of learning characteristics

His initial LPQ profile indicates a preference for achieving motivation:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
O	-	O	O	+	O

Steven's initial LPQ profile indicated a preference for achieving motivation, which matches statements made in the interview and on reflection sheets.

Identification of changes in learning characteristics.

Steven's learning profile following the second administration of the LPQ indicates only one change, a reduction in preference for deep motivation.

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
O	-	-	O	+	O

Investigation of changes.

Every question on Steven's reflection sheets was completed in a neat, concise manner. However, it appeared as though his goal was to simply answer every question, and those which required more detailed responses and a deeper level of reflection were generally answered in a very simple fashion with very few revealing insights or evidence of reflection. This may have been a result of his preference for achieving learning, being more focused on getting the task done rather than much time reflecting

and using deep approaches, which, for him were a much less preferred approach to learning. Steven's responses in the interview situation were also limited, and often consisted of simply agreeing with what the other person was saying (his partner for the interview was Dion, who was also an achieving learner).

Steven's concept of learning was described on one of his reflection sheets as:

> Learning to me is getting to a stage where I can go into
> an exam and do it easily, pass every subject.

Steven reported in the interview that his learning had changed during the year,

> 'My ideas of learning have changed slightly since the start
> of the year because for me this year is very important. I
> want to get a good Junior Certificate at the end of the
> year.'

These statements confirm his achieving approach to learning. He indicated in the reflection sheets that he has come to be more aware of when he can't instantly understand a topic, On the student reflection sheets, Steven most commonly rated his understanding at the 'real' level, that is, it all seems common sense and fairly obvious, he could explain it to someone else and could apply the knowledge in new situations outside the classroom. On the reflection sheet for the chapter 'Acids and Bases', Steven rated his understanding as real, but expressed concern that he did not understand how to balance chemical equations. This could indicate that his learning was not actually at the real level, and reveals possible flaws in his metacognitive processes.

Steven made use of concept maps during the year, and the quality of these improved as the year went on. He was one of the few students who consistently answered the student reflection sheet question which delt with links between other topics and subjects, although sometimes these were too general or trivial.

Conclusion.

The data collected from Steven's interview, reflection sheets and teacher reflections confirmed his LPQ indicated preference for achieving. These data sources also indicate that while the teaching strategies aimed at promoting metacognition have introduced him to some additional learning strategies such as concept maps, there has been little

recorded changes to his metacognitive strategies or motives. The relatively small amount of data may be a result of Steven's reserved nature and lack of metacognitive reflection.

4.3.3 Case study 3. Mark.

Introduction to the student.

Mark is from Southport, on the Gold Coast, and is a boarder at the College. He was included in the study as an above average student (12 % above average). He states his motivation for learning is to get a good job when he leaves school. From my own observations, Mark seems to be a conscientious and diligent student, although he is sometimes self-critical and lacks confidence in his own abilities.

Identification of learning characteristics.

His initial LPQ profile was:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
O	-	O	-	O	O

Considering that Mark is an above average student, his profile is very interesting, showing a variation of the low-achieving profile explained in a previous case. When faced with a learning task, such as the 'Solving a Current Problem' task, this lack of strategy became apparent. Mark was well motivated and clearly wanted to do well but often lost his way by getting bogged down in the details of the task.

> 'Mark came up to me in class in an almost distressed state of mind. He couldn't work out some of the calculations, and was tangled up in voltage and current. One of his problems was that he was trying to run his 12 volt appliances off a 240 V source (the inverter). He couldn't see that the key to choosing the right inverter, was by firstly working out the total current that it would need to provide to the 240V appliances only. He finally realised that he could run his 12 volt appliances directly off the batteries, but it took alot of prompting' (Teacher reflection, 18/7/94).

It seemed as if he was unable to grasp an overall picture of the learning task and where he should have been heading. Thus, he could not formulate a logical progression through it.

Identification of changes in learning characteristics.

By the end of term three, Mark's profile had changed to:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
O	-	+	O	O	+

There are three changes to Mark's learning profile:
a) an increase in deep motivation
b) an increase in deep strategies
c) an increase in achieving strategies.

If Mark continues to change in this manner, his profile will soon reflect the desirable deep-achieving approach to learning.

Investigation of changes.

On the reflection sheet which was a follow-up to the interview, Mark describes learning as 'turning something you don't know into something you do know well and can understand.' This concept of learning contains elements of deep learning. He realises that his learning habits have changed through the year, but implies a decrease in the quality of learning 'after you study all year, you just get sick of it.' This statement is in conflict with his LPQ profiles and my own teacher reflections, which did not record any changes in application or behaviour.

On his reflection sheets, Mark alternated his rating of his understanding level between 'Mechanical understanding' and 'Real understanding'. On the reflection sheets, mechanical understanding meant that the work makes some sense, but it is not easy, that he could answer most questions on the topic, but only if similar to the notes, he couldn't or wouldn't use the knowledge outside the classroom, and would find it difficult to explain to someone else. Real understanding, in the context of the reflection sheets, was taken to mean that the work seems common-sense and fairly obvious to the student and that he or she could explain it to someone else and could apply the knowledge to new situations outside the classroom. The data drawn from self-reports

and reflections can sometimes be distorted by the overly self-critical nature of some respondents. This may account for variations between Mark's reflection sheets and his final LPQ profile.

