STRATEGIC APPROACHES TO LEARNING: AN EXAMINATION OF CHILDREN’S PROBLEM-SOLVING IN EARLY CHILDHOOD CLASSES

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A thesis submitted to the University of Western Sydney, Nepean in partial fulfilment of the requirements for the Degree of Doctor of Philosophy

1997
PLEASE NOTE

The greatest amount of care has been taken while scanning this thesis,

and the best possible result has been obtained.
I hereby certify that the work embodied in this thesis is the result of original research and has not been submitted for a higher degree to any other University or Institution.

Signed:..............................................

Dated:..............................................
ACKNOWLEDGMENTS

Undertaking a project like a doctoral thesis requires considerable patience, energy, forbearance and downright stubbornness, not to mention commitment and, at times, single-minded dedication to the task, almost to the exclusion of family, friends and lifestyle. My journey through this exercise has not been without moments of self-doubt, questioning of priorities and sheer exhaustion, at which times I often thought of relinquishing the academic goal to “get a life” as my children so aptly put it. Finally I am able to contemplate an existence without sleep deprivation, deadlines and idiosyncratic computers. Now having reached the end of the doctoral road, and completed the task I look back with enormous gratitude to the support given me and the sacrifices made by many friends and family.

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ABSTRACT

The research conducted and discussed in this thesis shows how the learning of children as young as five years of age is influenced and modified by the teaching environment. The study examines the metacognitive, self-regulatory learning behaviours of sixteen (16) kindergarten grade students selected from four (4) schools in the Northern suburbs of Sydney. It seeks to determine how students perceive learning, either by adopting deep approaches, where the focus is on understanding and meaning, or surface approaches, where the meeting of institutional demands frequently subjugate the former goals.

Several historical and contemporary learning theories have been discussed, but of major concern to this study is the work of Vygotsky (1978) who advocates instruction through the Zone of Proximal Development (ZPD), within a sociocultural context. Bruner's (1985) notion of scaffolding is discussed, as are characteristics within children’s affective dimension, such as attention, motivation and self-concepts.

The data have been analysed within a qualitative paradigm from a phenomenographic perspective. Phenomenography seeks to identify “what has been learned” rather than “how much has been learned” (Marton, 1994), through observations of students’ behaviour when categorised into hierarchies of meaning. The study attempts to address three issues: the nature and frequency of the strategic learning behaviours displayed by the sixteen subjects; the contribution that strategic behaviours, along with numerous affective characteristics make to the adoption of deep or surface learning approaches; and how “metacognitive” teaching environments influence higher-order thinking.
A major finding of the study reveals that within learning environments where teachers had "metacognitive" teacher training, the frequency of strategy use increased irrespective of the actual performance of the students. Also important and confirming previous research, was the fact that high achieving students used more strategic behaviours, and used them with greater efficiency than their lower achieving counterparts. In a similar manner, high achieving students also tended to display more of the characteristics of deep approach learners, than did low or underachievers.

Despite the complexity of high-level learning and flexible thinking, the value and consistent use of metacognitive strategies has been well researched and the effective results, thoroughly documented. This study suggests that many of the differential outcomes evident amongst students in schools may be substantially reduced through early and consistent training within a teaching environment conducive to the development of metacognitive, self-regulatory behaviours and deep learning approaches.
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Chapter 1

INTRODUCTION

Research into the educational enhancement of young children follows an age-old tradition of investigation established from before the time of the "parents" of cognitive training, Plato, Socrates and Aristotle (Bowen & Hobson, 1987; Edwards, 1991; Yates & Chandler, 1991). Edwards (1991) suggests that as far back as the sixth century BC, the Greeks were concerned about cognitive training, which aimed at equipping students with generalisable thinking skills as a preparation for life. Such training, it was presumed, would develop the faculty of theoretical reason and contemplation thereby enabling true knowledge to emerge; knowledge thought already to exist within the immortal soul. In the seventeenth century Descartes conceptually separated mind and body, thereafter providing the way for empirical study and analysis of the mind to occur. According to Edwards (1991), in the years that followed, much unwarranted credibility was accorded some cognitive theories resulting in considerable dissatisfaction with schools and teaching. For example, he discusses the writings of Baldwin (1896) who said:

Few really take this step, few really think. One person in a thousand thinks up to the truth. Is it strange? Do our schools teach pupils to think? Do our churches? Do political parties? It need not surprise you to find the unthinking masses drifting along in grooves made by their predecessors. A revolution is demanded. The school-room is the place to begin. A great want of the world is thinking teachers capable of educating a race of thinkers (Edwards, 1991, p.89, citing Baldwin, 1896).
Early this century, John Dewey, a major figure in education suggested that reflective thinking must be a basic principle for organising the curriculum. In 1916, Dewey wrote that “processes of instruction are unified in the degree in which they center in the production of good habits of thinking” (Dewey, 1916, p.163). More recently, Ramsden (1988b, p.15) has given us an inkling of what learning is about when he says that:

....if learning in an educational setting means anything, it must be a movement toward being able to solve unfamiliar problems, toward recognising the power and the elegance of concepts and toward being able to apply material learned in class to problems outside of class.

Failure to learn, therefore, may well be linked to teaching practices which offer no movement toward transfer of concepts to unfamiliar situations, nor any relevance to the learner either inside or outside the classroom. Ramsden (1988b) has suggested that one of the fundamental reasons why students fail to learn effectively can be found in the way that teachers view teaching and assessment. The purpose for which material is taught is often confused and misunderstood by teachers and students alike, and when mistakes occur, teachers react to the product of students’ performance, ignoring the misconceptions in thinking which underlie their errors. Edwards (1991), again recalling to the work of Baldwin (1896), believes that many of the problems of the late nineteenth century are still common today. Baldwin believed there was too great an emphasis, for example, on memory, and a neglect of reason. This, he argued, “allowed feeble student thinking through practices such as spoon-feeding and lecturing; poor modelling of clear thinking by teachers; failure to develop systems or structures of thinking; reliance on second-hand work rather than direct experience; and too much
hurrying" (Edwards, 1991, p.89). Although written a century ago, the same could apply to teaching practices today. However, Ramsden goes further, noting that teachers today tend to focus on the content (the “what”) of learning rather than on the unified whole, which must include not only content but also the process (the “how”) of learning (Ramsden, 1988b).

In Australia, like so many other countries still pondering the goals of education, theories of learning and teaching and how these can be enhanced, are constantly being evaluated. In spite of this evaluation, however, and continued educational reform, many students do not appear to gain much from the school environment; an environment nonetheless thought to be so crucial for holistic developmental enhancement.

The intent of the research undertaken by this thesis therefore, is to investigate the way students in their early school years perceive learning phenomena. Biggs and Moore (1993) suggest that students’ thinking behaviours may be indicative of their approaches to learning and that by looking carefully at their displayed metacognitive behaviours while undertaking problem-solving tasks, perceptions of learning as either a deep or surface endeavour will become evident. Although considerable research has been undertaken in this area at high school and university level (Marton, 1994; Prosser, 1993), little attention has been paid to exploring deep and surface approaches to learning in the early childhood years. This thesis attempts to redress that situation.

The thesis begins in this first chapter with an overview of several historical and contemporary learning theories, especially as they relate to early childhood education. Three fundamental issues are then introduced: firstly, the importance of the sociocultural context for thinking and learning; secondly, the notion of guiding or scaffolding children’s own discovery of
knowledge through the implicit as well as explicit use of metacognitive, self-regulatory strategies; and thirdly, the importance of the development of these strategies for acquiring deep approaches to learning, approaches which with time, may help decrease the gap between high and underachievers. The chapter concludes with a general description of the research undertaken in the thesis.

**Theoretical Learning Perspectives**

Complex cognitive activity such as thinking and learning, has been thought to involve the use of mental processes which enable individuals to make sense of their world (Eggen & Kauchak, 1994). In attempting to propose a single definition of learning, however, we are in danger of “constructing conceptual boundaries around a phenomenon so that everything within the boundary line may be classified as being of that particular phenomenon and everything which lies beyond may be excluded” (Jarvis, 1983, p.2). Indeed, the foundations of students’ learning are so complex that not only do characteristics within the student need consideration, but also the characteristics of teachers, methods of instruction, the nature of the curriculum, the classroom environment, as well as students’ and teachers’ perceptions of their interactions with each other (Marjoribanks, 1991). Even so, while ever mindful of the danger of constricting learning phenomena within proscribed boundaries, learning is generally described under three broad theoretical perspectives which emphasise (a) behaviourist, (b) humanistic, and (c) cognitive approaches.
(a) **Behaviourist Approaches to Learning**

Behaviourist approaches to learning have a long history dating back to the Seventeenth Century Enlightenment. The ideas of John Locke (1632-1704) served as a forerunner to the twentieth century perspective of behaviourism. Locke conceived the infant child as “tabula rasa”, that is, a blank slate devoid of any reason, but one whose character could be shaped by experience as he or she matured (Berk, 1991; Bowen & Hobson, 1987; Morrison, 1991). Later, John Watson (1878-1958) and others built upon this behaviourist perspective in an attempt to create an objective science of psychology by looking at “observable events”, rather than “fuzzy internal constructs of the mind” (Berk, 1991, p.14). Ironically, many of the more contemporary views of teaching and learning which will be discussed in this thesis are vitally concerned with those “internal mind constructs”.

Behaviourist approaches to learning focus on observable behaviours following interaction with the environment. Such foci however, allow for only minimal recognition of internal cognitive structures, insights, and processes (Biehler & Snowman, 1986; Eggen & Kauchak, 1994). Mazur (1990) has described learning from a behaviourist perspective as an enduring change in observable behaviour that occurs as a result of experience.

Learning obviously occurs in numerous ways, at times as an intentional response, at other times an unintentional response to a range of stimuli (Slavin, 1997). Behaviourist approaches describe learning as either a response conditioned directly by the environment or regard it as the result of the observation of behaviours seen within the environment.
Conditional Learning

According to early behaviourist theorists, learning involves the process or processes by which associations are formed between a stimulus and a response (Pavlov, 1849-1936; Thorndike, 1874-1948; Skinner, 1904-1990). Berk (1991), Eggen and Kauchak (1994) and Summers, Borland and Walker (1989) suggest that learning is evident when, as a consequence of these associations, behaviour changes in specifiable ways. Conditioned responses elicited in this manner have been termed "classical" where a behavioural response is involuntary, emotional and psychological and which follow a given stimulus, and "operant" where a response is voluntary and precedes a stimulus.

The work popularised by the behavioural psychologist B.F. Skinner (1904-1990) continues to have a practical influence on teaching and research today. Appalled at the kind of education that his own daughter was receiving, Skinner concluded that teaching techniques were primarily negative and that most children engaged in study essentially to avoid negative consequences (Biehler & Snowman, 1986). Skinner also noticed that frequently the interval between children's responses and any subsequent feedback was in many cases too great to serve a constructive purpose and indeed was often not forthcoming at all. He determined therefore, that learning behaviours were more controlled by the prompt consequences of actions than by events preceding actions, and that these consequences may present as reinforcement or punishment (Berk, 1991; Biehler & Snowman, 1986; Bowen & Hobson, 1987; Eggen & Kauchak, 1994; Morrison, 1991).

Reinforcement, either positive or negative is likely to increase the frequency or duration of behaviours and commonly occurs when an individual receives something desired or when something undesired is removed. Punishments on
the other hand are consequences which are intended to weaken or decrease the frequency of behaviours and occur when an individual receives something undesired or when something desired is removed (Berk, 1991; Eggen & Kauchak, 1994; Slavin, 1997). Eggen and Kauchak (1994) also note that when reinforcement cannot occur because desired behaviours are incomplete or not yet present in learning situations, cues which are antecedent stimuli that prompt the learner to provide the desired behaviour, may sometimes be used. Cueing is also a feature of the sociocultural and dialectic theories proposed by psychologists such as Lev Vygotsky and Barbara Rogoff.

Although acknowledged that behaviours are at least partially learned and certainly influenced strongly by environmental experiences, behaviourist views fail to recognise the complex cognitive component in the learning process. Social learning theorists such as Bandura (1977; 1982; 1986; 1989), reject purely behaviourist views, arguing that human individuals are not merely passive receptors of information responding mechanically to factors in the environment. Rather, they suggest learning is a process involving thinking, reasoning, imagining, planning, expecting, interpreting, believing, valuing and comparing amongst a range of other components. Indeed, as Santrock (1995) notes, it is only through a combination of these very processes that the controlling influence of undesirable environmental behaviours may be resisted.

**Observational Learning**

Much of the development of “observational learning” has been attributed to Albert Bandura who although behaviourist in orientation, noted that the reinforcement or punishment of consequences alone ignored the effects of thinking about the observed actions of others. Bandura’s “observational learning” theory strongly emphasises the impact of behavioural cues,
especially behaviours observed in others. He noted in particular that when vicarious experiences affect an individual’s behaviour, then cognitive processes must be operational within the learner (Bandura, 1977; 1982; 1986; 1989). Although now adopting a more social cognitive approach, Bandura’s observational learning theories focused on conditioning behaviour through modelled and vicarious observation (Brehm & Kassin, 1993).

Modelling refers to “changes to individuals that result from observing the actions of others” (Eggen & Kauchak, 1994, p.282). It can be either direct, where the learner attempts to imitate the precise behaviour demonstrated by a model, or symbolic, where behaviours displayed by characters in books, plays or television are imitated. Modelling can also be synthesised where behaviours are developed by combining portions of observed acts, or abstract where a system of rules may be inferred by observing examples where rules are displayed (Berk, 1991; Eggen & Kauchak, 1994; Slavin, 1997). While there is little doubt that observing the actions of other people can influence the behaviour of an individual, Bandura noted that by observing the consequences of another’s actions, the learning effect is frequently amplified and this can result in vicarious reinforcement or vicarious punishment (Bandura, 1977; Eggen & Kauchak, 1994; Slavin, 1997).

Observational learning can be explained using four processes: attention, retention, reproduction and motivation. Bandura (1977; 1986) believed that the obvious starting point to all learning must be attention, and teacher models must, therefore, have the capacity to attract and maintain the attention of their students. Simply maintaining attention, however, is not entirely sufficient for effective learning to take place, although this can be enhanced when critical aspects of modelled behaviour are also verbally stressed during
teaching. When this occurs, critical aspects of modelled behaviour are then retained for future reproduction.

Ideally, desired behaviours which have been modelled in this manner will be learned, retained and subsequently reproduced to guide students’ performance. When this does not occur, however, the continued use of modelled behaviour to facilitate already discussed behaviours has also been found to significantly enhance learning (Eggen & Kauchak, 1994).

The final process identified by Bandura (1986) is motivation (also Berk, 1991; Eggen and Kauchak, 1994; Mc Knight & Sutton, 1994) which begins through direct or vicarious reinforcement. Unlike other behaviourists, however, observational theorists view reinforcement as motivation, not as learning. They suggest that learning only occurs when a representation of a model’s behaviour is first committed to memory and then later reproduced. Bandura believes that without internal representation, conditioning, especially that which is delivered vicariously, cannot be effective. For this reason it has been argued that observational learning theories are more cognitive in their orientation than traditionally behaviourist.

(b) Humanistic Approaches to Learning
As one of the primary objectives of teaching is to encourage continued learning even after formal schooling has been completed, students must be given the opportunity to become individual, independent, self-directed thinkers and learners (Gage & Berliner, 1992). The progressive humanistic movement which had its roots in the writings of Jean Jacques Rousseau as early as the 1700s and John Dewey in the early 1900s aimed at changing fundamental, regimented, pressured, competitive thinking about education toward a more individualised form of instruction.
The basic principles underlying humanistic education are that students only learn what they need and want to know. Secondly, according to Gage and Berliner (1992), humanists suggest that wanting to learn and knowing how to learn are more important than acquiring factual knowledge. Thirdly, it is argued that students’ own evaluation is the only meaningful judgement of their work, and fourthly, feelings are as important as facts, and learning how to feel is as important as learning how to think. Finally, humanistic theorists argue that learning can only take place in an environment where students do not feel they must achieve and meet externally imposed institutional requirements. To this end, Carl Rogers (1969) suggested that there should be less emphasis on, or even complete abolition of compulsory attendance, tests, and assessments.

At the foundation of humanistic teaching is the belief that students need to self-actualise and that teachers must plan to meet this need (Maslow, 1968). If this is allowed to happen, students will “wish to learn, want to grow, seek to find out, hope to master, [and] desire to create” according to Rogers (1969). The creation of the self-actualised person is within us all, according to Maslow, and requires only the right environment rather than any special talent or ability. The right environment however, is thought to be a special kind of freedom in school where people can accept themselves, their feelings, and others more fully (Gage & Berliner, 1992). The desire to nourish free growth and to protect students from extreme societal and family pressure are features of the humanistic classroom. Although academic outcomes are believed to be subordinate to social and emotional outcomes, humanistic educators believe that many students will in fact excel academically because their learning is self-directed and therefore highly meaningful (Gage & Berliner, 1992).
Glasser (1986; 1990), a prominent humanistic theorist, suggests that the humanistic teaching tradition focuses on a number of objectives. Firstly, it encourages the building of trusting relationships between the teacher and the student through a cooperative learning environment. Secondly, it suggests that misbehaviour can largely be prevented through cooperative learning endeavours, however, if minor misdemeanours do occur, humanistic teachers believe they should be promptly attended to and misbehaviour unobtrusively redirected. Glasser (1986; 1990) also notes that major disruptions should be managed effectively by removal of the disruptive child to an alternative safe, secure place, however, Ginott’s technique (1972, cited by Borich & Tombari, 1995) for major disruption is to communicate effectively with the offender and to “invite cooperation”.

Although humanistic approaches to education have as their main objective the teaching of self-control through effective communication and interaction between one adult and one child (Borich & Tombari, 1995), such individualistic opportunities are rarely possible within the average classroom. Furthermore, some of the “management techniques” utilised by humanistic teaching approaches have been found to be demeaning and punitive, harmful to the ‘self’ concept and unacceptable to some cultural groups.

Contrastingly, many humanistic management methods offer clear direction to students, and encourage positive ‘self’ perceptions. Teachers in humanistic classrooms are encouraged to direct behaviour in a forward manner rather than focusing on the negative which tends to blame, scold, preach, threaten and humiliate (Borich & Tombari, 1995). Empathy toward students’ feelings are also encouraged, as is the use of feedback on performance rather than personality. For example, expressions such as “let’s see how we can avoid so many smudges on the page” are preferable to “you are such a sloppy
boy". Similarly, humanistic approaches suggest that teachers be cautious about their use of praise which should be distributed judicially and given for exceptional performance and in terms which separate the deed from the doer (Borich & Tombari, 1995).

Of course, humanistic educators do not hold a monopoly on the development of self-direction. However, while most traditional educators insist that the leadership of a more experienced person is vital to the development of knowledge, humanistic educators such as Neill, founder of the famous school Summerhill, would strongly disagree (Gage & Berliner, 1992). Summerhill advocates argue that rather than enhance development, such guidance would inhibit creativity, stifle learning and eventually destroy motivation.

(c) Cognitive Approaches to Learning

While behaviourist approaches define learning as changes in observable behaviour through interaction with the environment, and humanists suggest that learning must be self-directed and unimpeded by institutional constraints, cognitive approaches to learning regard not only observed behaviours but also the processes learners use in gathering, organising and storing information (Eggen & Kauchak, 1994; Santrock, 1995), in order to gain self-direction as much within the institutional as in other learning environments. Cognitive approaches focus on internal mental processes and therefore, from a cognitive perspective, "learning is a change in an individual's mental structure that gives them the capacity to demonstrate changes in behaviour" (Eggen & Kauchak, 1994, p.305). According to Berk (1991, p. 207) cognition refers to the "inner processes and products of the human mind that leads to knowing". Berk (1991) and Eggen and Kauchak (1994) note that unlike behaviourism, which is fairly unified and cohesive in its approach to
learning, cognitive psychology has developed a more theoretical orientation resulting in numerous approaches.

Possibly regarded as one of the most influential approaches to the development of cognition in recent times, Piaget's theory (1952; 1976), calls attention to the value of allowing for the possibility of self-motivated learning. Piaget's theory, along with research which regards cognition as "information processing" have contributed significantly to our understanding of cognition (Biehler & Snowman, 1986).

Even more recently, however, and perceived as a significant contribution to cognitive understanding, is the work of the Russian psychologist, Lev Vygotsky. Vygotsky's theories have shed considerable light on the importance of the sociocultural context for the development of cognition. Hogan (1997) for instance, suggests that the social interaction occurring naturally through the dialogue shared by members of a society actually promotes understanding as well as the sophisticated thinking abilities necessary for competent cognitive functioning.

**Piaget's Cognitive Model of Learning**

Piaget saw human cognition as a network of mental structures created by an active organism as it sought to make sense of its environment (Berk, 1991; Piaget, 1952; 1976). Representing a radical departure from the dominant behaviourist position, Piaget's perspective was revolutionary for its time. Piaget concluded that human individuals possess an innate tendency (equilibration) to bring coherence and stability to their perception of the world (Biehler & Snowman, 1986, p.348). Piaget, therefore, recognised the human organism as being active, internally constructing information, rather
than as a passive entity being shaped and moulded from the environment (Berk, 1991).

As biological pressures to adapt to the environment increase, children pass through a number of stages where they restructure their thinking through processes Piaget (1952; 1976) termed assimilation and accommodation. This desire for order, structure and predictability, or a state of balance (equilibrium) is paramount in the learning process (Biehler & Snowman, 1986). As new information acquired through experience is received, it is required to be assimilated into an existing schemata, where it is changed and accommodated to create new cognitive understandings (Eggen & Kauchak, 1994; Eysenck & Keane, 1996; Kaplan, 1991).

Piaget believed that at each of his four stages of learning, development was qualitatively different. Children, Piaget argued, move spontaneously through these four stages (sensorimotor, preoperational, concrete operational and formal operational) in the same sequence and at approximately the same age irrespective of their cultural environment and range of experiences (Berk, 1991; Clyde, 1995; Eggen & Kauchak, 1994; Eysenck & Keane, 1996; Piaget, 1952; 1976). Learning, in Piaget’s view, is subordinate to development and is a limited process which occurs as a result of exposure to a single problem or a simple solution (Ebbeck, 1995; Kozulin, 1990).

While unquestionably more advanced that previous theories about thinking and learning, Piaget’s four discrete stages of cognitive advancement have in recent times concerned many learning theorists, as they seem to indicate that by reaching a cognitive standard, that is, having developed the characteristics outlined in the formal operational stage, there must be an endpoint to development. Similarly, inflexible age requirements are no longer held to be
true. Rather, carefully designed training programmes have demonstrated that concrete or formal operations can in fact occur much earlier than Piaget thought possible (Gage & Berliner, 1992). In fact, a rigid, staged structure is in danger of implying that learning is a static, passive process unlike the active, dynamic, learner initiated process that it is (Clyde, 1995; Kaplan, 1991). Furthermore, it fails to acknowledge the close relationship between instruction and a child’s individual level of development which other theorists (Rogoff, 1990; Vygotsky, 1976) have found to take children further in their intellectual development.

**Information Processing Models of Learning**

One of the more recent influential cognitive approaches to learning has been termed the “information processing model”, although there are possibly many, rather than one, single, information processing theory (Biehler & Snowman, 1986; Biggs & Collis, 1982; Das, Kirby & Jarman, 1979; Schmeck 1983; Winne, 1991). Information processing models with their strong implications for teaching, regard the way new knowledge may be entered, stored and ultimately retrieved from memory. Information processing models identify three major components which comprise a system first described by Atkinson and Shiffrin (1968).

The first component comprises (1) *information stores* which are repositories for data and are termed (a) sensory registers; (b) working or short-term memory; and (c) long-term memory. The second component consists of (2) *cognitive processes* or internal, intellectual actions. These transfer data from one information store to another and include amongst a range of processes, attention, rehearsal and organisation. The third component of the information processing model is (3) *metacognition* which Eggen and Kauchak (1994, p.307) define as “the knowledge and control of our cognitive processes”.

(1) Information Stores
Each of Atkinson’s and Shiffrin’s (1968) components have been identified as critical in the processing of information. Within the first component, the information stores, sensory registers fleetingly hold a copy of environmental stimuli until this information can be transferred to the next store, the working or short-term memory. Information is retained in the working memory briefly until discarded or processed for retention in the long-term memory. The long-term memory then becomes a permanent information store with a virtually unlimited memory capacity (Biehler & Snowman, 1986; Gage & Berliner, 1992; Hamachek, 1995; Santrock, 1995; Summers, Borland & Walker, 1989).

In addition to episodic memory (or the information store holding personal experiences) and semantic memory (holding the facts, concepts, generalisations and rules of our content areas together with problem-solving strategies and thinking skills), the long-term memory is also described as containing declarative and procedural knowledge. Declarative knowledge has been described as knowledge of facts, definitions and rules, while procedural knowledge is knowledge about how to perform various activities (Berk, 1991; Eggen & Kauchak, 1994; Santrock, 1995; Summers, Borland & Walker, 1989; Yates & Chandler, 1991). Understanding the distinction between declarative and procedural knowledge is vital for teachers because the conditions for learning content information and the strategies pertinent to each are very different.

(2) Cognitive Processes
The underlying principle of information processing theories is that learners are active organisers of their own understanding, not passive recipients of information (Berk, 1991; Eggen & Kauchak, 1994; Hamachek, 1995; Kaplan,
1991; Kirby, 1988). The second component of information processing strategies, therefore, looks at the *cognitive strategies* used by individuals who will inevitably construct meanings that are personally relevant. This occurs when information is reorganised into a structure that makes sense to learners personally as presented ideas are never merely ingested, but are reconstructed to fit with information already known (Atkinson & Shiffrin, 1968; Berk, 1991; Eggen & Kauchak, 1994; Eysenck & Keane, 1996). Similar to Piaget's notion of schemata, information processing theorists suggest that learners develop complex schemata or sets of interconnected ideas, relationships and procedures with each schemata including both declarative and procedural knowledge.

Eggen and Kauchak (1994) as well as Rogoff (1990) suggest that it is not just in the *amount* of knowledge that 'expert' and 'novice' learners possess that differences in learning will be apparent, but will also be distinguished as variations in their *ways of thinking*. For example, whereas expert learners tend to develop complex and interrelated schemata, novices appear to have fewer associations in the information learned. Additional to this, experts and novices differ significantly in their procedural knowledge.

Procedural knowledge or knowing how to perform suggests the use of strategies for attending, memorising, storing, retrieving and processing information. The knowledge and control of memory strategies or metamemory and its development in students is important for numerous reasons. Utilisation of a range of processing skills maximises memory effort and ensures effective learning and understanding takes place (Eggen & Kauchak, 1994; Kaplan, 1991).
Although cognitive flexibility has frequently been associated with maturity (Piaget, 1952; Piaget & Inhelder, 1962; Sternberg, 1990), teaching practices nevertheless should encourage students to become aware of memory strategies as well as the strengths and weaknesses of these strategies. An awareness and use of strategic behaviours encourage learners to develop self-regulation which Eggen and Kauchak (1994, p.351) have defined as “the conscious use of strategies for encoding - activity, organisation, elaboration, and mnemonics - without direction from teachers”.

With maturity for example, children are more able to consciously and deliberately focus their attention on just those aspects of a situation which are relevant to task goals (Berk, 1991; Krantz, 1994). Obviously, to perform well, it is necessary to ignore incidental information, however, in some cases the context within which a task is presented may be used to augment retention. Explicit discussion in the use of such attentional strategies can assist children in distinguishing between material which is important contextually and that which is not (Berk, 1991).

As attentional processing changes and develops with age, so do memory strategies, and as a temporary repository, the working memory serves two vital and interrelated functions. Firstly, it holds limited amounts of information (between 5 and 9 items) briefly (20 seconds), and secondly, it performs mental operations such as the processing of information for longer-term storage. One of the strategies for transferring information from the working memory into a more permanent store has been termed rehearsal or repetition of material required to be memorised. Keeney, Canizzo and Flavell (1967) have noted that although rehearsal is a very successful memory strategy, young children rarely rehearse when presented with a memory task. When non-rehearsing children are taught to rehearse, however, their recall improves substantially, although continued instruction is
imperative until the strategy becomes less effortful and more automatic (Berk, 1991; Eggen & Kauchak, 1994; Kaplan, 1991; Krantz, 1994).

Another but more complex memory strategy than rehearsal, is organisation. Going beyond mere repetition, organisation links together items to be remembered causing recall to be improved dramatically (Berk, 1991; Eggen & Kauchak, 1994). Like rehearsal, organisational strategies change with age and while younger children will most frequently organise material on the basis of association (monkey - banana), older children will organise on the basis of categorical relations (fruits; items of clothing; animals).

A third memory strategy, elaboration, involves the creation of a relationship or shared meaning between pieces of information which have no natural categorical relationship to one another. Pressley (1982) suggests that compared to rehearsal, organisation and other memory strategies, elaboration is even later developing. Pressley and Levin (1977) have noted however, that when elaboration is eventually developed and used, it is so effective in high memory performance that it tends to replace all other strategies.

Once information has been stored in the long term memory, it must be recoverable or retrievable for use again and information processing theorists recognise three different types of retrieval: recognition, recall and reconstruction (Berk, 1991; Krantz, 1994). Recognition memory is evident even in infancy and involves noticing things that are identical or similar to something previously experienced. Perlmutter (1984) suggests that recognition memory appears to be less dependent on a systematic search of the memory store than other types of retrieval and therefore is regarded as an automatic process.
Unlike recognition memory, *recall* is a form of productive memory involving the ability to spontaneously remember things not present. Recall therefore demands generation of a mental representation of the absent stimulus, although how much must be generated depends on the context and other retrieval cues (Perlmutter, 1984). Berk (1991) suggests that although the beginnings of recall appear before one year of age, it is slower to develop than recognition and continues to increase through adolescence. Recall also appears to be linked to the way information is transferred from the working to the long-term memory. Items which are strategically organised at encoding and deeply processed and connected with other materials in the long-term memory, are more readily recalled (Berk, 1991; Eggen & Kauchak, 1994; Krantz, 1994).

The third type of retrieval, *reconstruction*, involves the recall of complex meaningful information in a reconstructed form. While important features of a story or information may be remembered, amalgamation with other pieces of information may occur, and sequencing may be changed for logic and consistency. This behaviour has been found to offer children a variety of helpful retrieval cues that assist in information recall (Berk, 1991).

**(3) Metacognition**

The third major component of information processing strategies, *metacognition*, refers to an awareness and an understanding of our own cognitive processes (Biehler & Snowman, 1986). Berk (1991) describes three aspects of metacognition as: knowledge of self as a cognitive processor; knowledge of strategies; and knowledge of task variables. Although a general conclusion regarding the knowledge and use of metacognitive strategies is that they are poorly understood and only minimally used by young children, significant research has suggested that these can be enhanced
through direct instruction (Biehler & Snowman, 1986). Gage and Berliner (1992) and Krantz (1994) note that metacognitive understanding can be achieved through the kind of explicit tuition which demonstrates a range of strategies, when and where they can be used and how they can impact learning. Once children develop these understandings, their primary task is to enhance self-regulation.

**Self-regulatory Behaviour**

Self-regulatory skills form the basis for adaptive, planful learning which involves thinking, reading and problem-solving across a number of academic domains. Borkowski (1992) suggests that the initial function of self-regulation is to assess the requirements of a problem-solving task and then to select ways to tackle it through the use of certain strategies. As involvement with the task progresses, self-regulation then deals with monitoring the course of the learning and possibly the adjustment or the revision of the learning strategy (Borkowski, 1992; Purdie & Hattie, 1996). Describing self-regulated behaviours, Schunk (1994) says that:

> self-regulation has been found to include such activities as attending to and concentrating on instruction; organising incoming material, coding and rehearsing information to be remembered; establishing a productive work environment and using resources effectively; holding positive beliefs about one's capabilities, valuing learning, being aware of the factors influencing learning, anticipating the outcomes of actions; and experiencing pride and satisfaction with one's efforts (p.75).

When self-regulated learners become independent of adult assistance, they tend to display behaviours which lead to self-competence and self-confidence. For example, Zimmerman (1986, p.308) notes that students who
self-regulate are “metacognitively, motivationally and behaviourally active participants in their own learning processes”. Gardner (1994) suggests that children develop self-competence through the acquisition and the usage of cognitive strategies which enable them to monitor their own problem-solving activities as they are taking place. Similarly, self-confidence arises from the motivation involved in the application of the cognitive strategies available for successful completion of the task being undertaken.

According to Zimmerman (1986; 1994) therefore, the construct of self-regulation is grounded in three domains namely, the psychological, behavioural and affective. Self-regulation therefore, might be said to refer to the degree to which learners metacognitively, behaviourally and motivationally become active participators in their own learning. The most effective self-regulators are recognised by their ability to initiate their own learning; they are generally resourceful, self-reliant and persistent especially in the face of demanding tasks (Zimmerman, 1994).

Development of the metacognitive skills which enable students to become self-directing, self-regulating and competent learners has become significantly important in teacher education programs and researchers have sought to design and test numerous instructional intervention programs which are intended to promote these types of skills (Ghatala, 1986; Levin, 1986; 1988; Palinscar & Brown, 1987; Pressley, 1986; Raphael & Pearson, 1985; Swing, Stoiber & Peterson, 1988; VanLeuven & Wang, 1991; Wong, 1986). Much of this research has served to highlight the importance of encouraging the use of instructional activities within the classroom which will in turn foster the development of metacognitive skills by students. Zimmerman (1994) notes however, that simply teaching cognitive strategies to children will not necessarily promote self-regulation. He suggests that children need to be presented with a range of options, strategies and learning styles and
must ultimately be entrusted with the control of the learning dimension themselves. This is in stark contrast, Zimmerman argues, to traditional learning methods which have been viewed as being passive, stressing receptive skills and rarely encouraging self-regulatory options and student control (Zimmerman, 1994).

The development of self-regulatory behaviours is enhanced in the classroom through explicit guidance by mediational means such as through the use of cognitive tools, modelling and language (Bruner, 1966; 1985; Elliott, 1995; Rogoff, 1990; Vygotsky, 1978). The development of self-regulation is implicit in information-processing models of cognition, however, it is also recognised as an important goal in sociocultural theories of learning.

**Sociocultural Models of Learning**

The Russian psychologist Lev Vygotsky, concluded that mental activity is uniquely human and that it is the result of social learning involving the internalisation of social signs developed through social and cultural relationships (Kozulin, 1990; Vygotsky, 1976; 1978; 1996). Vygotsky believed that cognitive development is a sociogenetic process operating through our superior human nervous system which, coupled with the cultural milieu within which each human exists, is responsible for the formation and development of higher mental processes. According to Vygotsky, children’s immature mental structures change when constantly exposed to the more mature thinking of adults and peers as they engage in the cooperative dialogues surrounding everyday activities (Rogoff, 1990; Vygotsky, 1976; 1978; 1996; Wertsch, 1991). The process of internalising higher level mental functions such as perceptions, voluntary attention, memory, thought, language and problem-solving also depends largely on the historical context of the culture (Kozulin, 1990).
Unlike Piaget and others who stress the biological nature of learning as a natural maturational process, Vygotsky argued that teaching (social interaction) creates the learning processes which lead development resulting in zones of proximal development. Zones of proximal development have been defined as the distance between an individual's actual level of development and that individual's potential level of development (Vygotsky, 1978, p.85). The social context of instruction during the school years provides substantial opportunity to generate zones of proximal development.

These concepts have significantly impacted on education in recent years resulting in an increased emphasis on the internalisation of externally provided guidance (Bruner, 1985; Ebbeck, 1995; Elliott, 1995; Fleer, 1992; 1995; Hogan & Pressley, 1997a; Kozulin, 1990; Roehler & Cantlon, 1997; Rogoff, 1990; Vygotsky, 1978) through scaffolded instruction. This perspective promotes early learning as a mediated activity occurring through interactions with competent others (Ebbeck, 1995; Rogoff, 1990; Vygotsky, 1978) which results in ongoing stimulation and motivation for learning as well as support of a more metacognitive or self-regulatory nature. Scaffolded support for learning in a sociocultural context assists thinking as it proceeds from an interpersonal to a personal domain.

*Scaffolding Children's Learning*

"Scaffolding" a term coined by Jerome Bruner (1966; 1986; Wood, Bruner & Ross, 1976), has been applied to the mediation process between teacher and learner as a process which enables novice learners to carry out tasks, achieve goals and solve problems which without assistance would be beyond their efforts (Gage & Berliner, 1992; Rogoff, 1990; Vygotsky, 1978). Scaffolded instruction includes the simplification of tasks by the teacher along with discussion of the important and relevant features of a task, enabling learners
to organise information for future efforts and for generalisation and use with other related tasks, leading ultimately to independence and self-regulation. Characteristics of the simplification and discussion process may take the form of teacher modelling, questioning, explaining and suggesting. The "scaffolding" or assisted guidance by the teacher is gradually replaced by the efforts of the student (Anderson, 1989; Hogan & Pressley, 1997b) who continues the process by self-regulating his/her own learning.