From my own reflection, Mark took the structured thinking handout very seriously. When the class discussion turned to learning strategies and hints that might help, he always listened attentively and tried to incorporate these into his work.

> 'We went outside onto the lawns and sat in the sun for today's lesson. I gave out the structured thinking sheet, but may as well have not bothered. Most read it, but no one was in the mood to spark off a discussion. Mark, Steven, Dion and Michael later asked me some good questions about it, the others just threw seeds at each other.' (Teacher reflection, 12/8/94).

Conclusion.

The triangulation of Mark's data has shown divergence on a number of points. At the start of the year, his LPQ results resembled the low-achieving profile, which was not supported by the other data sources. At the end of term three, Mark's learning preferences developed the characteristics of the deep-achieving profile, while his conception of his own learning was one of regression. These examples of Mark's contradictory data may have been due to his lack of self confidence and self-critical nature. I believe the teaching strategies aimed at promoting metacognitive learning have aided Mark's progress, and as his self confidence develops, he should be able to consolidate his deep learning habits and build on them.

4.3.4. Case study 4. Alex.

Introduction to student.

Alex is an American whose father is on work exchange for a year. In the interview, Alex stated that he likes coming to school, and in particular he likes sports and maths. 'I could do maths forever....'. He tries to do well at school and doesn't misbehave because he wants to do 'the right thing'. Alex stated on a reflection sheet that his motivation for learning was self improvement. As his teacher, my impressions of him match these statements. He is quiet, well behaved and works well in class. He seems confident in his own abilities, and described himself as 'a good learner' in the interview.

Identification of learning characteristics.

Alex is an above average student (18.5% above class average in term 1). His initial LPQ profile was:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
O	-	O	+	+	+

Alex was chosen early for inclusion in the study because he was one of two students whose profiles most closely resembled the deep-achieving approach to learning (00 ++ ++ or -- ++ ++). Students with this type of approach to learning combine an interested search for meaning and personal relevance with a carefully organized and syllabus-oriented strategy to achieve high marks in the subjects concerned (Biggs, 1987b).

(The second student with a similar profile was a very shy, hardworking Papua New Guinean student whose +- ++ ++ profile is an almost perfect deep-achieving profile. Because of the student's shyness, perhaps caused by a lack of confidence with his spoken English and an almost perfect learning approach where very little improvement could have been expected, the student was not included in the study. As a point of interest, his profile did change to +0 ++ ++, indicating an increased preference for surface strategies).

Identification of changes in learning characteristics.

At the end of term three, Alex's profile had changed to:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
-	-	+	O	+	O

Three changes have taken place with Alex's learning profile.
a) a reduced preference for surface motivation,
b) an increased preference for deep motivation and,
c) although initially indicating an above average preference for deep and achieving strategies, his preference for both of these decreased through the year.

Investigation of changes.

In the interview and through reflection sheets, Alex indicated that he was aware of changes in his learning. He mentioned a increase in note taking ability and time management.

On his chapter reflection sheets, Alex consistently rated his understanding level as 'Real', the highest of the four given choices, indicating it all seems obvious to him and that he could explain it to someone else and could apply the knowledge in new situations outside the classroom. He also indicated that he knew what he was doing and why all of the time.

Alex consistently drew concept maps which were of a good standard on his reflection sheets, and used concept maps as part of his own revision and study. He was one of the few students to persist with this technique, despite the fact that his second LPQ profile indicated a decrease in preference for deep and achieving strategies.

Alex reported that the 'Solving a Current Problem' task was '...confusing at first, before you figured out what to do, work out the equations and stuff....' He read the assignment through completely to see what question was being asked and then tried to find a starting point. He was one of the few students who did this. He also reported that the assignment made use of many different skills, reading, looking at tables.... He was confident that he had been able to learn better by doing the assignment because '...you are working for yourself.'

With regard to homework, Alex reported that he does between 3-4 hours per night. He does not give each subject an even weighting of time and tend to set his own time limits. '....and sometimes when you assign exercises you might say go to 7, but I'll keep going until I feel that I'm done with it.' He also stated in the interview that this approach can have a down side as '.....sometimes I say, I'll do my maths first, and then 3 hours later I think 'Oops, I've still got my science to do!' Despite this problem, Alex appears to be in control of his learning and can easily reflect on his progress, confirming his preference for deep learning.

In describing how he goes about learning and understanding something, Alex reported in the interview that 'My best technique of learning is repetition of hearing. I find it more difficult to learn by reading only.' This was written on a reflection sheet. In

the interview, he said '.... I feel that as long it is explained to me, I can understand it really well....... I can see it in my mind, most of the time if I hear it once I can do it.' If he is working at home or has no one to explain it for him, '....then a lot of the time I have to read it over a couple of times and then look in the back at the answers and try and relate it back to the question.'

He reported that he knows when he has learned something when he can explain it to others and make them understand.

Conclusion.

The data collected indicates that Alex has control of his own learning and seems to be metacognitively active. He displays the characteristics of deep-achieving learning and is well motivated, confident in his own abilities and open enough to discuss problems. Despite an LPQ indicated decrease in preference for deep and achieving strategies, the exposure to teaching strategies aimed at developing metacognition have provided him with a way of reflecting on his learning in a more formal fashion and a wider selection of strategies to help his learning as shown by his continued use of concept maps.