Vygotsky, like Bruner (1966; 1986) believed that the central context for learning through the scaffolding process is collaborative dialogue. Although generally occurring between partners of unequal ability, such as between an adult and a child, it is also effective amongst peers of unequal ability. Rogoff (1990), along with Roehler and Cantlon (1997), suggests that when the scaffolding metaphor is used, it refers not only to the conversational, but also to the modelled support given by the expert and is instrumental in directing cognitive thinking and encouraging on-task behaviour.

While expert learners tend to be independent of adult assistance and are recognised for their ability to initiate their own learning as resourceful, self-reliant and persistent pursuers of set goals (Gardner, 1994; Zimmerman, 1994), many novice learners, as well as children who experience difficulty with academic tasks, have been found to be deficient in their knowledge and use of metacognitive self-regulatory processes (Borkowski, 1992).

**Differences in Approaches to Learning**

By using metacognitive, self-regulatory strategies to facilitate learning, high achieving children display a concern for the process or the "how" of learning, and are desirous of gaining meaning which results in deep rather
than surface approaches (Biggs, 1988a). Low achievers on the other hand are more likely to concentrate on the learning of facts and skills or the “what”, which is indicative of a surface approach to learning (Biggs, 1988a), and according to Meece (1994), they find it difficult to sustain the effort required for problem-solving tasks, especially in the face of constant failure.

**Classroom Connections**

Svensson and Hogfors (1988) have suggested that the nature of teaching concerns the relationship between the ‘teaching situation’ (what goes on in the classroom) and the ‘learning outcome’ (what students learn). From a sociocultural perspective, effective classrooms are those where teachers adopt an instructional approach that promotes meaningful understanding by fostering the metacognitive strategies so characteristic of deep approaches to learning, self-regulation and high achievement. Such teachers facilitate students’ participation in learning tasks by modifying lessons to meet student needs, by encouraging the use of collaborative and cooperative dialogues between teacher and student and amongst peers, and by emphasising the intrinsic rather than the extrinsic values of learning (Meece, 1994).

Unless teaching is explicitly directed toward the use and encouragement of the metacognitive, self-regulatory skills so necessary for deep approaches to learning, the focus of learning behaviours may be interpreted differently by different children within the same classroom. Phenomenographic methodological approaches address the manner in which individual children may interpret the learning phenomenon in qualitatively different ways (Prosser, 1993). Although Marton (1994) and Prosser (1993) have suggested that “how” the world is experienced and understood is inseparable from “what” is experienced and understood, students within the same classroom have been found to interpret the reality of classroom lessons in markedly
different ways. When students interpret learning as “what”, they generally concentrate on memorising the detail of a range of skills and facts for later reproduction. Such students may be motivated extrinsically by rewards such as fear of failure or a high TER (Tertiary Entrance Rank) or may through a history of repeated academic failure, give up altogether. Students however, who interpret learning as “how”, tend to be intrinsically motivated to discover meaning at a deep or deep achieving level (Biggs, 1988a).

**Summary and Conclusion**

Behaviourist approaches to learning with their emphases on extrinsically imposed motivation activated through a system of rewards and punishment continue to inform considerable educational practice today. Behaviourist approaches however, fail to fully explain the critical cognitive element which is believed to be fundamental to the thinking, knowing, problem-solving process and which ultimately leads students to be deep learners and achievers, self-regulating their own cognitive behaviours.

In a similar manner, humanistic approaches to learning also continue to influence educational practice, and in particular the emphasis on independence and self-direction has been of considerable value. For the most part, many of the more radical teachings of the humanistic tradition have been reassessed to the extent that very few today would advocate the extreme philosophy of Neill (1960), the principal of Summerhill who is reported to have said:

> Everytime we show Tommy how his engine works, we are stealing from that child the joy of life - the joy of discovery - the joy of
overcoming an obstacle. Worse! We make the child come to believe that he is inferior, and must depend on help (Neill, 1960, p.25 cited by Gage & Berliner, 1992, p.481).

Therefore, while humanistic approaches accurately recognise the importance of personal motivation and of learning processes rather than assessment, curriculum and grades, they fail to recognise the value of the cognitive, physical and psychological support given novice learners by those with greater depth of understanding and considerably more experience (Rogoff, 1990).

Cognitive approaches, especially information processing theories, have recognised that learning is an active, participatory process, involving the use of strategies which incorporate new understandings into those already developed. They rely on cognitive processing skills such as attention, rehearsal, organisation, recall and reconstruction, and require learners to be aware of and to understand their own knowledge about learning (Berk, 1991; Eggen & Kauchak, 1994).

Sociocultural perspectives, incorporating many information processing characteristics, view learning as a cognitive activity naturally occurring in social and cultural contexts such as the home, school or within an individual’s community. They recognise the importance of intrinsically motivated behaviours, encouraged and facilitated through the efforts of teachers and parents. Elliott (1995), Rogoff (1990), Vygotsky (1978) and Wertsch (1991) believe that the efforts of teachers and parents enable children to learn and build upon the skills, values and knowledge which are often modelled and discussed as they interact on a range of tasks. Implicit in sociocultural views of cognitive development is the notion that children’s
learning must be effectively guided in the classroom. Indeed, teachers who facilitate and guide children's discovery of knowledge have been found to provide not only facts (declarative knowledge) but also enhanced understanding of the processes required to remember, apply and transfer understandings across academic domains. Of even greater importance, however, is that effective teachers communicate an understanding of the processes involved in the application of knowledge for problem-solving (procedural knowledge) which results in deeper learning and self-regulation.

While Borkowski and Thorpe (1994), Biggs (1988a) and others have found that there are qualitative differences in the way that low achieving and high achieving children approach learning and problem-solving tasks, classroom instruction has not always been conducive to developing higher-order thinking skills (Anderson, 1989). Low achievers, frequently as a consequence of repeated failure, mistrust their own abilities and tend to be motivated extrinsically. They are more likely to focus on task completion rather than display interest in processes, especially when strategies which help to regulate and monitor tasks have not been explicitly taught nor modelled in the classroom (Anderson, 1989).

High achievers on the other hand, have been found to approach learning in a more confident manner. They are more frequently motivated intrinsically, they recognise the value and the importance of the use of strategies to regulate and monitor behaviour and while satisfactory task completion is ultimately an important end goal, high achievers are usually process oriented, indicative of a deep learning approach (Biggs, 1988a). Consideration of individual learning styles, facilitating and guiding behaviours, direct intervention, explicit instruction and modelled use of a range of strategies are
imperative in classrooms if all children are to develop meaningful understandings of their environment.

Phenomenographic methodologies explore the unique experiences of individual learners. Prosser (1993) and Walsh, Dall’Alba, Bowden and Martin (1993) have noted that while “what” is taught in a classroom may be the same for each child, “how” that material is interpreted and what the focus of that teaching means will be qualitatively different for each individual. Biggs (1988a) suggests that the way a task is undertaken (the process) and the ultimate academic outcome of that task are likely to be a reflection of the type of understanding an individual has developed in the classroom.

The Focus of This Thesis

This chapter (Chapter 1) commenced by considering a number of historical and contemporary learning theories adopted by researchers to explore some of the complex components of higher-level problem-solving. While recognising that elements from many learning theories are in fact incorporated into everyday classroom teaching practice, this study specifically regards the learning approaches adopted by the sociocultural theorists (Vygotsky, 1978; Rogoff, 1990). The work of Vygotsky, Rogoff, Wertsch and others places learning firmly within a social and cultural milieu and adopts elements of the information processing model of knowledge acquisition through guidance by more expert learners.

Along with the home, school classrooms have been identified as valid sociocultural contexts, dynamic environments for the transmission of the knowledge, understandings, rules and skills necessary for successful learning.
Development, however, of some of the more complex cognitive activities thought to be necessary for problem-solving and self-regulation are frequently not acquired in the classroom, and unless the home environment supports higher-level thinking, some children will continue to experience difficulties with learning. In many classrooms, content material is delivered in a didactic teaching manner where the emphasis is placed heavily on the memorisation of facts through a system of rote learning procedures (Anderson, 1989). Memorised facts are frequently reproduced for assessment purposes but, if seen as irrelevant to the learner, material may be imprecisely learned and quickly forgotten. Biggs (1988a) has suggested that children who believe that the reproduction of facts to meet institutional requirements is the most important aspect of the learning process are likely to adopt a surface approach to learning and problem-solving. If strategies are used to facilitate learning, they are likely to be at a minimal level targeted at merely meeting essential requirements.

Students on the other hand, who regard learning as a discovery of meaning, linking new knowledge with that already existing, and who use strategies to facilitate problem-solving for personal achievement, are likely to adopt a deeper approach involving task management of the learning process (Biggs, 1988a). Deep approaches to learning and problem-solving involve an understanding and use of metacognitive, self-regulating strategies. Deep achievers not only search for structure and meaning from learning tasks but organise their time and content optimally.

Concerned then with the development of the thinking and learning skills necessary for an effective transfer of information with a minimum of differential performance outcomes, this study focuses on the characteristics and learning behaviours of children in their first year of school. Chapter 2
reviews the literature regarding deep, surface and achieving approaches to learning, and how such approaches are facilitated in the school environment. It further discusses the role that attention, motivation and self-esteem have in the adoption of learning approaches and the most appropriate learning environments for their development.

Rogoff (1990, p.7) has suggested that students are “apprentices in thinking”, and like all apprentices, are active in their efforts to learn through observation, participation and dialogue with more “expert” members of society. Chapter 3 therefore, examines the literature relating to the development of self-regulation through the use of a range of metacognitive strategies and discusses how these strategies might be developed in the classroom. Although teachers have frequently been viewed as “experts” regarding knowledge about facts and skills, higher-level thinking processes have rarely been explicitly taught or modelled in the classroom (Ghatala, 1986; Levin, 1986; 1988; Pressley, 1986; VanLeuven & Wang, 1991).

In some cases, a student’s ability to access the strategies required for successful learning and problem-solving will be limited unless strategy use has been encouraged in other contexts. Indeed, poor academic outcomes have been thought to be the result of an immature ability to access learning strategies and certainly significant differences in the self-regulating and learning approaches of low achieving children have been discerned (Borkowski & Thorpe, 1994; VanLeuven & Wang, 1991). Explicit instruction in those aspects of learning considered essential to deep level involvement is imperative if desired behaviours are to be acquired (Prosser, 1993). Chapter 4, therefore, looks at the literature regarding differences in learning approaches of low and high achieving students. Prosser (1993), as well as Marton, Hounsell and Entwistle (1984), Marton and Saljo (1976) and
others, suggest that within any learning environment students will experience substantially different teaching emphases, irrespective of the fact that the reality of the lesson may be identical for each. Phenomenographic studies have shown that students tend to understand, perceive, experience, conceptualise and apprehend aspects of teaching phenomena in a number of qualitatively different ways (Marton, 1994). The way students experience teaching therefore, determines not only their future understanding about what is taught (content), but also how problems are approached (concepts and processes) (Prosser, 1993). Students who focus on meaning through the use of processes as well as content, rather than on content alone, have been thought to gain different understandings from a classroom lesson to students whose focus is exclusively on task mastery and reproduction of learned facts.

Chapter 5 summarises the literature of the previous four chapters and finally concludes with a statement of purpose outlining the major research considerations under review in this study.

Chapter 6 details the methodology and describes the study in two parts as Study 1 and Study 2. Firstly, it explains the objectives and methodology of a major research project undertaken in conjunction with my supervisor and how it relates to this thesis, and secondly, it details the procedures and the theoretical approach adopted for this study. In particular, Chapter 6 reviews the theory and provides the rationale behind phenomenography as a qualitative research method of investigation and the use of case studies as a reporting tool. Marton and Saljo (1976) suggest that categories of meaning can be discerned from students’ language and behaviour as problem-solving tasks are undertaken. Phenomenographic approaches to analysis involves ascertaining an individual’s personal perspective of learning phenomena.
Chapter 7 describes the findings of this study in general terms and in order to discern the precise nature of children’s approaches to learning, four illustrative case studies (Chapter 8) detail aspects of the attention, motivation, levels of interest and self-esteem of eight different children. They explore the verbal and non-verbal language indicative of higher-level cognitive strategy use and compare the behaviours of children from the same classrooms, in terms of deep and surface learning approaches.

Chapter 9 discusses these findings and Chapter 10 concludes the thesis with a summative account of the study and includes implications for teaching practice as well as highlighting areas for future research.
Chapter 2

APPROACHES TO LEARNING

Contemporary teaching and learning theories and the research which drives and is derived from them are merely the next stage in what has been a continuum of ideas which have flowed since the time of the enlightenment. Beginning in the 1970s, however, significant research has explored the way students approach learning (Biggs, 1988b; Biggs & Moore, 1993; Entwistle, 1991; Marton, 1994; Trigwell & Prosser, 1991), along with the way these approaches impact on classroom achievement. Although a great deal of research attention has been directed toward an understanding of how students perceive learning at the primary, high school and university levels, it must be remembered that the early childhood years are also critical learning periods. Indeed, Piaget, Vygotsky and others believed that the early years constitute the most critical period for the development of cognitive behaviours. By determining the factors therefore, which characterise different learning approaches in those early years, it may be possible to challenge the behaviours which ultimately lead to immature learning and negative outcomes (Prosser, 1993). In the early childhood years, children are at the very threshold of what is likely to be twelve years or more of formal, school based learning, and frequently the behaviours learnt during this time impact greatly on the motivation, approaches to learning and eventual outcomes of children as they progress through their school years.

This chapter examines the literature relating to the development of qualitatively different learning approaches. It explains the characteristics of
deep and surface learners, the factors which contribute to the adoption of each and the influential aspects of the classroom environment and teaching practices.

Although early childhood education has primarily been seen as a process of development (Berk, 1991; Eggen & Kauchak, 1994; Kaplan, 1991; Piaget, 1952; 1976), the work of Vygotsky and other sociocultural theorists (Bruner, 1985; Rogoff, 1990), has challenged the purely developmental stage theories proposed by psychologists such as Piaget. Consideration has been directed recently to factors other than those implied by rigid developmental stages such as the social environment, the learning context and the learner's contribution (Clyde, 1995; Elliott, 1995). Debate also continues about the appropriateness of the school environment as a venue for higher cognitive thinking rather than as merely the provider of facts and skills, added to which considerable discussion highlights the teacher's role as a scaffolder of children's understanding beyond that perceived to be developmentally appropriate in a Piagetian sense.

Certainly in recent years, research has investigated the importance of the development of self-regulation and the use of the metacognitive strategies thought to promote it (Borkowski, 1992; Brown & Palincsar, 1982; King, 1989; Pressley & Ghatala, 1990; Schunk & Zimmerman, 1994). The link, however, between metacognitive strategies, self-regulation and approaches to learning in early childhood has not been adequately debated. Although older children learn material in qualitatively better ways than younger children (Biggs & Collis, 1982), even in the early school years, delivery of material, teacher responses, assessment procedures, as well as numerous intrinsic factors can influence students' approaches to learning. Indeed, Cullen and St George (1996), in a study which looked at the dynamics of classroom life,
reported that scripts for school learning are acquired even in the first year of school.

Deep and Surface Approaches to Learning

According to Biggs (1987) and Biggs and Moore (1993, p.310), ideas regarding the way students approached learning were originally conceptualised by Ferrence Marton in the 1970s. Marton found that students approached set tasks, for example, the comprehension of text with one of two intentions: to remember the words used or to discover the author’s meaning. Depending on their intention, students chose strategies accordingly. If the intention was to remember words, rehearsal strategies were used to facilitate rote learning; if however the intention was to gain meaning, strategies designed to create links and aid understanding were used. Marton, together with Saljo (1976) further developed deep and surface notions which were thought to relate to the quality and complexity of outcomes. Surface outcomes it was thought, led to the reproduction of words and detail; deep outcomes reflected meaning (Biggs & Moore, 1993; Trigwell & Prosser, 1991). Schmeck (1988) describes learning in a similar manner, from the experiential or phenomenological perspective as defined by individuals engaged in learning. He says that when described thus, learning can be categorised in several different ways, that is, everyone’s experience of learning is not the same. Where for example, “one learner might describe learning as the literal retention of knowledge achieved through repetition and recitation, another might describe it as an interpretive process aimed at understanding reality” (Schmeck, 1988, p.3). Schmeck (1983) also suggests that rather than there being a simple bipolar distinction between deep and surface, there is in fact a great deal of overlap.
Ramsden (1988a) has noted that approaches to learning have both a referential and a relational component. The referential component is concerned with the student's intent within a learning task - whether the focus is directed toward meaning of the whole or on components of the whole to the exclusion of what they signify. The relational component deals with the process of the learning task or the cognitive aspects which involves (a) manipulation of tasks in such a manner that the underlying structure is maintained, suggestive of a deep approach, or (b) looking only at aspects of tasks so that content becomes distorted, suggestive of a surface approach (Ramsden, 1988a).

Biggs (1987; 1988a), as well as Biggs and Moore (1993) have argued that there are in fact three dimensions congruent to learning at a deep or surface level; namely motives, strategies and achievement motivation. Furthermore, Biggs (1988a) links these dimensions to particular types of outcome or learning at a surface or deep level. Biggs goes on to note that there is in fact a third outcome level which he terms "achieving approaches", which may in fact be attached to either deep or surface level motivation. It is suggested that surface-level approaches may show rich detail but poor structure while the use of deep-level approaches may produce well-structured outcomes and higher academic scores. The focus on the first is on lower-level components rather than higher-level, or on words and sentences rather than on main ideas and themes (Schmeck, 1988).

Biggs' (1988b) approaches to learning have been replicated by factor analysis several times and are described as follows:
surface, where the motive is to meet institutional requirements minimally and the congruent strategy is limiting the target to essentials that may be reproduced through rote learning;

deep, where the motive is intrinsic interest in the content learned, and the congruent strategy is discovering meaning and acquiring competence by reading widely, inter-relating with existing knowledge, etc;

achieving, where the motive is ego enhancement through high grades and the congruent strategy is organising time, working space and syllabus coverage in the most efficient way;

surface-achieving, where the motive is to achieve but where the student conceives the accurate reproduction of detail as the way to do so;

deep-achieving, where the student is motivated both by intrinsic interest and high grades and so approaches work through an organised and strategic search for meaning (Biggs, 1988b, p.129).

The Surface Approach

According to Biggs, “students adopting a surface approach to learning are instrumentally or pragmatically motivated” (1988a, p.186). Tasks such as a story to be written or spelling lists to be learnt are frequently seen as demands to be met without intrinsic value. Surface learners in fact tend to be extrinsically motivated by anticipated positive or negative reinforcing consequences (Biggs & Moore, 1993; Entwistle, 1988; Schmeck, 1988). They may be over anxious, worried alternately by the time a task is taking and about potential failure, if insufficient time is spent on the task (Biggs, 1988a). Surface motivated learners engage in tasks for expediency, preferring a minimum of effort to outright failure or punishment, focusing on what they see as the “essentials”, usually factual data and the ways they are represented symbolically. Marton and Saljo (1976) state that surface approach strategies regard the “signs” of learning words, rather than on meaning. Biggs and
Moore (1993, p.311) have suggested that for surface approach learners, learning involves the steering of a middle course between two undesirable fates: working too hard or failure.