4.3.5 Case study 5. Pedro.

Introduction to student.

Pedro lives in the same suburb as the school, is of Italian decent and is an only child. He is an average student (1% above class average in term 1). In class he can be impulsive and excitable, wanting to be involved in everything that is going on around him. He has relatively poor concentration and gives up easily, often asking for help and saying 'I can't do this' before he has thought the question through fully.

> We then went and did three exercises on locating earthquakes. Pedro wanted to be helped continuously and appeared not to want to think at all, or even to be able to formulate the question that he wanted to ask me. (Teacher reflection, 29/7/94).

In the interview, he stated a mixed opinion of school, saying that 'school is OK .... (but) sometimes it is a drag..... like boring subjects where we write write write.....' He goes on to say that the level of involvement and whether he likes the teacher or not are important factors in his liking a subject. He sees himself as an average learner who '......knows what the teacher says doesn't sink in straight away.'

Identification of learning characteristics.

Pedro's initial LPQ profile indicated a strong preference for surface learning:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
+	**+**	**O**	**-**	**-**	**-**

It is on this basis that he was included in the study.

Students who are surface motivated treat the learning task as an external imposition, an obstacle to be negotiated. These students have a quantitative view of learning, believing that the reproduction of detail is the appropriate way to go and the more that is reproduced, the better the learning. The corresponding strategies adopted by the students are usually based on rote learning, as students focus on what appears to be the most important topics or elements and try to reproduce them accurately (Biggs & Moore, 1993).

Biggs describes students who display a surface predominant or surface exclusive profile (++ 00 00 or ++ -- --) as tending to have a poor academic self-concept. They underestimate their own performance relative to their peers and are dissatisfied with their performance (Biggs, 1987b). This was confirmed in the interview, Pedro said 'I know I can learn better' and feels that he could improve his learning by '.....reading over my chapter more, so that I can remember things. At the moment, during the week, I never do more than just my homework.' Thus, Pedro feels that the way to improve his learning is by further applications of surface learning strategies. As exams began to loom closer, Pedro's lack of academic self confidence was confirmed when he continually sought insights into whether he was going to fail or not, despite the fact that his results were usually close to the class average (around 65-70%).

Identification of changes in learning characteristics.

By the end of term three, Pedro's learning profile had changed to:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
+	**+**	**+**	**-**	**-**	**O**

Two changes have occurred with Pedro's learning profile.
a) an increase in deep motive from '0' to '+', and

b) an increase in achieving strategy from '-' to '0'.

Investigation of changes.

The second LPQ indicated an increase in preference for deep motivation, however this was contradicted by the other data sources. In the interview, Pedro described his motivation for learning as external, '.....I have got to do it'. On the reflection sheet which followed the interview, Pedro stated that 'Learning to me means to sit down and take notes or just sitting there and listening to a teacher.' From the interview and the student reflection sheets, Pedro's concept of learning seems to be that of absorbing information that can be reproduced at a later date as this reflection sheet comment testifies: 'You know that you have learned something when you have remembered it weeks later without revision.' This statement mirrors Biggs' description of the surface learner.

On his early chapter reflection sheets, Pedro rated his understanding of the work at the lowest of the four choices, indicating confusion, a lack of sense-making and an inability to answer any questions. In later reflection sheets, he rated his understanding as 'Partial', meaning some of the work made sense and he could answer questions on these parts but not others and could not see how the work all fits together. This inability to make links between topics was confirmed in the interview:

> 'On the feedback sheets, you ask how this (the work we
> have just done) fits with other chapters. I can never see it.'

Pedro stated in the interview that the only time he reflected on his learning was when he was prompted to, by the student reflection sheets, and that he was not aware of his learning changing in any way during the year. These statements confirm a lack of metacognition and his below average preference for deep strategies.

Pedro reported in the interview that he found the "Solving a Current Problem' task '... quite challenging, and we had to think a lot.' Pedo required much guidance with the task. Surface strategies, which were his main preference seemed to be of little use when dealing with the learning task. He was like Liam in that he constantly asked 'what do I do next?' Eventually, from persistent questioning of myself, as teacher and questioning and observing other students in the class, he was able to establish a strategy and was able to complete the task to a satisfactory degree.

Conclusion.

The data collected from Pedro's interview, reflection sheets and teacher reflection showed strong convergance and confirmed his initial preference for surface learning as indicated by the LPQ. The convergence of the data supporting surface learning contradicted his indicated increase in deep motives. This change in reported motive may have been due to Pedro wanting to provide the 'right' answer to the questions. With time and the increased maturity and experience that it brings, Pedro may gain the self-confidence to over come his dependence on surface learning and adopt deeper approaches.

4.3.6 Case study 6. Dion.

Introduction to the student.

Dion is of Indian decent, and lives with his family near the College. From my own observations, he is a quiet in class and is a reliable student. He is fairly self-confident and is able to argue a point. In the interview, when asked whether he liked school, Dion replied: 'I suppose I like it because I have to do it, and if you have to do something and be good at it, you make yourself like it.' He went on to say the best thing about school was his friends and the worst things were the assignments. He works hard because 'You have to get good marks to get a good job.' On a reflection sheet, Dion stated that his motivations of learning were 'self improvement - (goals)', which may mean self improvement through the attainment of goals, and to secure a job by 'doing hard work now so I can benefit in future life.'

Dion defined learning as 'remembering things, facts etc, and applying that to my life', learning was 'also a way of achieving set goals, ie passing and achieving a high grade in all subjects.'

When asked whether different styles of teaching affect the quality of his learning, he thought that the teacher, as a person, had a greater effect on the quality of his learning than the techniques that the teacher used. '......because teachers have a tremendous effect on you.'

Identification of learning characteristics.

His initial LPQ learning profile indicated initial an exclusive preference for the achieving approach to learning, which accords well with his interview comments:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
O	O	-	O	+	+

Dion was chosen early for inclusion in the study because of his strong preference for achieving learning. Biggs describes students with a predominantly achieving profile (00 00 ++ or -- -- ++) as mainly interested in getting good marks (Dion confirmed this motive in the interview, again proving the helpfulness of the LPQ). They are deliberate, careful in planning, and ambitious. These students have a high academic self concept and perform well in formal examinations (Biggs, 1987b). These descriptions fit Dion very well. He is an above average student, who, form my own observations and reflections as teacher, is well motivated, organized and self-confident.

Identification of changes in learning characteristics.

By the end of term three, Dion's learning profile had changed to:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
O	O	O	O	+	O

Two changes have occurred to Dion's profile:
a) an increase in preference for deep motives from '-' to '0', and
b) a decrease in preference for achieving strategies from '+' to '0'.

Investigation of changes.

In the interview, Dion stated that he thought the quality of his learning had improved, but he added that he was getting individual help with his study skills from a tutor.

Dion was quite clear in the interview about his thoughts of the assignment: 'I didn't like it. I didn't learn anything about electricity.' He said the main problems he had with

it were trying to do the mathematical calculations, and the lack of guidelines led him to:

> 'stumble through it not knowing what to do. I want to do
> well, but I don't know what you want.'

Dion is confirming his preference for achieving learning with this statement, he wanted to do well, wanted criteria set so that he could fulfil these external conditions.

In another instance, Dion said that he found the process question sheets from Geology very difficult.

> Dion called me aside during a lesson when we were
> working on the sheets and said that he 'didn't feel as if he
> was learning from doing these sheets'. (Teacher reflection,
> 29/7/94).

He later explained that he felt this way because in some cases there was no right or wrong answer, showing that he has the ability to reflect critically on his own learning.

In the interview, Dion said that the reflection sheets made him think about his learning.

> '...they make us think about what we have learned..... it is
> difficult to rate your own understanding. If you are honest
> and think about it, they are difficult.'

His rating of his own understanding varied from chapter to chapter from partial to mechanical understanding. On some sheets, he was able to identify how different aspects of chapters fitted together, for instance, he was able to apply the knowledge from the chapter on 'Reflection, Refraction and Colour' to the refraction of seismic waves through the outer core of the Earth in one of the Geology chapters, confirming his increased preference for deep learning.

Conclusion.

Confirmation of Dion's LPQ indicated preference for achieving learning was provided by the triangulation of the data collected from the interview and reflections. However, he has demonstrated the ability to reflect critically on his learning and to express his

concerns. Having already established the characteristics of achieving learning and demonstrated an increased preference for deep motivation, Dion has the potential to learn in the deep-achieving manner, provided he ensures he is open to new ideas. He is analytic, confident and motivated. He has benefited from the strategies aimed at promoting metacognition by giving him opportunities to give feedback to me as his teacher and to practice establishing links between topics and subjects.

4.3.7. Case study 7. Julian.

Introduction to the student.

Julian was the last student to be included in the study and was chosen after the second LPQ had been administered because his profile had apparently undergone a marked change. He is from a western Queensland town and is a boarder at the College.

Identification of learning characteristics.

His initial LPQ profile indicated a preference for the achieving motivation.

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
-	O	-	-	+	O

Identification of changes in learning characteristics.

At the end of term 3, Julian's LPQ profile had changed to:

Surface		Deep		Achieving	
motive	strategy	motive	strategy	motive	strategy
+	O	+	+	O	+

The main changes to Julian's profile were:
a) an increase in surface motivation from '-' to '+'.
b) an increase in preference for both deep motives and strategies from '-' to '+'
c) a decrease in achieving motives from '+' to '0', and
d) an increase in achieving strategies from '0' to '+'.

The overall result of all of these changes is that Julian's profile now resembles that of a deep learner, with an inconsistent preference for surface motivation. At the start of

the year, Julian tended to be easily distracted and was one of the more poorly behaved students in the class. His behaviour improved significantly through Terms Two and Three, becoming a reliable and co-operative student. Julian's assignment work improved as did his exam results, his term three result being some 13% better than the Term One result.

Investigation of changes.

When asked in the interview if he could explain the improvements in his results and classwork during the past two terms, Julian said ' After first term report, I realized that I had been unsettled and I realized that grade ten is pretty important for marks.' He had come to the realisation that the people he was working with were having a bad influence on him. 'There were some people I looked at in the class and I said yeah, they are doing really well, and so I moved places and tried to work with them.' He went on to report that this process was not restricted to science. 'In most of my subjects, I did the same sort of things, moved myself so that I could work with other people.'