Strategies adopted by surface approach learners help them focus on important topics or elements which are perceived as being learned for future accurate reproduction. When this occurs however, meanings, implications, and interconnections between elements are frequently lost. This is not to say of course that accurate reproduction of some learned facts is not important, for example, when learning mathematical formulae. As Biggs and Moore (1993; also Entwistle, 1988; Schmeck, 1988) suggest, however, when adopted exclusively, the surface approach is too restrictive and inflexible for use with many school based tasks, although students holding a quantitative conception of learning may believe that the reproduction of as much detail as possible results in better learning.

Although surface approaches may well show some metacognitive strategy use, surface approach learners generally tend to display minimal metacognitive, self-regulation, opting for rote-learning of key details (Biggs & Moore, 1993; Schmeck, 1988). Biggs and Moore (1993) note, however, that this does not imply that surface approach learners are all prone to rote-learn details, as rote-learning they suggest, is just one symptom of surface approach pathology.

Surface approaches to learning, according to Biggs and Moore (1993), are learning pathologies which are corner-cutting and do not encourage complete task engagement. Such an approach they argue, is frequently likely to develop when students are faced with imposed tasks about which they have little interest or motivation. Regrettably, many students view much of the school curriculum in this manner.
The Deep Approach

Whereas surface approach learners are frequently motivated by external factors, deep approach learners tend to be intrinsically interested in the task and motivated to use strategies in order to seek meaning (Biggs, 1987; 1988a; Biggs & Moore, 1993; Ramsden, 1988a; Schmeck, 1988). Biggs and Moore suggest that when there is a personal commitment to learning, students relate content material to personally meaningful contexts or to existing prior knowledge depending on the subject concerned (Biggs, 1987; 1988a; Biggs & Moore, 1993). While surface approach learners usually rely on reproduction of concrete detail, deep approaches to learning suggest that students (a) possess a great deal of relevant content knowledge; (b) operate at a high or abstract level of conceptualisation; (c) reflect metacognitively on what is to be done using optimal strategies for handling tasks; (d) enjoy the process, and (e) are prepared to invest time and effort (Biggs & Moore, 1993).

Students adopting a planful approach to learning, are aware of their motives and intentions, their own cognitive resources and the demands of academic tasks. More than that however, they have the ability to control these resources and monitor their cognitive processes (Biggs, 1988a). The awareness of such cognitive states and the controlling and monitoring of these processes through the use of a range of strategies are the defining attributes of metacognition (King, 1989), which will be discussed at length in the following chapter (Chapter 3).

For successful academic learning outcomes, strategy must be matched with motive and task (Biggs, 1988b; Biggs & Moore, 1993; Ramsden, 1988a). Biggs and Moore (1993), cite Schiefele (1991), who noted the strategies deep approach students used when reading high and low interest text. Schiefele
found students prepared to expend time and effort and to use strategies for relating new material to that previously known, to search for main ideas, to pose questions and to seek new information. Not only do the strategies used by deep approach students facilitate learning but they increase performance, thereby influencing achievement on problem-solving tasks.

The Achieving Approach

A simple achieving approach, like surface approaches, tends to focus on the product; on an extrinsically imposed goal such as a high grade, a university degree or indeed a gold star on a weekly achievement chart. Although such a goal might frequently involve optimal engagement in a task at a deep approach level, such engagement nonetheless is the means, not the end. Biggs and Moore (1993) suggest that student strategy use will frequently depend on the way the teacher’s distribution of rewards are perceived. If for example, students perceive the teacher as rewarding accurate recall of detail, that is what the achieving student will give!

Deep-achieving strategies, while still having as their aim the procurement of an extrinsic reward, may however, involve a high degree of meta-learning which relates to the context and involves planning of time and resources, as well as content, resulting in optimal task engagement (Biggs, 1994; Biggs & Moore, 1993).

In summary, deep and deep-achieving approaches therefore involve the use of metacognitive strategies requiring self-knowledge as well as task knowledge, while surface and surface-achieving approaches may suggest a reliance on facts and detail without a clear understanding of the importance of congruity between motive, strategy and achievement. Biggs (1988a), and Biggs and Moore (1993) go on to say that because surface approaches rely on
reproduction of facts while deep approaches seek meaning, at any given moment, the two are mutually exclusive. Because this is the case, an achievement approach may therefore be linked to either. For example, rote-learning, or alternatively seeking meaning, can each be accomplished in an organised or an unorganised manner.

While surface-achieving approaches are usually adopted by students who see reproduction of mastered facts as essential to achieve high grades, deep-achieving learners search for the structure and meaning from learning tasks as well as organising their time and context optimally, albeit cost-effectively (Biggs, 1988b; Biggs & Moore, 1993).

**Learning Outcomes**

Differences in learning outcomes have been found to relate significantly to differences in learning approaches and the understanding each student gains about the subject material in question (Biggs, 1987; Biggs, 1994; Marton, 1988). Qualitative differences in the outcome of learning point to differences in perception of the importance given to aspects of what learning has been about. Marton (1988) discusses the work of Svensson (1976) who notes that qualitative variations in learning are congruent with differences in approaches to learning. Focusing on the structural or organisational aspects however, Svensson distinguishes between a *holistic* approach which is characterised by the learner’s direction toward understanding, and an *atomistic* approach characterised by the learner’s focus on sequence without any orientation toward the whole.
While Biggs and Collis (1982) suggest that quality of learning and learning outcomes may be of concern to all educators, most find it difficult to define, especially as it relates to evaluation of thought. They go on to suggest however, that it is “the structural organisation which discriminates well learned from poorly learned material in a similar manner to the way mature thought is distinguishable from immature thought” (Biggs & Collis, 1982, p.xi). Frequently, however, although educators discuss the merits of the structural aspects of learning or open learning approaches, the desired outcome is still closed, with greater interest shown in how much and how well certain content skills have been assimilated rather than in evaluating strategy use (Biggs & Collis, 1982; Collis & Biggs, 1991).

Biggs and Collis (1982) as well as numerous other researchers (Biggs, 1988b; Marton, 1994; Marton, Hounsell & Entwistle, 1984) have concluded that learning outcomes can only be assessed from the student’s own perspective, and indeed only evaluated in terms of the content of the learning or what students themselves believed about the intent of a particular learning episode. They have suggested therefore, that outcomes need to be assessed qualitatively and not exclusively in terms of numbers or reproduced facts. Such “assessments should be made in terms of the structural complexity of the outcome and levels of response should be ordered in terms of characteristics which include progression from concrete to abstract with increasing consistency”, and the use of organising strategies encouraging self-regulation of the task (Biggs & Collis, 1982, p.14).

**Developing Learning Approaches**

In recent years there has been considerable interest in what influences students to adopt a specific learning approach. Biggs and Collis (1982) for example, suggest that approaches to learning as well as learning quality often
depend on numerous factors intrinsic to the learner such as attention, motivation, the stage of development at a given moment, self-esteem, as well as factors extrinsic to the learner such as the type and quality of instruction. Idol, Jones and Mayer (1991) have noted that while metacognition has been largely defined as an individual behaviour, without reference to motivation, they suggest that it may also be defined as shared behaviour and should include reference to learners’ beliefs, judgements, attitudes, motivation and self-concept. These have been perceived as integral factors in the development of deep approaches to learning in addition to use of the metacognitive strategies necessary for the successful completion of problem-solving tasks.

Attention

Attention has been defined as a capacity to activate, organise and maintain the mental structures necessary for task performance or “that which controls access to conscious experience” (Eysenck & Keane, 1996; Slavin, 1997). Fundamental to this process is the ability to attend selectively to task-relevant aspects of the environment whilst at the same time ignoring stimuli which are not relevant to the task and which may detract from it (Eggen & Kauchak, 1994; Eysenck & Keane, 1996; Slavin, 1997).

The role that attention plays in the successful completion of tasks is varied, however, it does appear that attentional abilities increase with maturity. For example, Masur, McIntyre and Flavell (1973), suggest that while young children have difficulty sorting and discarding information, the adaptable attention patterns employed in memory processing improve over the first years of school. In her research into kindergarten grade students, MacMillan (1995) noted that attentional flexibility when engaged in problem-solving
activities was evident, however, it appeared to relate directly to concept knowledge and the mental structures of the students.

Attention is useful for translating knowledge into performance often by the use of strategies which enable higher attenders to select relevant aspects of the task to be completed rather than responding to the whole (Eysenck & Keane, 1996). Some learning strategies have been used to assist students locate and focus attention on important aspects of tasks for example, the repetition of key facts, or underlining meaningful words or phrases (Derry, 1990). Selected attention has been related very frequently to learning. Children who are low attenders have been found to be consistently poorer on memory tasks and less able to use strategies than high attending children.

Researchers interested in deep approaches to learning and self-regulation note that not only attention, but also motivation is a critical factor in student's use of problem-solving strategies and in academic outcomes. Pintrich and DeGroot (1990), and Wigfield (1994) have suggested that students must be motivated to use the metacognitive self-regulatory strategies indicative of deep approaches to learning in order to improve academic achievement, because simply developing a knowledge of cognitive and metacognitive function is insufficient.

**Motivation**

According to Garcia and Pintrich (1994, p.135), motivational strategies are "affectively laden processes" linked to the "self" schemas and goals held by individuals. Motivational strategies are based on perceptions of self-worth and can therefore be self-handicapping or self-affirming. Meece (1994) states that there are two types of motivation goals: learning or task-orientated and performance or ego-orientated, both of which, like other cognitive models
of motivation, involve the active participation of the individual in choosing, structuring and interpreting their own experiences. Learning or task-oriented goals may be valued as ends in themselves, engendering a sense of pride, success and achievement often based on self-referenced standards. Performance or ego-oriented achievements however, are often assessed by individuals in relation to a set of standards based on the performance of others (Dweck & Elliott, 1983). Meece (1994, p.26) suggests that "a sense of accomplishment may be derived [with a performance or ego-orientation] from doing well with little effort, doing better than others, or meeting some other normatively defined standard of success".

According to Meece (1994), students who believe they will improve their ability by expending greater effort are more inclined to adopt a learning or task orientation and will generally pursue tasks which challenge and lead to enhanced self-efficacy. Students who adopt performance or ego-oriented goals however, are often preoccupied with ability, view high ability as necessary for success, judge their personal ability against others and tend to equate the need for high effort with low ability.

Goal orientations have been found to be influenced by the learning environment and Meece (1994) suggests that teachers who emphasise students' improvement, who foster the discovery of new information and who promote the usefulness of learning materials can enhance learning or task-orientations. While success may be attributed to high effort in such situations, it also results in perceptions of high ability. On the other hand, a learning environment which emphasises interpersonal competition, intellectual skill and norm referenced evaluations, performance or ego-orientations are more likely to develop. Meece notes therefore that in some cases, success which may result even from low effort may serve to increase
perceptions of ability, especially when individuals outperform others displaying high effort (Meece, 1994).

The motivation to self-regulate learning and to adopt deep learning approaches is closely related to students' attributional processes (Borkowski & Thorpe, 1994). Children who attribute their own academic failure to low ability are likely to encounter frustration in spite of their efforts and are less inclined than their more able peers to persevere on difficult tasks. The provision of task related feedback, suggesting that improvement is contingent on sustained effort can provide students with the confidence to believe that perseverance breeds success. Academic feedback, rewarding effort, has been found to encourage progress, sustain motivation and increase the self-efficacy needed for further learning (Zimmerman, 1994).

Performance-oriented students who perceive their ability to be low tend to adopt a negative approach to their learning and cannot sustain effort on problem-solving tasks when they encounter failure (Meece, 1994). Learning-oriented students, however, tend to use deep processing strategies which require cognitive effort such as integrating information and monitoring comprehension. Effort not only enhances learning but instils perceptions of competence necessary for self-efficacy and continued motivation.

Students tend to show high levels of metacognitive or self-regulated learning when they conscientiously engage in tasks and are oriented toward learning or mastery goals (Meece, 1994). Studies examining the influence of the classroom environment on students' goal and strategy use have been described by Meece (1994; also Meece, 1991), who found that the type of classroom most likely to elicit high mastery students is one where the teacher uses an instructional approach that promotes meaningful learning. Such
teachers facilitate student’s participation in learning tasks by modifying lessons in order to increase the personal relevance to students. They also provide opportunity for students to collaborate and cooperate on tasks and many teachers emphasise the intrinsic value of the learning material. Meece (1991; 1994) went on to note that high mastery classes were far more actively engaged in learning activities than low mastery classes and that motivation was enhanced when high mastery teachers presented lessons in small steps, when students' comprehension of the lesson was constantly monitored and when students were held to be individually accountable for their own learning. In these classes little emphasis was placed on extrinsic incentives such as examinations and grades.

By contrast, there was found to be an emphasis on memorisation and recall of isolated facts in low mastery classes (Meece, 1994), where students had little opportunity for active engagement in tasks or collaboration and cooperation with peers and where teachers made little effort to adapt lessons for relevance. Common features of low mastery classes were evaluation and ability grading. Wigfield (1994) has argued that although the importance of encouraging students to adopt deep approaches to learning and become self-regulating is undisputed, there are many students who will not become self-regulated and who will not achieve their educational goal, if indeed they choose to formulate such goals at all. Students must value achievement as an incentive to learning otherwise it is unlikely that they will effectively regulate their behaviour when engaged in learning tasks. Wigfield (1994, p.102) therefore, argues that students’ achievement values are “crucial motivational mediators” of self-regulation. If learning tasks are valued then students are more likely to spend time and effort on their completion.
Achievement values, according to Wigfield (1994, p.), are described as "the relative attractiveness of succeeding on a given achievement task" or as "core beliefs about what an individual should or should not do". Students therefore with differing approaches to learning will see competing achievement goals as more or less attractive and their motivation to achieve these goals will largely be based on the value placed on each. Wigfield (1994) believes that the likelihood of actually achieving a goal will also influence students' behaviour. He notes that while a goal may be valued, a task may not be undertaken if there is little expectation for success.

Achievement values which are intrinsic to the learner often result in more positive competence beliefs about an activity, however, even some extrinsically valued tasks can be motivating if the goal is highly desired. Wigfield (1994) notes for example, how older students might take disliked subjects in order to achieve a specific goal.

Students' use of cognitive strategies, their degree of self-regulation and their measured performance have been found to correlate with the way they value set tasks (Wigfield, 1994). Generally speaking however, research (Eccles & Midgley, 1989; Wigfield, 1994) suggests that motivation is frequently stifled during school years and students have been found to devalue some academic activities, especially when they reach the high school years.

**Self-Concept**

It has been suggested that the self-concept is "the most significant cognitive structure organising an individual’s experience and self-esteem, the most influential affective evaluator of this experience" (McCarthy & Schmeck, 1988, p.131). Self-concept refers to an individual’s store of self-attributes, while self-esteem refers to the extent to which those individuals regard these
self-attributes in positive or negative terms (Sinclair, 1991). It is the self-concept therefore, which organises all that we think we are, what we think we can do and how best it should be done. Self-esteem on the other hand is the extent to which we feel worthy or pleased by our self-concept (Berk, 1991; Harter, 1983; Marsh, 1990; Marsh & MacDonald Holmes, 1990; McKnight & Sutton, 1994).

Although there are differences in opinion regarding the nature of the self-concept and its relation to learning, McCarthy and Schmeck (1988) suggest that self-schema are unlike other cognitive schemata in that more time and energy is invested in the processing of information concerned with personal identities. Self-concepts have been found to be powerful cognitive “prototypes” through which incoming stimuli are interpreted. The self-concept therefore, can either facilitate learning or bias or misguide it (Covington, 1989; McCarthy & Schmeck, 1988). Harter (1981) too, believes that academic self-esteem predicts children’s school achievement as well as their curiosity and motivation to tackle challenging tasks. If a sense of competence regarding cognition is communicated by adults when children are engaged in tasks, this is likely to increase not just motivation, but autonomous functioning and a takeover of the adult’s regulating role (Harter, 1983).

Harter stressed the multidimensional nature of self-esteem, noting that children’s perceptions of their abilities (academically and physically) and acceptance (at home or with peers) are frequently independent of each other (Harter, 1983). Therefore, while a child may evaluate himself/herself positively on an overall measure or in one or more factors, evaluation may be negative on others. Marsh’s research (1993; Marsh & Seeshing Yeung, 1996) also points to its multidimensional nature, noting that academic self-
concepts can vary between subjects and frequently affects attributions for success and failure in specific content areas.

McCarthy and Schmeck (1988) also note that there appears to be a significant relationship between self-esteem and choice of learning strategies. They discuss the work of Dean (1977) who found that students with high self-esteem were more likely to use sophisticated learning strategies and perform better on a range of tasks than students with low self-esteem. Students with low self-esteem on the other hand were found to be more rigid in their learning approach, employing repetitive rehearsal strategies when more complex strategies would have been more efficient. McCarthy and Schmeck’s (1988) findings seem to indicate that students with high self-esteem prefer to use “deep, elaborative strategies”, while students with low self-esteem prefer more “shallow, repetitive strategies” (McCarthy & Schmeck, 1988, p. 134). Sinclair (1991) also notes that learning and self-concepts are interrelated and links low levels of self-esteem with low levels of achievement motivation and high levels of anxiety. The manner in which teachers deliver praise or perhaps criticism depending on a student’s success or failure and the extent to which they are able to keep personal threat to a minimum, greatly influence student motivation (Sinclair, 1991), and therefore approaches to learning.

Borkowski, Carr, Rellinger and Pressley (1990, p.58) have also studied the importance of the self-system for learning and suggest that “it is a complex, interdependent system (which includes constructs such as self-efficacy, self-esteem, locus of control, achievement motivation and attributional beliefs) that supports both metacognitive functions and academic performance”. They go on to note however that although the self-system provides the
affective qualities which encourage self-determination, it is the metacognitive system which enables students to reach their goal.

**Developmental Readiness**

Stage theorists such as Piaget, believe that cognitive development proceeds in an orderly irreversible sequence from the very elementary, such as Piaget’s sensorimotor stage to the very complex (formal operational). Such theorists also hold that stages and sub-stages are stable, that is, once a stage has been reached, thinking will only be accomplished in a manner characteristic of that stage (Berk, 1991; Biggs & Collis, 1982; Eggen & Kauchak, 1994; Fleer, 1995; Piaget, 1952). If children are not able to perform a given task, proponents of the stage theory will assume that children will also be unable to perform other logically related tasks.