Julian explained other techniques he had adopted to improve his learning. 'At the start of the year I thought that I was pretty disorganized, when we were doing chapters, I would have my work scattered everywhere, not getting everything down and I would miss work and stuff we had to copy. I realized I had to stay organized and stay ahead, instead of saying I'll do it tomorrow.'

During the interview, he mentioned that homework and study have become easier. '..... when I write things down now, I think about things more, rather than just copy things down straight from the board. I go through it and concentrate on it more. Then when I go back through it that night to do revision questions, it is much easier to do.' During the times when certain guidelines were removed and students encouraged to find their own way through learning tasks, Julian referred to previous work as a guide. When taking his own summary notes, he stated that he went through the book and wrote down the main points in his own words. He could not accurately explain his process for selecting important points, ' .....I read through and it is just clear, you just know. You can see when the text is going overboard.'

When asked the difficult question of 'How do you know when you when you have learnt something?', he replied 'You get used to it I suppose, you know when to stop. If you have a definition in the text, it might go on and on.....'

He thought that the reflection sheets did make him reflect on his learning:

> '....although I thought sometimes they were rushed and I didn't answer them as best I could. It said things like 'Have you learnt anything from this chapter?' and 'Does it relate to what we have done in other chapters?', and especially in other subjects, like I'm doing the green house effect in geography at the moment.' In science, I can see how some chapters fit together, but not all of them, the geology ones all fitted together and so did the temperature and gases chapters.'

When asked in the interview whether he though his learning had changed in any way, he reported that it had, and that he could feel himself learning more. 'I keep all my previous chapters and reports and I read the comment and I know what I need to do. You have a goal in mind, with some points that you can improve on.'

Conclusion.

Julian's LPQ results indicated a significant change in his approach to learning. This change was supported by the convergance of data collected at the interview, student reflection sheets and teacher reflections. Julian has made significant progress with his learning this year, due to a self directed revision of his motivation and attitude. The exposure to teaching strategies aimed at promoting metacognition has aided in his learning development through making him reflect on his motivations and learning in science, and provided him with opportunities for independence in learning, and to receive positive feedback on his changes.

4.4 Discussion of the results.

The use of the LPQ as a means of identifying the general learning characteristics of the students was successful. The approach to learning identified by the LPQ for an individual student was very often confirmed by the other data sources. A second application of the LPQ did uncover changes in individual students' approaches to learning. Subsequent, more detailed investigations into these changes through the use of reflection sheets, interviews and teacher reflections brought to light some patterns in the data.

The second LPQ results of Liam, a below average student, indicated a decreased preference for metacognitive learning. The triangulated data confirmed this with some contradictions. It would seem that the strategies aimed at promoting metacognition have had little effect or have been rejected. His initial LPQ results also displayed contradictory elements; possibly pointing to a lack of metacognitive ability.

Steven's relatively small amount of data confirmed little change in his preferred approach to learning. The lack of data may be a result of Steven's reserved nature and lack of ability to articulate his approach to learning.

The triangulation of Mark's data showed divergence on a number of points, while his second LPQ profile indicated a much stronger preference for deep-achieving learning. He showed a tendency to be highly self critical.

Alex's data triangulated to confirm his preference for deep-achieving learning. The exposure to teaching strategies aimed at developing metacognition seems to have provided him with a way of reflecting on his learning in a more formal fashion and a wider selection of strategies to help his learning as shown by his continued use of concept maps. Alex's initial LPQ indicated a preference for deep and achieving approaches, which may have allowed him to recognize the usefulness of the metacognitive strategies introduced and was able to utilise them to a greater extent than others.

Pedro's data showed strong convergence and confirmed his initial preference for surface learning as indicated by the LPQ. The convergence of the data supporting surface learning contradicted his indicated increase in deep motives. This change in reported motive may have been due to Pedro wanting to provide the 'right' answer to the questions to satisfy the researcher.

Dion's triangulated data confirmed his preference for achieving learning, although he demonstrated some reflective ability. This mirrored a slight improvement in deep motivation between the first and second LPQ.

Julian demonstrated an increased preference for metacognitive strategies and motives. His data triangulated to confirm this and the strategies aimed at promoting metacognitive learning seemed to have been beneficial for him. This was an interesting contrast to the case of Alex, as Julian's initial LPQ showed no preference for deep

learning. Observations suggest that other factors encouraged him to re-evaluate his approach to his work in general.

The amount and richness of the data collected for each student varies enormously. As the methods of collecting data were themselves often aimed at evoking metacognitive processes, those students who indicated a preference for metacognitive approaches, and were perhaps more practiced in their use, produced data in greater volume and richness than those who indicated that their preferences lay with other approaches. It could also be hypothesized that personal qualities of the students such as open-mindedness, honesty, ability and mutual respect for other learners and the teacher, also contribute to the facilitation of conditions suited to deeper learning. Factors external to the student also need consideration.

This study confirmed a number of the conclusions of the PEEL study, in particular, that factors such as the time of day, the weather, the make up of the class and the nature of the students' previous lesson can cause considerable fluctations in student motivation and will influence the amount of active learning the students are willing to attempt. Factors such as these may have led to a reduction in the reliability of the data (Baird & Mitchell, 1993).

Factors such as student teacher relationship and interest in the subject may affect motivation over a longer periods reduce the reliability of the study. From the data presented in the case study of Liam, it is clear that factors such as these have influenced his motivation and approach to learning during the course of the study. However, Liam was the only student who's data displayed this pattern. The apparent interest, motivation and student-teacher relationships with the class group as a whole were generally stable throughout the course of the study.

It is an accepted scientific principle that one can not observe or measure a system without altering the system in some way. This concept holds true for ethnographic research. The process of observing and recording behaviour, and gaining insights into learning practices through interviews and self-reports will to some extent influence the behaviour and reported learning practices in those being studied. The Hawthorne or Halo effect is a well documented form of abnormal behaviour, where the subjects may consciously plan to reveal themselves in the best possible light. This effect may also occur when subjects unconsciously distort the data by providing what the subject believes the researcher wants to see (LeCompte & Goetz, 1981).

A further conclusion of the PEEL study was that students have definite, conservative and restricted views about what constitutes learning and what are appropriate teacher and student classroom behaviours. From interviews, teacher observations and class discussions, it was clear that the class felt that the teacher should provide notes and that rote learning these constituted good learning, although this approach was seen as boring. In addition, most students felt that they could improve their learning, but appeared not to know how. Despite these facts the implementation of alternative strategies aimed at promoting metacognitive thinking were often met with very little enthusiasm from many students. On the other hand, there were students who welcomed the changes and adopted the strategies used. The case study of Alex is an example of this.

This study investigated changes in students' approaches to learning when exposed to teaching strategies aimed at promoting metacognitive learning. It was found that students' approaches to learning did change and seem to have been stimulated by the metacognitive strategies. There are a number of implications arising from this study. Firstly, it seem that many students are aware that their learning is deficient, but do not know how to improve the quality of their learning other than to 'do more of it'. Identification of individual approach to learning and exposure to other approaches and their strategies are thus extremely important.

As mentioned earlier, the LPQ proved to be a reliable means of identifying learning characteristics of an individual. A single application of the LPQ can allow a teacher to gain some significant insights into the learning of individuals and a class group. With mature classes, it may be possible to administer the LPQ and have the students themselves mark it. A handout based on the LPQ handbook could be produced and the students could interpret their own profile. A discussion of the different approaches and their implications may be a revealing exercise for many students.

A number of learning strategies were introduced to the students during the study. Of these concept maps seemed to be one of the more effective ways of promoting reflective thinking. Over-use however, was found to have the reverse effect. This was also true of the student reflection sheets, which through over-use became seen by some as just another worksheet to be completed, rather than an opportunity to spend time reflecting and thinking critically about each question. The reflection sheets have the potential to continue evolving, and the variations produced may be a way of overcoming the above problems. I will continue to use both of these methods in my future teaching, and I recommend their use to others.

Most students found the learning task, 'Solving a Current Problem', which was used in the Energy Alternatives Unit, to be interesting, challenging and rewarding. Less gifted students found the lack of teacher direction to be frustrating. A happy medium must be found between encouraging students to think for themselves and the amount of guidance they receive. The construction of a flow-chart by each student, showing the proposed strategy for going about the task will be emphasised in the future. Other, smaller tasks of the same nature will also be used on a regular basis in the future.

In conclusion, the results indicate that changes in approach to learning did occur in the students involved in this study. Many of these changes seem to have been influenced by the introduction of teaching strategies aimed at promoting metacognition. It is also realised that many other factors influence student learning. The results seem to indicate that the extent to which a teaching style aimed at promoting metacognition is successful depends very much on its acceptance by the class and the individual students. Pre-existing preferences for the deep and achieving approaches to learning enhance the effect of the metacognitive strategies. It could also be hypothesized that personal qualities of the students such as open-mindedness, honesty, ability and mutual respect for other learners and for the teacher also contribute to the facilitation of conditions suited to better learning.

CHAPTER FIVE.
REVIEW AND SYNTHESIS.

5.1 Purpose of the study.

The purpose of this study was to investigate, using a case study approach, changes in students' approaches to learning when exposed to teaching strategies aimed at promoting metacognitive learning.

One of the conclusions drawn from the original PEEL study was that it was difficult to determine the nature and extent of change in student learning (Baird & Mitchell, 1993). This study has used a variety of data sources to explore such changes. Through anomalies were found, it was possible to gain a greater understanding of changes in students' approaches to learning.

5.2 Design of the study.

A case study approach was used as it captures meaning through a process of research which tries to provide understanding of some entity within a particular context as it unfolds over a period of time (Wilson, 1979).

Case studies have long been respected as a form of research. Case studies focus on information in a complex, holistic, process-orientated, particularistic way which mirrors the reality of life in school settings (Wilson, 1979).

The case study approach used in this research to address the research question was characterised by three stages:

1. Identification of the initial learning characteristics of the students.
2. Identification of any changes in these learning characteristics following the exposure to teaching strategies aimed at promoting metacognitive learning.
3. Monitoring the students' perceptions of their own learning during this time using a variety of data sources.

Stages one and two were firstly applied to the class as a group, and provided a framework within which the more detailed investigation of the individual case studies were situated.