Certainly there is considerable agreement that students’ ability to understand and master critical thinking varies with age and that teaching needs to be tailored within reason to each student’s developmental level, however, it does not necessarily logically follow that all students will attain each cognitive stage with maturity. Kennedy, Fisher and Ennis (1991) for example, note that there is substantial evidence to indicate that even many university-age students have not yet attained the formal operational stage of thinking even though a characteristic of this type of thinking, the ability to deal with abstract concepts, is necessary for successful academic endeavours. Gelman (1985) on the other hand, following research into the nature of cognitive development in preschoolers, concluded that young children’s cognitive competencies were more like older children’s than once assumed, and the idea that their cognitive structures differ fundamentally from those of older children is questionable.
Although in recent times most teacher education courses have espoused Piagetian concepts, their application in the classroom has been equivocal. How many teachers for example, have perceived student errors as natural developmental phenomena, rather than the result of carelessness, inadequate learning or poor teaching? (Biggs & Collis, 1982). Rowe (1994) agrees and notes that student learning “should focus on the process rather than the knowledge already constructed” (p.25). The development of meaning and understanding must be viewed in terms of its ongoing properties, as a “continuous process to use and interpret a variety of communication systems” (in all learning domains). Most importantly, Rowe (1994) notes, that children’s errors and confusion should never be stigmatised as deficits in relation to adult standards but rather as a movement toward clearer understanding.

Fleer’s (1995) response to the Piagetian notion that learning is subordinate to development is consistent with other views regarding the limitations inherent in this educational paradigm. Certainly, if learning were subordinate to development, then encouraging students to develop thinking at a higher stage other than that at which they are currently capable of thinking is pointless (Biggs & Collis, 1982; Collis & Biggs, 1991).

Developmental stage theories such as that proposed by Piaget are contrary to Vygotsky’s cognitive theory (1978) which holds the position that cognition begins in social situations such as in the home or at school, and indeed can be extended beyond the limitations of the child’s current stage of development (Ebbeck, 1995; Rogoff, 1990). Within a richly equipped sociocultural environment, through collaborative dialogue, parents, teachers and more able peers may extend children’s learning to cognitive levels beyond their perceived present capabilities (Fleer, 1995).
Developing Appropriate Learning Approaches

The school learning environment, especially the quality of teacher-student interactions has been perceived as crucial to enhancing or inhibiting deep learning approaches. According to Halliday (1978), all social discourse delivers messages not only about personal and social values and attitudes, but about the systems which underlie these constructs. Persons therefore, holding rigid, non-adaptable beliefs about the purpose of learning are unlikely to be accepting and tolerant mediators (Halliday, 1978). Realistically however, it is the students themselves who must adapt to the vagaries of the environment and cope with various institutional practices, a range of assessment methods, the skills and attitudes of teachers and the myriad of learning tasks presented (Ramsden, 1988a).

Irrespective however, of the consistency of the school environment as well as student’s adaptability, individuals will still perceive the importance of classroom material in vastly different ways (Marton, 1994; Prosser, 1993). Vygotsky (1996) suggests that even when the environment is stable, the age of a child along with his or her experiences become essential factors which explain the influence of the environment. The psychological development of children and the development of their conscious personalities are made up of their emotional experiences within the environment. It is not the factors themselves however, which determine the course of development, but rather these factors "refracted through the prism of a child’s emotional experience" (Vygotsky, 1996, p.341). Vygotsky argues that by determining the characteristics which have played a decisive role in determining a child’s relationship and attitudes toward a given situation (such as learning), then the environment must be one which supports the individual characteristics of the child (Vygotsky, 1996).
Marton (1988) has suggested that learning can be improved in at least three different ways. Firstly, he believes that teachers should be clear about the kind of learning they value and then build upon that to create an educational system which is directed toward that goal. If the goal of education is to change and improve students’ ways of apprehending reality, then learning should be both promoted and assessed with this as its aim (Marton, 1988). Secondly, Marton suggests that the instructional means by which students can adapt to these specified goals must also be provided if ultimately they are to meet expectations. Thirdly, in addition to focusing student’s attention on certain types of learning goals and supporting their learning endeavours, students also need to be made aware of their own ways of approaching tasks. Some students may need to consider alternative ways of approaching the same task, the efficacy of such methods for greater understanding and the benefits of other approaches for more successful outcomes (Marton, 1988).

Once developed, Entwistle (1991) believes that individual differences in students’ approaches to learning remain relatively stable over time, however, the balance between deep and surface learning for an entire class can be altered for example, by something as simple as an assessment procedure. Therefore, while at an individual level, as Entwistle (1991) argues, the approach adopted by students appears to be related as much to their personal characteristics as to external factors such as teaching foci. In reality of course, both are important. Students’ perceptions of the learning environment and factors such as attention and motivation are all crucial elements in how learning is achieved (Entwistle, 1991).

Given, therefore, that approaches to learning are influenced by a range of factors which need consideration for maximisation of the teaching effort, instruction in schools which has largely been domain specific, focusing on
the acquisition of facts and the development of skills in a disparate fashion, may have contributed to the failure by some students to effectively learn and transfer information adequately. According to Anderson (1989), the development of expertise and academic goals are often incongruent and the learning of facts and skills in isolation has become the end goal of instruction rather than a means to fuller understanding.

Teachers have always been viewed as the providers of information through direct instruction about facts and skills. Anderson (1989) and Entwistle (1991) suggest however, that the teacher's role should be more mediational, facilitating learning rather than being didactic in its approach. Teaching they argue, must be enacted through interaction with students and through collaborative exploration of problem-solving tasks. Mediating teachers have been found to encourage the use of strategies to help children see conceptual connections between new ideas and skills and encourage the generalisation of strategies where appropriate across learning domains. As mediating participator-facilitators, teacher must be encouraged to guide students toward critical thinking and questioning, not necessarily to provide all the answers (Entwistle, 1991).

Mediation is thought to be most effective during social interactions when novices and experts together are engaged in problem-solving tasks (Rogoff, 1990; Vygotsky, 1978; Wertsch, 1991). Interaction between teacher and learner, jointly working to reach solutions on problem-solving tasks eventually leads to the internalisation of metacognitive, self-regulatory skills. Rowe (1994) suggests that when the adult (or expert) works within this interactive environment, the relinquishment of the adult’s identity as an authority to one who rather converses and confers with the novice, frequently results in a joint contribution to shared meanings.
The first task during mediation is to discourage surface or superficial learning. Many children engage in surface strategies as a matter of pragmatics; frequently as a means of self preservation. Biggs (1988b) believes that amongst children who exhibit stress as a consequence of authoritarian attitudes, poor personal relationships, non-negotiable assessment procedures and irrelevantly perceived tasks, then a major inducement to surface learning is pressure.

The second task during mediation is therefore, to encourage deep learning. Rather than applying pressure to accomplish tasks, Biggs (1988b) suggests that by arousing the interest of students in a proposed task, deep learning is then likely to result. This will only be accomplished however if students become actively involved and can be encouraged to monitor and reflect on what they are doing so that they may improve their approach in order to achieve optimal results.

As a consequence of, but also integral to the previous mediation tasks is greater achievement on task performance. In the past, achievement has been associated with the teaching of study skills, however, when students are encouraged to optimise the use of their time and working space as well as monitor their learning activities, they become self-managers of their own learning or self-regulating, and begin to develop a deep-achieving approach (Biggs, 1988b).

The use of metacognitive, self-regulatory strategies enables students to not only maximise their learning and problem-solving efforts, but also increases intrinsic motivation, general competence and confidence in their own abilities to successfully complete tasks. Biggs (1988b) notes that as "metacognition" is a process and not an end state, the teaching of cognitive skills should be
undertaken "metacognitively", perhaps via special sessions but almost
certainly as a regular activity. Ultimately of course, a better approach to
teaching and learning must be the outcome of any metalearning activity.

**Appropriate Learning Environments**

Although the end goal of all teaching programs is to produce learners who are
confident and capable of regulating their own learning at a deep level, the
environment within which such teaching occurs is not always conducive to
meeting these goals. As previously discussed, competent teaching is that
which enhances the facilitators or mediators of task performance (Ramsden,
environments put students in situations where their thinking is challenged,
enabling them to develop complex concepts about learning and encouraging
practice in the use of deep, holistic approaches (Ramsden, 1988b).

In recent years, the management of learning has been developed into a highly
salient, formal, largely institutionalised structure. Although institutions adopt
several ways to improve the learning outcomes of students, methods still fall
roughly into two broad categories. Firstly there are traditional prescriptive
patterns of instruction which tend to focus on the use of a range of strategies
such as the development of skills and the following of procedures, and
secondly, tactical strategies such as note-taking, recitation and self-testing
(Biggs, 1988b). According to Biggs however, although such approaches are
widely used in high school, college and at university, their efficacy is
equivocal. He suggests that although students may initially progress when
following such strategies, they often revert to their original practices,
rationalising strategy rejection over time, believing them irrelevant for their
own purposes (Biggs, 1988b).
In the very early childhood years, especially when considering the education of children in long day care services and preschools, the use of such traditional, prescriptive teaching strategies is inappropriate (Gardner, 1996). When children commence school however, many of the teaching approaches adopted in those very early years are abandoned for a more didactic style similar to those used in higher grades (Briggs & Potter, 1992; Idol & Jones, 1991; Jones & Idol, 1990).

Ramsden (1988a) maintains that there are three domains influential in students’ approaches to learning and their deployment of learning strategies: namely, the style of teaching (method of transmission of what is learned), the assessment (method of evaluation of what is learned) and the curriculum (content and structure of what is learned). Ramsden further notes that each contextual domain may directly constrain the use of strategies. For example, he suggests that learning material may lack the structure for meaningful understanding to develop and material may be such that it precludes the use of other than mnemonic or memorising strategies. Each domain has the potential to influence student’s learning by influencing their perceptions of the learning task.

Specific teaching goals are frequently related directly to teaching styles and may have either a product or a process orientation (Dweck & Elliott, 1983; Dweck, 1986). Similarly, the product versus process construct is likely to structure the motives or the beliefs underlying teaching goals which may in turn determine task-specific behaviours (Gardner, 1994; Prosser, 1993). Given that students of similar cognitive abilities frequently develop qualitatively different understandings and perceptions about learning, even within the same classroom, teaching should always implicitly and explicitly reflect desired teaching goals (Anderson, 1989; Biggs & Moore, 1993,
Prosor, 1993). If self-regulation is important, and indeed, at least the ideological goal of most teaching is directed toward this end, then a process orientation placing as much importance on the acquisition of strategies for thinking and problem-solving, must equal the emphasis given to learning about facts and skills.

Despite its perceived limitations, education, according to Vygotsky (Kozulin, 1990; Rogoff, 1990), is a vital tool for enculturation, and the school a critical forum for higher learning. Children must be provided in an organised way with the psychological tools required to assist in the reorganisation of their mental functions as well as with the educational process of internalising pedagogical activity and elaboration of the contents presented to them. Pressley (1995) has noted that after years of research into children’s learning, instruction is at its best when it is matched to students’ zones of proximal development (ZPD) (Vygotsky, 1978). Pressley goes on to say however, that instruction matched to the ZPD must include a great deal of modelling and explanation of mature thought followed by considerable practice with interesting and authentic academic tasks with both the teacher and with peer scaffolding, thereby minimising frustration and maximising progress (Pressley, 1995).

Biggs (1988b), believes that in order to adapt to the formal institutionalised structures imposed by schools, students need to adopt strategies rather than tactics; to determine goals, to ascertain risks, to predict outcomes and to be prepared to change strategies following evaluation in order to successfully complete tasks. To enhance students’ learning therefore, the focus must be on learners themselves and it must involve an awareness within individuals of their own cognitive processes as well as the control that can be exerted over these processes (Biggs, 1988b). In order to develop expertise in particular domains, learners must have not only extensive networks of knowledge, but
also the self-regulatory mechanisms necessary to determine which knowledge to access for use with specific tasks and how to use them (Anderson, 1989). Competent learners have been found to monitor their own performance by reorganising information and redefining problems by means of self-questioning, summarising background knowledge and predicting end results.

Zimmerman (1994) believes that there are some essential conditions necessary for self-regulation if students are to gain maximum advantage from their school learning. School activities and indeed research procedures, which compel students to participate in a specific manner may, suggests Zimmerman, inhibit self-regulation and motivation. Strategy choices need to be made available for students as well as the opportunity to monitor the efficacy of each, thereby ensuring comparative judgement. A study conducted by Lodico, Ghatala, Levin, Pressley and Bell (1983), demonstrated students’ ability to self-regulate their learning when given a choice between two specific strategies. After learning both strategies and being given the opportunity to evaluate the efficacy of each, a greater number of students in an experimental group chose the more effective strategy over that in the control group. When given the opportunity to work consistently therefore, at their own pace with strategies of their own choosing, individual differences amongst students were found to be significantly reduced (Lodico et al., 1983).

In recent years cognitive development has been thought to involve increases in skills and knowledge in particular domains, rather than in a generic sense. Research has focused on the goal structures of specific skills which have included language, reading and mathematical problem-solving and has been concerned with the thinking that occurs behind the resolution of cognitive activities. The nature of the cognitive process and the strategies employed by
the individual to assist in the resolution of a task have been the subject of much debate. For years cognitive awareness and ability have been assumed to be the result of maturation based on hereditary and environmental factors but more recently have been thought to be grounded in social and cultural contexts (Rogoff, 1990).

**Summary and Conclusion**

To summarise, deep and surface approaches to learning or learning which has as its intention, the remembering of facts or alternately the discovery of meaning, are influenced by a complex range of factors. The way students perceive the teacher’s expectations for learning for example, is likely to influence the time, effort and direction of energy expended on any one task. Students perceiving learning as a reproduction of mastered skills for examination purposes only are likely to use different, possibly less demanding strategies from those adopted by students who are interested in pursuing learning for its own sake. Other factors intrinsic to the learner such as attention, motivation, stages of development and self-concept are also influencers of deep and surface approaches to learning.

The mediational rather than the didactic role of teachers has been highlighted, as well as the importance of collaboration between expert and novice learners in the facilitation of higher-level thinking.

Within this chapter the nature and characteristics of appropriate learning environments which have been thought to contribute to the development of metacognitive understanding and self-regulation in students, and thus deep approach learners, have also been discussed. The appropriation of the psychological tools required for complex learning must be encouraged in the
school environment however, teachers and students alike must be very clear about teaching and learning objectives and how they are imparted.

In the following chapter (Chapter 3), Vygotsky’s sociocultural theory will be discussed, along with the importance of collaborative dialogue. The literature relating to the term “scaffolding”, and its importance for assisting with the development of higher-order thinking skills will also be explored. This material leads on to discussion about the higher-order skills or the use of the metacognitive strategies necessary for self-regulation which of course ultimately lead to perceptions of learning as a deep, meaningful, intrinsically motivated endeavour.
Chapter 3

SOCIOCULTURAL THEORIES
METACOGNITION AND
SELF-REGULATION

Some of the early literature relating to deep and surface approaches to learning and the subsequent development of those theories, especially in the work of Biggs (1987; 1988a; 1988b; 1994; Biggs & Collis, 1982; Biggs & Moore, 1993; Collis & Biggs, 1991; Ramsden, 1988a; 1988b; Schmeck, 1988) were discussed in the previous chapter (Chapter 2). The development of learning approaches were seen to be contingent on a range of both intrinsic factors such as attention, motivation and self-esteem, as well as extrinsic factors such as the perceived goals of the teacher and the importance of appropriate teaching and learning environments.

In this chapter (Chapter 3), relationships between the adoption of deep and surface learning approaches and the sociocultural environment for the enhancement of metacognitive, self-regulatory strategies will be examined. In the first section, sociocultural contexts and the importance of collaborative dialogue are discussed. This is followed by an examination of the characteristics of metacognition and the development of metacognitive strategies for self-regulation. The chapter concludes by linking metacognition, self-regulation and deep and surface approaches to learning together.
Sociocultural Framework

Vygotsky’s sociocultural theory offers a “unique seamlessness of individual, social and cultural processes” (Rogoff, 1990, p.13). His perspective is one which emphasises the societal context of an individual’s cognitive development and highlights the relationship between the tools for thinking that are provided by culture and the development of individual thought processes. Leont’ev (1981, p.55-56) summarises Vygotsky’s views in this manner:

Vygotsky identified two main, interconnected features [of human productive activity] that are necessarily fundamental for psychology: its tool-like ['instrumental'] structure, and its inclusion in a system of interrelations with other people. It is these features that define the nature of human psychological processes. The tool mediates activity and thus connects humans not only with the world of objects but also with other people. Because of this, humans’ activity assimilates the experiences of humankind. This means that humans’ mental processes (their “higher psychological functions”) acquire a structure necessarily tied to the socioculturally formed means and methods transmitted to them by others in the process of cooperative labour and social interaction. But it is impossible to transmit the means and methods needed to carry out a process in any way other than in external form - in the form of an action or external speech. In other words, higher psychological processes unique to humans can be acquired only through interaction with others, that is, through interpsychological processes that only later will begin to be carried out independently by the individual (p.13).
Sociocultural theories such as those offered by Vygotsky, Leont’ev, Luria, and others study the mind in a societal context (Kozulin, 1990; Rogoff, 1990). From a sociocultural perspective, the basic unit of analysis is no longer the (properties of the) individual but rather the (process of the) sociocultural activity (Rogoff, 1990). Central then to Vygotsky’s theory is the notion that when children participate in cultural activities with the guidance of more skilled partners, they can internalise a more mature approach to problem-solving using the cognitive tools that those partners model for thinking (Ebbeck, 1995; Kozulin, 1990; Rogoff, 1990). Rogoff (1990; Rogoff, Ellis & Gardner, 1984) notes that Vygotsky’s mechanism through which social interaction facilitates cognitive development resembles apprenticeship. As novices work closely with experts in joint problem-solving ventures through the zone of proximal development, their shared cognitive experiences together result in task completion and enhanced learning.

Problem-solving involves the use of complex resources and strategies, and the strategies used along with the way they are used which are derived from the sociocultural milieu, employ the technologies available to any given culture (Rogoff, 1990). Luria (1996) suggests that the use of such resources and strategies enables a transition from a base scheme of behaviour to civilised habits by applying natural functions to the solution of a definite task. Indeed, due to its social nature Vygotsky (Kozulin, 1990), believed that higher-order mental functioning is initially external, provided by the more skilled partner. Vygotsky noted however, that gradually, interpersonal (or interpsychological) processes are transformed into intrapersonal (or intrapsychological) ones (Vygotsky, 1976; 1978; 1996).
The motives and beliefs underlying teaching goals as well as learning objectives are frequently shaped and formed by the prevailing socio-culture (Gardner, 1994). So important is the sociocultural milieu that it has been stressed not only by Vygotsky and his adherents, but also by other psychologists such as Freud (1927-1931), who also note the integral nature of the relationship between culture and the cognition of those who embrace it. That which occurs naturally within the sociocultural context may be harnessed and deliberately utilised to influence the behaviours considered desirable by educators (Luria, 1996).