5.3 Findings of the study.

The use of the LPQ as a means of identifying the general learning characteristics of the students was successful. The approach to learning identified by the LPQ for an individual student was very often confirmed by the other data sources. A second application of the LPQ was also successful in identifying changes in an individual student's approach to learning over time.

The teaching strategies aimed at promoting metacognitive learning did apparently provoke some changes in student learning. However, it is also recognized that these changes may have also been influenced by a wide variety of social and emotional factors.

Through the use of student reflection sheets, semi-structured interviews and teacher reflection, the changes in the LPQ results were able to be investigated further. The use of three data sources to investigate the changes provided the opportunity to triangulate the data. This process allowed for the identification of factors other than the teaching strategies which may have had an impact on the students' approach to learning.

The process of triangulation resulted in convergence of the data for five of the seven case study students. Liam's learning preferences were confirmed by the triangulated data but with some contradictions. Mark's data showed divergence on a number of points. The data which gave rise to a contradictory or divergent triangulation results for both of these students came from the interview and may have been influenced to some degree by the Hawthorne effect.

5.4 The conclusions of the study.

This study investigated changes in students' approaches to learning when exposed to teaching strategies aimed at promoting metacognitive learning. It was found that students' approaches to learning did change. This change seemed to have been stimulated by the metacognitive strategies.

The findings of this study confirm many of the conclusions drawn by Baird & Mitchell (1993) from the PEEL project. Firstly, it is difficult to determine the nature and extent of change in student learning; that students have definite, conservative and restricted views about what constitutes learning and what are appropriate teacher and student classroom behaviours. From interviews, teacher observations and class

discussions, it was clear that the class felt that the teacher should provide notes and that rote learning these constituted good learning, in spite of the fact that this approach was seen as boring and requiring little thought. In addition, most students felt that they could improve their learning, but often appeared not to know how to do so.

Teaching in a manner which encourages metacognition is more than just the application of strategies, but rather, a completely different approach to teaching. The process of encouraging students to take control of their own learning and to make decisions for themselves involves the sharing of the powers of control and decision making. It would seem from the results that the extent to which this metacognitive approach to teaching and learning is successful depends very much its acceptance by the class and the individual students. Pre-existing preferences for metacognitive enhance the effect of the metacognitive strategies. It could be hypothesized that personal qualities of the students such as open-mindedness, honesty, ability and mutual respect for other learners and for the teacher, also contribute to the facilitation of conditions suited to better learning.

APPENDIX ONE.

STUDENT REFLECTION SHEET.

Name_____

Class_____ Date _____

Chapter title _____

* What is this chapter all about?

_____
_____
_____

* List some of the new ideas that you have come across this week.

_____
_____
_____

* What strategies did the teacher use to help you understand the work?

_____
_____

* What strategies did you use to help you understand the work?

_____
_____

* In what ways does the work we have covered in this chapter link or fit in with other chapters that we have studied?

_____
_____

* Of all the things we did this week, which made you think the hardest?

_____

* How hard did you have to think? (circle one)
low / med / high
* How MUCH work was there to do?
low / med / high
* How interesting was the work?
low / med / high
* How much did the activities EXTEND my interests, knowledge and skills?
low / med / high
* What was the level of my MOTIVATION to do the work.
low / med / high
* How hard did I TRY to do what was required?
low / med / high
* How ACTIVELY did I PARTICIPATE in class?
low / med / high
* How much did I enjoy what I did?
low / med / high
* How satisfied was I with my performance?
low / med /high

* Circle the most correct response:
This week I:
  * Didn't ask any thinking questions.
  * Didn't ask many thinking questions or if I did, I wasn't able to find the
       answer.
  * asked some thinking questions, and was able to answer some.
  * asked some thinking questions and was able to answer most.
  * asked a lot of thinking questions and was able to answer most.

* This week I:
  * didn't really understand what was happening or what I was doing.
  * sometimes didn't fully understand what was happening or what I was doing.
  * knew what I was doing and why I was doing it most of the time.
  * knew what I was doing and why I was doing it all of the time.

* Choose one (either A, B, C or D) which best describes you understanding of the work
covered this week.

  A.   I felt very confused.
       Not much made sense.
       I couldn't answer any questions.

  B.   Parts of it made some sense.
       I think I could answer questions on these parts, but not on other parts.
       I don't see how it all fits together.

  C.   It all makes some sense, but it is not easy.
       I think I could answer questions on most of it, but only if the questions were
            similar to the ones in the notes.
       I couldn't or wouldn't use the work in any new situation outside the classroom.
       I would find it very hard to explain to someone else.

  D . It all seems common sense and fairly obvious.
       I think I could explain it to someone else.
       I think I could use this in new situations outside the classroom.

  * Using the given concepts, draw a concept map of the work covered this week in the
space below.

APPENDIX TWO.

SEMI-STRUCTURED INTERVIEW QUESTIONS.

Questions for semi-structured interview.

1) What do you like about school?
2) What are your dislikes about school?
3) Do you try and do well at school?
4) Why?
5) What does learning mean to you?
5) How do you learn?
6) Have you noticed any changes in the way that you learn this year?

APPENDIX THREE.

INTERVIEW FOLLOW-UP REFLECTION SHEET.

LEARNING QUESTIONAIRE.   NAME:_____

1) What is the source of your motivation for learning?

2) What does <u>learning</u> mean to you?
   (eg, for some, learning might mean being able to remember lots of facts and figures, perhaps learning allows you see the world/yourself in a different light, perhaps learning is what you have to do to pass exams, perhaps it is a way of achieving awards and goals).

3) Have your ideas of learning changed in any way since the start of this year? Please explain.

4) Explain how you learn. What techniques/strategies do you use?

5) How do you know when you have learnt something? (How do you know when you know???)

6) Has the way in which you learn changed this year? Explain.

7) If you had absolute freedom in your learning, a) describe the topics you would really like to pursue (they do not have to be current school subjects)

   b) describe how you would go about your learning.

THANK YOU.

APPENDIX FOUR.

SAMPLE TEACHER REFLECTIONS.

Sample Teacher Reflections.

Friday. 8/7/94

Sat the boys in pairs of my choosing and gave them the 'Solving a Current Problem' booklet. I did this so that a weaker student was paired with a stronger student, in the hope that they would both benefit from the experience. I Instructed them to read for 20mins and then ask questions. Some boys got into it immediately and began taking notes as they read, while others (Liam and S.H. for example) complained about their partners. Some asked if they had been put with their partners for punishment. Most boys worked quietly for the 20 minutes. The questions asked were generally of good quality. A reasonable start to the task.

Mon. 11/7/94

Boys sat with their partners and worked on their assignments. Most worked fairly well, but others (particularly J.C., Pedro, SH, Liam) just walked around complaining about their partner. They lobbied with me at the front desk about changing partners. In the end, I called the class to attention and began negotiating with them some sort of agreement that if they changed partners that they would work to their best abilities. In the end, we came to an agreement and I agreed to let them swap partners. The people involved were: Pedro, S.H., M.C., M.M, Liam, L.B and D.M.

Tues. 12/7/94

Boys worked on with their assignments. Some good work being produced, although there was some who just walked around and socialized. Liam was very vocal about 'what exactly did we have to do?', 'What did I want?', 'What is the marking scheme?'

Thurs. 14/7/94
   Away on camp.

Fri. 15/7/94
   Away on camp.

Mon. 18/7/94

Worked on task. Some getting caught up on the maths, or getting caught up in the details and can't see the big picture or the logical way through. Mark came up to me in class in an almost distressed state of mind. He couldn't work out some of the calculations, and was tangled up in voltage and current. One of his problems was that he was trying to run his 12 volt appliances off a 240 V source (the inverter). He couldn't see that the key to choosing the right inverter, was by firstly working out the total current that it would need to provide to the 240V appliances only. He finially realised that he could run his 12 volt appliances directly off the batteries, but it took alot of prompting.

Tues. 19/7/94

Told the boys that his would be the last class lesson on this task, and renegotiated the due date. The task is now due at the start of the class next Wednesday. The boys kept working on their task, with many seeking my help out the front. I looked up a number of times to see a group down the back (J.C, Liam, M.M, S.W and D.M.) not working. I broke the group up and they returned to work. At another time, Liam and MM were playing with an electric balance. I asked them to leave it alone and they returned to work. My attention was drawn back to them towards the end of the lesson when they dropped the pan from the balance. I called up the back row (M.M, Liam, J.C & D.M). MM and Liam admitted responsibility and I gave them writeouts from the lab safety rules. I later called them all up again ans spoke to them about how they had broken our agreements and promises. I had checked J.C's work and he and his partner were no very far into the task. Liam said that he was working better with his new partner, but he was still below a satisfactory standard.

APPENDIX FIVE.

STRUCTURED THINKING SHEET.

SOME POSITIVE STEPS TO TAKE TO HELP YOU LEARN.

1. **When learning theory in class or at home, ask yourself these questions:**

   a) Can I identify what is important here? What is the author really trying to say?
   Strategy: summarise, underline.

   b) Could I explain this to someone else?
   Strategy: mentally try it, or find a parent or family member who can give you feedback. Draw a concept map.

   c) How many links can I find with other topics and other subjects?
   Strategy: Concept maps.

2. **When solving problems, ask yourself these questions:**

   a) Do I understand the question?

   b) What is wanted? What information is given?

   c) Do I recognize a general type? Can I apply a formula? What will be my strategy?

   d) are there any traps?

3. **When stuck on a problem, ask yourself:**

   a) What have I done? Why did I do this?

   b) What am I stuck on: where to go now or how to do it?

4. **Before moving on, ask yourself:**

   a) Is my answer sensible?

   b) Is my answer in the form required? (check the question, check units).

5. **When doing practical work, ask yourself these questions:**

   a) what are we meant to be doing/looking for/writing down?

   b) why are we doing this? (check your aims).

   c) What do we expect might happen - can I link it with the theory?

> * **CONFUSION is a natural part of learning. In fact to be able to identify the bits which don't make sense is a sign of PROGRESS.**
> * **Don't PROCRASTINATE. Start your revision EARLY and revise OFTEN.**
> * **If in doubt, write.... try and explain it to yourself.**
> * **PLAN your revision, and have the SELF-DISCIPLINE to stick with it.**
> * **Give yourself REWARDS, but be HONEST.**
> * **Set realistic GOALS.**

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