Bronfenbrenner (1977;1979), also highlighting the sociocultural dimension, notes however, that there are numerous local as well as personal or individual forces which impact on learning. He suggests that changes in these forces or differences in the focus of these forces can also contribute to changes in what people do and what they are capable of doing. Nonetheless, Rogoff (1990) and her colleagues suggests that it is the cultural component which has the greatest influence on aspects of children's lives (Rogoff, 1990; Rogoff, Ellis & Gardner, 1984; Rogoff, Mistry, Goncu, & Mosier, 1992); influences which transcend local settings and personal forces. It is the cultural forces which impact on schooling, child rearing practices, language and the development and display of abilities (Hatch & Gardner, 1991). When children share ideas within cultural environments, discuss procedures and together solve problems, this collaborative effort serves to inform learning and skills acquisition.

Bruner (1985) believed that the transition from novice learner to expert within the sociocultural environment requires person to person interaction during which time the knowledge and the complex cognitive understandings that comprise expert behaviour are created and shared during meaningful
problem-solving activities. Cooperative groups with peers as tutors have also been found to provide a context that promotes and supports problem-solving through the identification of a common goal. Common goals develop positive interdependence between expert and novice problem solvers. Problem-solving skills need to be developed through a cooperative learning environment which allows individual problem-solving skills to be refined through sharing ideas (Arenz, 1991). Vygotsky (1978) and Kozulin (1990) describe the ability to acquire skills and knowledge as internalisation, while the knowledge to be internalised is constructed through the collaboration process (Gardner, 1994).

The Importance of Collaborative Dialogue

As previously stated, the higher-level mental functions which lead to deep approaches to learning and the structured methods required to achieve problem-solving goals are the cultural influences which are provided by a society. One of the structures used to organise thinking is language, and it has provided various systems for counting, mnemonic techniques, algebraic symbols, works of art, writing schemes, diagrams and maps (Vygotsky & Luria, 1996). From birth, children interact with adults who socialise them into a culture complete with its stock of meanings, its language, conventions and ways of performing (Rogoff, 1990). As a normal process of development, children utilise lower-order mental processes such as elementary attention, perception and memory. It is constant interaction however, with adults and with stimulating environments which ultimately transform these lower-order processes into higher-order processes.

Unlike Piaget, who saw language as an adjunct to cognitive development, Vygotsky (1978) believed that the acquisition of language must be the most significant moment in the development of human cognition. When language
becomes a psychological instrument for the regulation of behaviour then perceptions change, new memories are formed and higher-level cognitive processes are developed. Vygotsky (1978) also noted that young children in the early stages of their cognitive development tend to think the way they perceive and remember. However, following social interaction within a cultural context, children learn to perceive and remember the way they think.

Informed dialogue between teacher and learner is essential to scaffolded instruction (Palinscar, 1986; Rogoff, 1990; Vygotsky, 1978). For the teacher serving as a mediator and scaffold, the agency of dialogue will be the cues and prompts, direct explanations and questions used to encourage the development of conceptual links within a topic area. Anderson (1989, p.321) believes that "through scaffolded instruction during dialogue about problem-solving tasks, teachers should ensure that students recognise purposes, make appropriate conceptual connections in their understanding of new content, select and use strategies to accomplish their goals and learn to apply content flexibly across several contexts". This form of dialogue is quite different from that currently displayed in many classrooms where teacher-student interactions consist frequently of questions requiring correct answers, management discourse, didactic instruction and reinforcement. Without sufficient inquiry, encouragement and guided discovery, dialogue often leads to the development of surface learning approaches as meaningful discussion is rarely encouraged at any depth nor are issues explored which move students beyond their current understanding (Anderson, 1989; Biggs & Moore, 1993).

So important is dialogue in the development of deep learning approaches and higher level understanding that serious research into students' self-dialogue has also been conducted (Berk, 1992; Vygotsky & Luria, 1996). Berk
VanLeuven and Wang (1991), Vygotsky and Luria (1996) and others have found that self-dialogue, often called private, inner or egocentric speech, which is used by many children in problem-solving contexts is in fact monitoring in nature much like the dialogue of the teacher or parent. Vygotsky and Luria (1996, p.118) noted that “difficult situations evoke excessive egocentric speech and that under conditions of hyper-difficulties, the coefficient of egocentric speech is almost doubled in comparison to uncomplicated situations”. Egocentric speech is most likely to occur when no expert is available for consultation. Speech which may previously have been addressed to an adult is turned to the child herself in which case, the speech informing the solution shifts from an “inter-psychological category to an intra-psychological category” (Vygotsky & Luria, 1996, p.119).

Self-dialogue then is used to make statements of information suggesting a depth of knowledge and skill which is indicative of self-regulatory, deep learning behaviour. Inner or egocentric speech has been considered to be as important as action in planning and regulating activity, first emerging in the social dialogue which takes place between an adult or more knowledgeable language user and learner. Englert, Raphael, Anderson, Anthony and Stevens (1991) note that although adults initially model much of their cognitive thinking through verbalisation as they complete most of the required actions in the cognitive process, learners soon participate by assuming responsibility for those aspects of the dialogue and action of which they are capable. With time, private or inner speech gradually becomes covert and automatised self-guiding speech which requires little conscious thought (Englert et al., 1991).

Teachers, too, frequently see themselves only as facilitators of activities designed to present content rather than as mediators of thinking and learning (Anderson, 1989; Biggs & Moore, 1993). According to Vygotsky (1978)
however, cognition and social development must both reflect and emerge from social activities such as those encountered in the classroom. Vygotsky believed that as the central context for learning was through collaboration, then ideally this would generally occur between partners of unequal ability such as between adult and child, however, he conceded that it was also possible amongst peers (Morrison, 1991). Whatever model is used, good strategy instruction needs to emphasise social speech and conversation amongst teachers and students or amongst peers in the context of tasks. Teachers or peers must model strategies as they “think aloud” to make visible the normally invisible cognitive processes related to planning, monitoring and revising tasks (Englert et al., 1991).

Students need to be able to see the actions and hear the inner dialogue used by these skilled learners, as well as being allowed to participate when appropriate. Through collaborative and dialogistic exchanges with teachers and peers, students internalise the processes which are central to Vygotsky’s notion of cognitive development, as social collaboration gradually becomes internal collaboration with oneself (Englert et al., 1991).

Social collaboration on learning and problem-solving tasks, where more expert learners take the responsibility for the cognitive and metacognitive behaviours used for the task, has been termed “scaffolding”. Teachers who scaffold students learning take them beyond that which they are capable of attaining at a given moment, enabling them to move into a higher level of development (Biggs & Moore, 1993).

*Scaffolding Children’s Learning*

The scaffolding metaphor is derived from the work of Bruner (Wood, Bruner & Ross, 1976) as a term which most effectively encapsulates the notion of the
use of strategic teaching behaviours which are designed to support a child's
cognitive problem-solving as he/she moves toward self-regulation. Elliott
(1995) suggests that these behaviours might include memory jogs, guidance
and specific cues, which enable students to plan, evaluate and revise, as well
as the articulation and modelling of metacognitive, self-regulatory processes.

Scaffolding has a number of distinctive functions which may be performed
by a tutor, whether parent, teacher or more able peer. According to Wood,
Bruner and Ross (1976), the first function of the tutor must be to recruit or
engage the interest of the child in the proposed task and define the
requirements of the task. Gardner (1994) suggests a "let's see what we can
discover together" rather than an "I am going to teach you about...." type of
approach and might include dialogue along the lines of ....

Teacher:    "Let's see what we can discover about the size
            of things in this room today."

Child:      "Like we did with the animals when we visited
            the zoo?"

Teacher:    "Which was the tallest animal we found, and
            which was the smallest? Can you remember?"
            "Why don't we find the tallest and smallest
            things in our classroom?"
            (adapted from Gardner, 1994).

The second aspect of scaffolding according to Wood, Bruner and Ross
(1976), is that the tutor needs to be able to reduce the degrees of freedom or
the number of steps required to solve a problem by simplifying the task so
that the learner can manage components of the process and recognise when a
fit with the requirements of the task has taken place. Gardner (1994) has
looked at the strategic support given by parents of preschool children and noted the reduction of task steps used on a puzzle task.

Gardner noted that:

Dyads worked on a matrix puzzle with colours in rows on the left margin, and star shapes in columns across the top. Individual cards needed to be placed into this matrix. All but one child commenced by randomly selecting a card and then placing it by a process of trial and error.

One child commenced by selecting a yellow card at random and moving the card to the square next to the yellow colour. The mother pointed to the yellow colour on the board.

Mother: Colour and shape. [pointed to shape line and pushed card along to the correct square]. Under that one there, see, yellow [pointed to shape indicator on board]. O.K. you can find the rest. Start with the red, the top ones [pointed to red line] and we'll get there.

The child continued with the puzzle, with accuracy by working at each colour line at a time, commencing with the red line (Gardner, 1994, p.43).

A third aspect of scaffolding is the need for direction maintenance or maintenance of motivation. Comments such as "sit up straight" or "come on" are traditionally used by parents and teachers who display little scaffolded support. While such comments are designed to maintain task focus, they tend to place an emphasis on children's behaviour rather than the task being undertaken. In contrast to this approach, parents and teachers who offer
scaffolded support focus on the task or aspects of the task to maintain children's attention and motivation, using statements and questions such as "You have done that really well", "We are nearly finished here", and "What about the green piece?" "Do you think it might belong here?" Gardner (1994) maintains that very clear information is required by children to enable them to move forward confidently. When information is vague then attention is likely to wander and further action may be required to secure attention and ensure involvement.

Marking critical features is another aspect of scaffolding. According to Gardner (1994), parent or teacher tutors must highlight relevant elements of tasks for children in order to clarify any discrepancies between what the learner has accomplished and what would be the ideal. Gardner reports, for example that children who were required to copy a model of a farmyard using toy animals achieved greater results when parents labelled objects and discussed their correct positioning. Attention was thus found to be focused specifically on the critical elements of the task, as noted in this excerpt from Gardner's transcript:

*Mother:* "Are my pigs next to my horses?" [pointing to horse in the model]

*Child:* [looked at model, shook head, then moved pig in her copy into the right position]

*Mother:* "That's right, my pigs are next to my sheep. Ahh, you have chosen the milkmaid have you, where is she?"

*Child:* [pointing to the model]

*Mother:* "Yes, there she is, between the cows"

(Gardner, 1994, p.44).
This scaffolded interaction sharply contrasted to the directive strategy of another parent in Gardner’s study, where rather than fostering learner independence, the child remained dependent on the parent for completion of the task.

_Mother:_ Pick another animal [child picked up a cow and looked to its mother]. That is here, [pointing to the model] So you put it here [pointing to the correct place on the copy where the child places the cow]. Alright, another animal [procedure repeated]. (Gardner, 1994, p.44).

A fifth aspect of scaffolding is the _controlling_ by the tutor of _frustration and risk_ in problem-solving tasks. Children who constantly fail may attribute their failure to a number of causes. Irrespective of the cause however, the resultant lack of self-esteem from the frustration of constant failure can lead to learned helplessness and an unwillingness to take risks in problem-solving situations. Learning requires risk taking since learning involves functioning at the edge of one’s own competence (Rogoff, 1990). A balance therefore must be established between sensitivity to the degree of frustration which may eventually lead to loss of self-esteem and the need for challenge which will force children to stretch their understanding (Rogoff, 1990).

The last distinctive aspect of scaffolding identified by Bruner is _demonstration_ or modelling of the solutions to the task or explanation of a solution already partly accomplished by the young learner. If intervention with an effective strategy occurs when help is needed after completion of part of a task, this builds on the child’s existing abilities and is sensitive to the child’s active participation and commitment to the task (Gardner, 1994).
Gardner's studies have focused on parent interactions with their children and have demonstrated a strong link between children's competence in independent task performance with the strategies parents use in collaborative activity. Greater competency and independence have been seen in children whose parents focus on the *process* of doing tasks through the use of a variety of indirect teaching strategies. When the focus has been on the successful completion of a task, the finished *product*, managing instruction using direct teaching strategies, independent task competency has been found to be reduced (Gardner, 1994).

If a child is an active participant in problem-solving tasks, the child is both more able and more motivated to make physical and cognitive adjustments to that activity when proposed (Gardner, 1994; Rogoff, 1990). Encouraging children to make their own responses to questions and to reflect on statements maintains their continued interest and promotes cognition. During goal-directed social interaction, tasks are accomplished, skills are developed but also metacognition is enhanced enabling independent application at a later stage on comparable tasks. When attention is drawn to relevant aspects of a task, children are learning to observe critical features embedded in the task environment. Encouraging task focus and re-attention which results in task completion, children learn that persistence can bring about desired results (Gardner, 1994).

Support or the scaffolding given by teachers in the zone of proximal development should not be seen in terms of "amount" but rather as "kind". The successful strategies used by teachers to scaffold children’s cognitive thinking vary remarkably in their approach and the kind of dialogue used. Scaffolding teachers have been observed using cued elicitations, paraphrases of the contributions made by children, directing and framing of responses, the
use of praise, reinforcement, silence and direct questioning (Palinscar & Klenk, 1992). Although Palinscar and Klenk (1992) have suggested that elicitation and paraphrasing may mask children's understanding rather than extend it, when examined in a metacognitive learning context this does not appear to be the case (Palinscar & Klenk, 1992).

Webb (1989) suggests that although the scaffolding of tasks by more able peers may make problem-solving tasks more manageable for individual children, the effectiveness in all situations depends on a number of factors. He believes that (a) the help given by the competent peer must be relevant to the particular misunderstanding or lack of understanding of the target student; (b) the help must be given at a level of elaboration that corresponds to the level of help required; (c) the assistance must be given in close proximity in time to the target student's error or question; (d) the target student must understand the explanation; and (d) the target student must have the opportunity to use the explanation given to solve the problem. There are also important differences between adult and peer teachers and the support given for problem-solving tasks. Ellis and Rogoff (1982) note that peer teachers are often more concerned with completion of the task being undertaken rather than the development of skills which will encourage independence of the learner, and this needs to be a consideration when engaging peers as tutors. When however, peer tutoring is encouraged as an instructional and learning strategy, and children have been assigned certain tasks within a learning group, then such collaborative endeavours can result in increased cooperation, leadership opportunities, communication, trust building, conflict resolution skills and mutual respect (Morrison, 1991).

Teachers and students together must also focus on the mutual appropriation of goals rather than have teachers incorrectly appropriate students' goals.
This mutual agreement is viewed as imperative for learning and interactions between teacher and student will only be successful in encouraging the development of cognition when this occurs (Weir, 1989). Teachers need to be able to recognise students' goals, however, students also need to be able to articulate their goals in academic settings. For students who have been unsuccessful for a variety of reasons in their learning attempts or have difficulty with the language in which teaching occurs, the role of the teacher must be more than just determining students' goals. The teacher's role must also be to encourage students to develop and articulate appropriate goals and see them as personally relevant.

To recapitulate, Vygotsky's sociocultural theory is built on the premise that intellectual development cannot be understood without reference to the sociocultural milieu within which the child is embedded (Rogoff, 1990). Cognitive development is understood as taking place with social support, or scaffolding through interaction with other more competent learners. It also however, involves the development of skill with the sociocultural tools or cognitive strategies that mediate intellectual activity. Vygotsky (1978) and Wertsch (1991), have said that higher cognitive processing is grounded in sociocultural activity, rather than being found exclusively within the psychological characteristics of the individual.

Rogoff (1990) likens novice learners to "apprentices" who have not yet gained competency and therefore mastery in the learning process. When problems are shared between novice and expert learners, a system of guided participation enables novice learners to complete tasks which they would otherwise be unable to accomplish. Ultimately, the cognitive support or scaffolding given in an overt form through dialogue and modelling should gradually be internalised to become part of the cognitive repertoire of the
learner (Rogoff, 1990; Vygotsky, 1978). When this process is accomplished successfully, students assume control of their own learning and problem-solving to become self-regulated learners.

**Self-Regulation**

Both Piaget (1976) and Vygotsky (1962), viewed self-regulation in terms of enabling students to develop the conscious, critical, deliberate, reflective awareness that is necessary for abstract conceptualisation. Encouraging students to become deep approach, self-regulating learners, has become a desired goal of many classroom teachers in recent years (Borkowski, 1992; Brown & Palinscar, 1982; King, 1989; O’Flahavan & Tierney, 1991; Pressley & Gharala, 1990; Schunk & Zimmerman, 1994). O’Flahavan and Tierney (1991) for example, have said effective classrooms are those which empower learners with the inalienable right to guide their own learning. The development of higher-order thinking skills which involves the use of the cognitive and metacognitive strategies so necessary for deep approaches to learning has been the subject of considerable theoretical and practical research (Winne, 1995). However, determining the precise nature of metacognitive strategies and how they are used by individuals to self-regulate their learning thereby influencing learning approaches and academic outcomes is frequently open to interpretation. Because understandings relating to strategies, their use and their efficacy for academic proficiency are likely to be qualitatively different amongst individuals, the personal characteristics of individuals participating in such research must be explored.

Nonetheless, learning strategies are behaviours or thoughts that facilitate encoding in such a manner that knowledge integration and retrieval are
enhanced (Weinstein, 1988). Specifically, learning strategies constitute organised plans of action designed to achieve a goal and may include rehearsal, summarisation, paraphrasing, imaging, elaborating and outlining (Weinstein, 1988). Competent self-regulating students have been described by teachers and researchers alike as motivated and active in constructing knowledge and acquiring skills in a deliberate, efficient and strategic manner (VanLeuven & Wang, 1991).

Paris and Byrnes (1989) have described competent, enthusiastic and successful learners as:

students who seek challenges and overcome obstacles sometimes with persistence and sometimes with inventive problem-solving. They set realistic goals and utilise a battery of resources. They approach academic tasks with confidence and purpose. The combination of positive expectations, motivation and diverse strategies for problem-solving are virtues of self-regulated learners (p. 169).

The construction of knowledge is therefore, an active process and children explore, solve problems, and remember rather than just acquire skills (VanLeuven & Wang, 1991). One of the purposes of cognition is to guide action and to solve problems through active participation. This results in the reorganisation and enhancement of understanding thereby making considerable advances in skill acquisition. Winne (1995) suggests that as tasks evolve, self-regulating students (1) seek and retrieve information in the task domain; (2) monitor their involvement in the task in relation to goals; (3) focus on strategic plans based on the specific task; and (4) revise domain knowledge and assess perceptions of self-competence. Although many cognitive skills are domain specific, the ability to recognise and understand
similarities in cognitive functioning across the curriculum is also possible (Grossen, 1991).

While self-regulated information processing is said to involve a knowledge of important concept skills, it also requires procedural knowledge about specific tasks as well as metacognitive knowledge about how and when to use procedural knowledge (Derry, 1990; Pressley & Ghatala, 1990). Even so, in line with other researchers (Paris & Byrnes, 1989; VanLeuvan & Wang, 1991; Winne, 1995; Weinstein, 1988), Pressley and Ghatala stress that a most important factor for self-regulation is understanding the value of the use of strategies for successful task achievement. They see this as a critical motivator for expending the extra effort required by their use.

According to Zimmerman (1994), self-regulated students tend to rely on planned, automatised methods of learning or learning strategies, and he divides these into two major classes: strategies associated with the product or outcome and those associated with the process. It is these latter, "process" strategies which Zimmerman (1994) terms self-regulatory and which like Weinstein’s (1988) strategy list, include goal setting, planning, organising, transforming, record keeping, rehearsing, memorising, self-monitoring and evaluating.

In the same manner, Schunk and Zimmerman (1994, p.ix) note that the cognitive and metacognitive skills determining self-regulation refer to "students' self-generated thoughts, feelings and actions, which are systematically oriented towards attainment of their goals". Some of the characteristics of achieving students have been identified and include self-direction, motivation and active participation in the construction of knowledge and the acquisition of skills in a deliberate, purposeful and
efficient manner (VanLeuven & Wang, 1991). Students who engaged in learning in this way approach tasks very differently from students who are less successful in academic tasks. VanLeuven and Wang go on to say that competent students not only identify the goals of instructional tasks readily, but can also restructure these goals to suit individual abilities and needs. Self-regulated behaviours enhance learning through the use of metacognitive strategies.

**Metacognition**

The concept of metacognition was introduced first by Flavell (1976), who believed that the term implied knowledge that takes as its object or regulates any aspect of cognitive endeavour. More recently however, the term has been used to refer to somewhat separate phenomena as King (1989) describes thus: "Metacognition refers to an awareness of one's own cognitive processes and the self-regulation and the orchestration of those processes in relation to a learning task" (King, 1989, p.367). Brown and Palinscar (1982) have also defined metacognition by dividing the term into two components suggesting that it implies a "knowledge about cognition" and "regulation of cognition". Persons therefore, displaying metacognitive abilities have not only stable and declarable information about their own cognitive processes but they are able to regulate their cognitive processes by planning, monitoring and checking activities necessary for task completion.

Borkowski, Estrada, Milstead and Hale (1989, p.58) have conceptualised metamemory and more generally metacognition, in terms of a number of interactive, mutually dependent components. They argue that these components can assist in explaining the differences in problem-solving skills developed by normal and exceptional children. These components can be
applied to a wide range of cognitive activities such as mathematics and reading comprehension although their model was first applied only to the operation of strategic processes in memory. The model Borkowski et al. (1989) propose includes (a) Specific Strategy Knowledge, (b) Relational Strategy Knowledge, (c) General Strategy Knowledge including attributional beliefs and self-efficacy and (d) Metacognitive Acquisition Procedures or executive processes. Siegler (1991) also refers to components or metacomponents, suggesting that they serve as a strategy construction mechanism, orchestrating other aspects of information-processing into goal oriented procedures.

The distinction between cognition and metacognition has been difficult to conceive, so much so, it has been argued that metacognition may simply be another set of skills so dependent on cognitive processes that there is hardly a need for a separate construct at all (Cavanaugh & Perlmutter, 1982 in Slife, Weiss & Bell, 1985). Research by Slife, Weiss and Bell (1985) however, suggests that cognition and metacognition may possibly be viewed as independent but nonetheless interactive components, although they found no empirical evidence for its validity as a construct separate from cognition. Acknowledging their constant interaction, Slife et al. (1985) investigated the separability of metacognition and cognition by measuring the effects of two metacognitive components with regular and learning disabled children of similar cognitive abilities. During this study they determined that knowing how to solve problems appears to be a different skill from knowing that you know how to solve problems and that learning disabled children were found to be less accurate in their knowledge about their problem-solving skills, less accurate in monitoring their problem-solving performance and less accurate in their predictions of which problems were right and wrong. Given that the self-esteem, motivation and cognitive ability of learning disabled and regular
children were matched in their study, Slife et al. (1985) determined that the learning disabled group were less able in problem-solving tasks partly as a result of poor metacognitive skills.

**Developing Metacognitive Skills**

Although some reports about the nature and development of learning suggest that maturity plays a significant role in its acquisition (Kirby, 1984), knowledge, although at times acquired vicariously, generally occurs through active participation by the learner within the sociocultural context (Rogoff, 1990; Vygotsky, 1978). Here, information from the environment is observed, cognitively processed and accommodated and assimilated to form new and revised understandings. The use of higher-order, metacognitive strategies enables students to monitor their own learning, thereby increasing the likelihood of positive outcomes, increased self-esteem and greater motivation for future tasks. Even memory for non-meaningful or arbitrary materials in addition to more necessary or relevant material can be significantly enhanced through the use of a variety of strategies.

King (1989) believes that self-questioning may be an effective way to regulate one's own learning and that this involves the use of a number of strategies consciously selected to match task demand. Self-questioning may take the form of self-testing, thereby forcing learners to focus on the important aspects of a task, encourage them to analyse content, relate new information to prior knowledge and review the task continually as it is in progress. According to King (1989), this monitoring process enables learners to evaluate their own understanding, giving an awareness of what they know, but equally as important what they do not know.
Wong (1986; 1992) has also found self-questioning to be an effective strategy for improving all levels of learning and superior to other strategies such as summarising, re-reading and answering teacher-posed questions. The gains resulting from self-questioning have been thought to be as a result of the metacognitive aspects of that process.

Borkowski, Weyhing and Turner (1986) have suggested that the teaching of strategies designed to facilitate knowledge is critical to learning, although they have noted that students must be convinced that strategic thinking will promote success; simply teaching how and when to use such strategies appears to be insufficient. Academic success therefore, must be attributed to an awareness of the importance of strategic thinking, as well as strategic planning and monitoring, and conversely, academic failure can be attributed to a lack of these strategic understandings (Borkowski et al., 1986; Pressley & Ghatala, 1990). Proficient human thinking must include the constant monitoring or evaluating of cognitive actions in order to determine whether they permit or inhibit progress with respect to stated goals. The heart of self-regulated thinking is monitoring the processes and products of thought as it occurs.

Borkowski (1992) and VanLeuven and Wang (1991) suggest that the complex components of self-regulation are not acquired easily; the self-instructive skills of goal identification, strategy planning, evaluation of progress and error monitoring have not been regularly modelled or taught during classroom instruction. Palinscar's program of reciprocal teaching (outlined in Palinscar, 1986; Palinscar & Brown, 1984; Palinscar & Klenk, 1992; Siegler, 1991) has been used effectively in numerous studies and relies on the use of dialogue where teachers and students construct meanings in reading and problem-solving tasks by together summarising, generating
questions, clarifying issues, working through problems and predicting outcomes. Palinscar's models initially show the teacher assuming the greater responsibility for learning. Gradually however, this responsibility is shifted from the teacher to the student as feedback is received. Strategic behaviours modelled and articulated by the teacher are frequently adopted by students which ultimately results in more self-regulated and effective learning (Palinscar, 1986; Palinscar & Klenk, 1992).

Pressley (1986) also notes the importance of language-based instruction for students in the use of learning strategies. He notes that outlining the benefits of the use of cognitive strategies is as important as the understanding of when, where and how they should be used. Pressley believes that the context in which instruction takes place is of critical importance and that the teaching of strategies is most effective when taught in the regular classroom and across all teaching domains. Application of metacognitive skills and self-regulatory learning will always be more effective if developed in this manner (Pressley, 1986; VanLeuvan & Wang, 1991). In Vygotskian research, as previously discussed, Bruner's scaffolding metaphor is frequently used to refer to the conversational support given by an adult or a more experienced peer which is designed to model cognitive thinking and encourage on-task behaviour (Bruner, 1985).

**Linking Metacognition, Self-Regulation and Learning Approaches**

The self-regulation of learning and problem-solving tasks or self-conscious and planful approaches to learning requires firstly that students be aware of their own cognitive resources, their motives and intentions and the demands required by academic tasks. Secondly, students need to understand that they are able to control those resources which are used to monitor their consequent performance on tasks (Biggs, 1987; 1988a). Approaches to learning therefore,
have been thought to "represent the deployment of learning strategies based upon metacognitive knowledge" (Schrneck, 1988, p. 320).

Boekaerts (1995) implies that deep or surface approaches to learning follow the adoption or otherwise of the metacognitive skills leading to self-regulation in conjunction with numerous intrinsic as well as extrinsic factors peculiar to the learner. She notes, however, that momentary aspects of the development of self-regulation are merely links in a series of interacting chain reactions which improve short-term, domain-specific competence (declarative and procedural knowledge). Each self-regulatory episode serves to increase beliefs, expectation, attitudes and skills, especially in domain-specific competence, and over time, long-term increments in self-regulatory skills (Boekaerts, 1995).

Ideally therefore, teaching needs to be directed toward the acquisition of (a) the metacognitive skills that guide and direct learning processes; (b) metamotivational skills that create favourable internal conditions for initiating and sustaining learning; and (c) self-management skills that enable students to interpret and cope with stress in the learning environment (Biggs, 1987; Boekaerts, 1995). Finally, Boekaerts notes that teachers need to be aware of the incremental nature of metacognitive skills and suggests that if the ultimate goal is for long-term self-regulation, then the development of such skills must be made explicit educational targets. Based on the assumption that all learning processes are behavioural change processes, deep approaches to learning are unlikely to develop without appropriate support mechanisms (Boekaerts, 1995). Instructional techniques should provide adequate cognitive and emotional scaffolding through the zone of proximal development, which encourages the use of metacognitive strategies for self-regulation, in a sociocultural environment (Makin, 1996; Pressley, 1995).
Summary and Conclusion

Throughout this chapter (Chapter 3), the review of research has focused on literature relating to Vygotsky’s theory of learning as a socially and culturally mediated experience (Arenz, 1991; Bronfenbrenner, 1977; 1979; Bruner, 1985; Elliott, 1995; Hatch & Gardner, 1991; Rogoff, 1990). This perspective emphasises the relationship between the cognitive tools provided by culture and the development of individual thought processes (Rogoff, 1990). As children participate in activities provided by their culture, guided by skilled partners (parents or teachers), the cognitive tools for problem-solving are articulated and modelled providing the cognitive supports which enable completion of tasks beyond the ability of children on their own.

As problem-solving involves the use of complex resources and strategies, informed dialogue between expert and novice learners is essential for scaffolded instruction (Palinscar, 1986). This chapter has therefore discussed the notion of scaffolding first conceptualised by Bruner (Wood, Bruner & Ross, 1976), to encapsulate the notion of support given as teachers and parents assist children in the move from immature to self-regulating learners. Self-regulating learners tend to display not only understanding about skills and concepts, but also procedural and metacognitive knowledge which involves the use of a range of cognitive strategies for successful learning (Paris & Byrnes, 1989; Pressley & Ghatala, 1990; VanLeuven & Wang, 1991; Winne, 1995; Weinstein, 1988). The concept of metacognition or the regulation of one’s own cognitive processes and the orchestration of those processes to inform learning (Brown & Palinscar, 1982; King, 1989), have also been discussed. Although several theories regarding metacognition have been summarised, all tend to note the importance of metacognition for self-regulation and the development of deep learning approaches which are critical for higher-order cognition. Finally, the chapter has outlined the links
between metacognition, self-regulation and deep approaches to learning as well as the importance of developing explicit teaching programs for their enhancement.

In the following chapter (Chapter 4) the links between self-regulation, metacognition and deep approaches to learning are further considered. It examines the qualitatively different aspects of cognitive behaviour displayed by high and underachieving students and thus their approaches to learning. Finally, the importance of developing the appropriate learning environments thought crucial to maximise the educational opportunities of all students is discussed.
Chapter 4

QUALITATIVE DIFFERENCES IN LEARNING APPROACHES

In the previous chapter, the literature relating to the importance of the sociocultural milieu as a critical vehicle through which the skills and understandings important to a society are transmitted, was reviewed. In particular, the theories of Vygotsky (1978) and the work of many of his adherents was discussed, especially as it relates to the notion of novice and expert learners who together undertake learning and problem-solving at a cognitive level, in many cases advancing understanding through the zone of proximal development (ZPD) (Arenz, 1991; Bronfenbrenner, 1979; Bruner, 1985; Elliott, 1995; Gardner, 1994; Rogoff, 1990; Vygotsky, 1978; Kozulin, 1990).

One appropriate sociocultural environment through which understandings might be transmitted is the classroom and the importance of collaborative dialogue between teachers and students was also discussed. Teachers must not only impart facts and skills for successful learning to take place but must be facilitators and mediators in the cognitive processing process (Anderson, 1989; Biggs & Moore, 1993; Englert et al., 1991). The chapter also looked at the notion of scaffolding children’s learning (Bruner, 1985; Elliott, 1995; Winograd, 1991), or the offering of cognitive support until children are ready to assume control of their own learning. Ultimately of course, the goal of any learning task is independence or self-regulation (Borkowski, 1992; Brown & Palinscar, 1982; King, 1989; Pressley & Ghatala, 1990; Schunk &
Zimmerman, 1994), and the latter part of the chapter looked at the importance of the use of metacognitive strategies enabling students to meet such goals.

This chapter (Chapter 4) focuses directly on the qualitative differences seen in the metacognitive strategy use, self-regulation and approaches to learning as they are displayed by high and underachieving students. Some of the antecedents of underachievement are discussed, along with the metacognitive strategy deficits that are characteristic of these children. Recognition is given to the importance of appropriate environments within which all children’s learning may be enhanced, but most especially for those children who experience difficulty with academic tasks. Once again, motivation and self-concepts are discussed as critical determinants of learning and finally, the chapter concludes drawing all literature together.

**Intellectual Potential**

Significant differences in the employment of metacognitive, self-regulating strategies by high and low achieving children have been the subject of considerable research (Borkowski, 1992; Borkowski & Thorpe, 1994; Simmons, Fuchs & Fuchs, 1991; VanLeuven & Wang, 1991) over recent years. Although intelligence is undoubtedly a factor in the achievement outcomes of many children, much of this research has pointed to other determinants which do not always appear to be linked to intellectual potential. For the purposes of this thesis therefore, each student selected for participation was perceived as having similar intellectual potential irrespective of their immediate academic outcomes.

Although Biggs and Moore (1993) found that students of low intelligence tended to adopt surface approaches to learning, they also found that deep
approaches are not particularly associated with either high or low verbal ability. It would appear therefore that it is not just the brightest students who have the ability to adopt deep approaches and indeed it is imperative that deep approaches are encouraged across all ability levels (Biggs, 1988b). What has been found is that average and underachieving students rather than high achieving students tend to use surface and achievement approaches to learning (Biggs & Moore, 1993).

High achieving students tend to adopt systematic and organised strategies which look beyond content areas to develop an understanding of the processes required to successfully complete complex tasks. Lower achieving students on the other hand have been found to rely heavily on content, see learning as a means to an end (assessment) and lack the ability to generalise strategy use on a range of tasks.

Saljo (1975), conducted considerable research into why students approached learning in qualitatively different ways. He tried to structure a learning situation in a manner that would facilitate understanding. He found however, that while most students flexibly modified their approach to the task presented, some of the students failed to approach the task in a manner that would lead to meaningful understanding (Schmeck, 1988). Saljo concluded that those students who had persistently committed information to memory in its literal form had perceived this new situation as one demanding descriptive recall, rather than understanding. Perception, Schmeck (1988) notes, involves the classification of a situation into, for example, “a test”, “a recital”, or “a report”. Once a situation has been classified, the learner then behaves in a manner thought to be appropriate for that situation and may continue to adopt such an approach, especially if other approaches have resulted in failure at some time in the past (Schmeck, 1988), or if the real
purpose of a situation has not been adequately articulated. Although it has been argued previously that both intrinsic as well as extrinsic factors contribute to the adoption of deep or surface approaches to learning, if teachers can structure classroom situations so that students perceive them differently, then they are more likely to approach them differently (Entwistle, 1988; Marton, 1988; Ramsden, 1988a).

Although there are discrepancies within the literature dealing with underachievement, Borkowski and Thorpe (1994, p.46) suggest that most researchers and educators today would agree that many children identified with learning problems show considerable “discrepancy between their predicted and actual levels of academic performance”. Many low and underachieving students, therefore, are those who fail to achieve at school at a level consistent with their perceived ability. As previously mentioned, Biggs and Moore (1993) note that while ability may have some bearing on the development of different learning approaches for some children, it is not the most important personal characteristic relating to academic performance.

**Antecedents of Low Achievement**

Given the fact therefore, that perceived ability or intelligence appears not to be the only factor in the academic performance of high and underachieving children, research (Borkowski & Thorpe, 1994), helps to explain some achievement antecedents. Borkowski and Thorpe (1994, p. 47) concluded that “the factors surrounding underachievement exist not in the biomedical histories of children, but rather in the environments within which they learn”. Some of these environmental factors include low socioeconomic status, parental education, bi-lingual experiences, high birth order, family size as
well as gender, with boys being more likely to be classified as underachievers, than girls (Biggs & Moore, 1993). Covington (1992) argues that failure to learn is closely related to the learning conditions present in the classroom as well as to student/teacher relationships. These Covington believes, have the potential to enhance or inhibit “self” concepts which may ultimately influence attributions of success and failure, motivation for learning and achievement orientation (Borkowski, Carr, Rellinger & Pressley, 1990; Covington, 1992; Meece, 1994). Furthermore, consistent academic failure is likely to affect the self-efficacy of students, especially when worth is frequently measured by academic performance, and considerable research has demonstrated that there is a tangible causal link between self-efficacy and underachievement (Borkowski, 1992; Borkowski et al., 1990; Borkowski & Thorpe, 1994; Covington, 1992; Meece, 1994).

Classroom instruction must be designed to intercept rather than advance academic failure (Simmons, Fuchs & Fuchs, 1991), however Biggs and Moore (1993) suggest that many experiences in learning institutions are counter-productive in encouraging positive learning behaviours. A national survey of Australian high school students found that on average the use of surface approaches decreased between Years 8 and 11, but so did the use of deep approaches and far more so amongst boys than girls. Increasingly it would appear students perceive learning as a faithful reproduction of material taught in the classroom (Biggs & Moore, 1993), especially in the higher grades.

Domain specific skills deficits have also been viewed as antecedents to poor academic performance and numerous programs have concentrated on remediating these skills to increase outcomes (Borkowski & Thorpe, 1994). Borkowski and Thorpe suggest however that while remediation dealing with
domain specific skills is important, there are other equally important factors which should be addressed and indeed should be integral to any training program for underachievers. Anxiety, fear of failure, impulsiveness, a desire for self-assurance and a high need for approval are all characteristics which have been found to impact achievement, and students’ perceptions of their own abilities and indeed to impact their actual academic abilities (Borkowski & Thorpe, 1994).

Most underachievers are likely to be motivated by extrinsic factors such as rewards or the fear of punishment, and underachievers tend to be more critical of themselves. Average and high achievers on the other hand often adopt a more personalised belief system being motivated more frequently by factors intrinsic to themselves or to the task at hand (Borkowski & Thorpe, 1994). So, while encouraging children in the classroom to feel confident about themselves and their abilities, to expend greater effort on tasks and to persist in the face of challenge are admirable goals, it is only through increasing intrinsic motivation, by giving students a sense of personal ownership over their learning through the acquisition of self-regulating support skills as well as a knowledge of content material that learning outcomes will ultimately be improved (Weiner, 1990).

**Self-Regulatory Strategy Deficits**

Low or underachieving children typically encounter difficulty with tasks in school which require intentional effort and the effective use of metacognitive skills (Palinscar & Klenk, 1992). Many of these children have been found to lack the metacognitive skills necessary for self-regulation of their own learning such as the spontaneous use of attentional and mnemonic strategies, the ability to encode and identify stimulus items and the planning, monitoring and evaluation necessary for such activity (Slife, Weiss & Bell, 1985).
Deficits in executive processes have also been observed by Snow (1992, p.265), who has suggested that underachievers have “disrupted organisational and planning abilities, generalised memory deficits, difficulties with mental flexibility and poor task initiation”. VanLeuven and Wang (1991) too have noted that underachieving children use less self-monitoring verbalisations with their discourses being less self-instructive than those of their normally achieving peers and they also display greater off-task behaviour. Overall, underachieving children have been found to be generally less accurate than achieving children on a range of metacognitive measures dealing with the regulation of cognition and the ability to monitor and check their own problem-solving attempts (Borkowski & Thorpe, 1994; VanLeuven & Wang, 1991).

Additionally, Borkowski and Thorpe (1994) believe that underachieving children may fail to comprehend the links between strategy based actions, the importance of focusing effort on specific tasks or elements of a task and the understanding that ability can be measurably enhanced through strategy governed actions.

According to Garner (1990), there are five main reasons why students do not use strategies, even those that have been explicitly taught: (1) when students have poor cognitive monitoring abilities, they will not use strategies to keep on task as errors will not be recognised; (2) when students adopt surface approaches to learning they will prefer low-level routines to complex strategies; (3) when students have inadequate knowledge of task requirements, then even the best repertoire of strategies will be insufficient; (4) when attributions for success are not matched with strategies; and (5) when strategies cannot be taken away from the context within which they are taught.
Undoubtedly, it is motivation which underlies these reasons or even more specifically according to Pintrich and DeGroot (1990), it is the motive-strategy congruence. Students who are motivated to achieve, who are intrinsically motivated, are more likely to adopt metacognitive strategies for deep processing. Biggs and Moore (1993) go on to suggest that students are more likely to use strategies only when they are highly motivated, have high self-concepts and attribute success appropriately. Additionally, they must have context knowledge about the task as well as feedback which will support their self-monitoring in a supportive learner-teacher environment (Biggs & Moore, 1993).

**Self-Esteem and Underachievement**

Mack and Ablon (1983, p.12) have noted that “at each stage of a child’s development after infancy, the achievement of a sense of positive self-worth contributes not only to a child’s sense of well-being, but also to the quelling of his or her fears for survival”. Smith (1992) also echoes the importance of a positive sense of personal well-being and suggests that perceptions of the self are drawn from a range of social spheres, initially developing within the context of the family, but which are enhanced or eroded as children mature, through other social contacts made especially at school and later with peers.

Perceptions of our own abilities and value are acquired very early, but they are also subject to interpretation (McCarthy & Schmeck, 1988) and are influenced by subsequent successful or unsuccessful performance in competitive or comparative situations (Jacobs, 1983). As development continues, esteem becomes increasingly contingent on performance outcomes or what has been earned. Beliefs about the locus of control and efficacy or competence become part of the self-concept, while associated feelings become components of self-esteem. Bandura (1982) suggests that self-
esteem is based on knowledge about one's efficacy, whether accurate or faulty and rests on four main sources of information: performance accomplishments; observations of the performance of others; verbal persuasion and psychological arousal (Bandura, 1982, p.26).

McCarthy and Schmeck (1988) have concluded that the consequences of failure can be either positive (motivational) or negative (disruptive). If negative feedback is given in a supportive way, although it may lower expectations, it does not appear to lower performance. If given in a punitive manner however, rejecting feedback lowers both expectations and performance. Because punitive feedback threatens overall self-concepts, anxiety is raised, self-statements are frequently negative and actual ability tends to be distorted.

In Western society, there is a pervasive tendency to equate human worth with accomplishment, and individuals perceiving themselves only as worthy as their achievements are likely to develop faulty self-concepts. Covington (1992) suggests that for many low and underachieving children, tying their sense of worth to their achievements only serves to further undermine self-esteem.

Children's perceptions of their own academic abilities are therefore greatly affected by their success or failure at school and frequently the ability to achieve is influenced by this ongoing appraisal of academic success (Mack & Ablon, 1983). Empirical studies (Heyman, 1990) indicate that underachieving children have lower perceptions of themselves than higher achieving children and that even deficits in only one subject area can result in lower self-perceptions overall.
Durrant, Cunningham and Voelker (1990) believe that academic self-esteem is a major focus of concern for educators as the self-perpetuating cycle of failure which appears to be endemic with some low achieving children may continue to influence academic behaviour in ways not found in higher achievers. Low and underachievers are also more likely to feel themselves less competent than their more able peers and that academic outcomes are beyond their control (Durrant et al., 1990).

Although the major focus of this study is on the development of deep approaches to learning through the acquisition of metacognitive, self-regulating strategies, self-esteem is recognised as a significant contributor to the academic outcomes of children and a major influencer of the motivation required to perform in a skilled manner (Groinick & Ryan, 1990). Children displaying low academic self-esteem tend to be extrinsically motivated and lacking confidence in their own abilities. Higher achievers on the other hand display a confident approach with academic tasks, are motivated intrinsically and frequently display positive perceptions of their own performance and ability (Ashton, 1993).

Supporting Underachievers
Support for low and underachieving children has frequently addressed behavioural characteristics in addition to specific learning deficits. Swanson (1989) notes however, that while many current research projects highlight the need for remediation for underachieving children, only some of the components of strategy acquisition (such as the need to heighten attention) have been stressed and this has led to a fragmented approach to the development of higher-order thinking skills.
Many programs have focused on behaviour modification involving manipulation of environmental factors; precision teaching with an emphasis on specific behaviours; direct instruction of teacher based academic goals; and reciprocal teaching involving cooperative understanding and trust (Van Kraayenoord & Elkins, 1994). Swanson (1989) and Van Kraayenoord and Elkins (1994) believe however, that unless underachieving children are explicitly prompted in the use of metacognitive strategies, their ability to access knowledge will still remain inert. According to Biggs and Moore (1993), students need to be taught to behave more metacognitively in particular situations; they need to understand how and when to use deep and achieving strategies when handling academic tasks.

Biggs and Moore (1993) suggest that there are three main ways in which students acquire appropriate learning strategies. Firstly, strategies may develop spontaneously in the learner through wit and experience irrespective of the teacher factor. In this situation, although teachers may transmit information, little responsibility is taken for its reception and acquisition. Secondly and possibly the most appropriate, strategies may be implicitly acquired when teachers create situations, scaffold learning and provide appropriate relevant tasks. Ideally, students acquiring understanding about strategies in this manner will have been guided and directed in their learning by expert strategy users assisting students through the zone of proximal development (Vygotsky, 1978). Thirdly, explicit teacher-directed training in the use of strategic routines, outside the normal curriculum increases students’ awareness of how learning and problem-solving is achieved (Biggs & Moore, 1993; Van Kraayenoord & Elkins, 1994). Although some students seem to be able to acquire and use metacognitive strategies on their own, many other students do not. For this reason it may be appropriate to explicitly teach about strategies. However, it must be remembered that all
strategy learning should take place within the context of the learning or problem-solving task and should aim at enabling students to transfer strategies learned from one context to another (Biggs & Moore, 1993). Students who have been encouraged to develop and subsequently use self-regulatory strategies on problem-solving tasks, have been found to greatly improve their performance, frequently reducing the discrepancy between perceived cognitive ability and task related activities (Van Kraayenoord & Elkins, 1994).

According to Borkowski, Estrada, Milstead and Hale (1989), the pattern of learning for children encountering academic difficulty may be quite different from what it is for proficient learners. Initially they argue, learning may appear to proceed smoothly, when with reinforcement, the attributes of a strategy become known. Borkowski et al. (1989) suggest that full strategy knowledge and use however, is only accomplished over time and moves through numerous stages.

The first stage is the development of Specific Strategy Knowledge with its attributes such as understanding the effectiveness of a strategy and its appropriate application. If the learning environment is stimulating and effort is rewarded by praise and feedback, then specific strategy knowledge is enlarged and enriched. At this point, most children begin to acquire the capacity to select and monitor the strategies which may be appropriate for certain tasks, but it is here, according to Borkowski et al.(1989), that low achieving children will most likely encounter problems with their problem-solving executive skills. When this occurs, children also need General Strategic Knowledge which will enable them to recognise the efficacy of being strategic thinkers and to be able to attribute their success (or failure) to
strategic effort (or lack thereof), rather than to luck or ability (Borkowski, Carr, Rellinger & Pressley, 1990; Borkowski et al., 1989).

A history of academic failure so common amongst low achieving children frequently results in negative self-esteem and poor academic motivation. Considerable research has suggested that low academic achievement amongst otherwise normally achieving children may occur as a consequence of difficulties with two aspects of the metacognitive behaviours which mark self-regulatory behaviour, namely Metacognitive Acquisition Procedures and Attributional Beliefs (Borkowski et al., 1989).

Although low achieving children may be trained to use metacognitive strategies on simple tasks, Borkowski et al. (1989) believe that many of these students still have difficulty transferring strategy skills in novel, complex situations. Buchel (1990) suggests however, that strategies will only become more accessible in novel situations and generalised over numerous subject domains if children thought to be at-risk are taught how and when strategies should be used with sequential steps in a highly structured routine. According to Feuerstein (1980), metacognitive strategies should simply not be thought of as applications for isolated events but rather, a system of structures which when applied can result in change over a range of events.

A number of reasons have been proposed for the inability to generalise strategies, including a poor understanding of the appropriateness of a strategy for a particular task, an inability to monitor the effectiveness of strategies or perhaps the belief that strategic effort will not be justified by the reward. Deficient cognitive functions can also include unplanned, impulsive and unsystematic exploratory behaviour, as well as the inability to select relevant cues for defining problems. Buchel (1990) notes that for some low and
underachieving students, the problem lies not so much with a lack of strategic knowledge, but rather with strategy/task congruence.

Achievement outcomes can be greatly improved in low and underachieving students through encouragement to be more active and to assume control in the selection of strategies to accomplish specific tasks (Paris & Oka, 1986). Teachers need to be able to foster this personal management within students by encouraging individual standards for success and failure so that failure is related to personal, individual expectations, rather than to comparisons with other students. Paris and Oka (1986) suggest that students need to be taught that unsuccessful learning may be attributed to a lack of strategies or an ineffective use of strategies rather than low ability or laziness.

Students’ motivational beliefs about learning and the efficacy or otherwise of the use of strategies are directly related to the type of academic tasks chosen and the level of engagement and persistence displayed (Garcia & Pintrich, 1994). They note however, that cognitive instruction is rarely integrated with motivational instruction and consequently cognition and motivation have developed as separate learning paradigms.

As self-regulated, deep approach learners are flexible problem-solvers, planning, selecting and monitoring effective strategies for their use, they are able to anticipate problems and reflect on completed tasks. Paris and Oka (1986), along with Borkowski et al. (1990) note, however, that as cognitive strategies are rarely taught explicitly in the classroom, students are unsure about their value or how they are used. Integrated instruction is vital to the development of self-regulatory behaviours, however, while considerable research has shown that strategy training programs are necessary, they are insufficient on their own to demonstrate the maintenance and generalisation
of strategies in novel situations (Borkowski et al., 1989), and must be accompanied by instruction in strategy use.

Furthermore, while instruction in the use of strategies is crucial, it must also be accompanied by explicit training in beliefs about the effectiveness of strategy use and instruction in management of the executive processes necessary for implementation of such strategies, along with the motivation to use strategies (Borkowski et al., 1990). Low achieving children need specific instruction in predicting task outcomes, analysing task demands, monitoring the effectiveness of strategy use, assessing task completeness and most particularly in understanding the efficacy of even undertaking such a process (Borkowski et al., 1989).

**Self-Instruction**

Many low and underachieving children have been found to have deficits in their *Metacognitive Acquisition Procedures*, but have shown some improvement through training (Borkowski et al., 1989). Self-instructional methods used to train executive processes have been found to be moderately successful not only in enhancing academic outcomes, but also enabling students to generalise strategies in novel situations. By internally verbalising task steps, children are encouraged in their efforts and attention to detail is reinforced. Extensions to this approach have been conducted by numerous researchers (for example, Bornstein & Quevillon, 1976; Leon & Pepe, 1983; Nazum, 1982) with encouraging results. Nazum, in an unpublished doctoral dissertation (1982), cited by Borkowski et al. (1989) established a training regime on three levels: (a) by emphasising the importance of the development of a plan with suggestions for plan construction; (b) by encouraging students to identify problems clearly and to articulate components of the problem and; (c) by giving students task-specific information about computational
procedures. Bornstein and QUEVILLON (1976) demonstrated the effectiveness of self-instructional training for teaching executive processes. Teachers modelled metacognitive strategies by the use of overt self-verbalisations, following which children were set tasks and encouraged to display similar behaviour. Similarly, Leon and Pepe (1983), as well as Paris and Oka (1986) instructed low achieving children in the development of metacognitive strategies through a five stage process which included modelling, self-administration of reinforcement, feedback, coping instruction and self-instructional dialogue.

While the trained executive cognitive processes which are used in conjunction with specific strategies have been found to be important prerequisites for effective problem-solving by low and underachieving children, self-instructional approaches have been found to be of value in remediating some of the deficits experienced by them (Borkowski et al., 1989). Many underachieving children however, due to a continued history of failure, lack the motivation to achieve. In such cases, irrespective of possessing knowledge about appropriate strategies and understanding about when and how to use them, as well as being clear about the benefits of such use to their ultimate performance, such strategies are not being used.

Motivating Students for Success-Use of Metacognitive Strategies
Students can increase their motivation and enhance their own learning by becoming aware of their own thinking as they read, write and solve problems in the classroom. Paris and Winograd (1990) suggest that when students develop a "consciousness" about effective problem-solving, the responsibility for learning is more likely to be transferred from teachers to the students themselves, which in turn promotes positive self-concepts and increases motivation for mindful task engagement. There are four dimensions of
motivation which are likely to influence strategy use by low achieving children when they encounter problem-solving tasks (Oka & Paris, 1987). Oka and Paris suggest that children are more likely to engage in the use of strategic behaviour if they (a) have a sense of control over the task; (b) have identified significant goals and values; (c) have self-management skills and; (d) can interpret and attribute success and failure.

Children who believe they have no control over academic outcomes are unlikely to persist on tasks and will anticipate failure in the future. This may lead to learned helplessness and will almost certainly damage self-esteem (Borkowski et al., 1989). In a similar manner, if children fail to see the purpose or goal and the value in completing tasks which are often influenced by previous failure, then motivation is likely to be low as task engagement may be perceived as heading for further failure. Oka and Paris’ (1987) third dimension deals with self-management or acquiring the executive control processes necessary to set goals, plan appropriate steps, select effective strategies and monitor goal progress. The final dimension, identified as the interpretation and attribution of success or failure, is likely to influence pursuit of challenge, persistence in the face of difficulty and the likelihood of being distracted (Oka & Paris, 1987).

Significant differences in the way children attribute success and failure and ‘on task’ motivation can be seen when they are engaged in problem-solving tasks. Diener and Dweck (1978) have noted that proficient learners are enthusiastic as they search for new and more effective problem-solving strategies, and they tend to remain optimistic about the ultimate outcome. In contrast, low achieving children often display negativity, employ escape behaviours and attribute failure to uncontrollable factors while focusing on the more negative aspects of their own performance. Furthermore, with
subsequent problem-solving tasks, proficient learners tend to be accurate in their prediction of future success or failure, whereas learned helpless children frequently underestimate success and overestimate failure.

Borkowski et al. (1989) suggest that the attributional beliefs held by low achieving children are acquired as a “consequence” of repeated poor or insufficient strategy use and from the subsequent feedback following their use. These same attributional beliefs however, may also be the “cause” of poor strategy selection and ineffective monitoring behaviours. Attributions, according to Borkowski et al. (1989, p.66), may “arise from lower level thinking skills, but they fuel higher level executive processes”.

Swanson (1989) has proposed a number of advantages and components of effective strategy instruction for use with low and underachieving children. Firstly, instruction in the use of strategies focuses on what is modifiable in the current behaviour of students. More precisely, it looks at what students are currently doing without strategy instruction and how this behaviour can then be modified to produce a more effective outcome following instruction. Secondly, strategy instruction allows for conscious and active rule creation and rule following as it focuses on the underlying plans which influence students’ behaviour, while at the same time proposing a counter perspective to that already adopted by the low achiever. Thirdly, strategy instruction must incorporate the idea that environmental factors may operate differentially on students declarative and procedural knowledge. Fourthly, strategy instruction allows children to be actively involved in their own learning which works best for them individually, and fifthly, strategy instruction allows for theorising and instructional development whereby materials can be developed which maximise strategy use (Swanson, 1989, p.5).
Others (Palinscar & Klenk, 1992; Garner, 1992) have noted the difference between incidental or spontaneous learning, where achievement and motivation are not considered to be factors, and intentional learning, where achievement occurs as a result of a learner's purposeful, effortful, self-regulated and active engagement. Incidental learning may occur vicariously as children interact with their environment, however, intentional learning requires metacognitive knowledge or a repertoire of strategies along with motivation which may arise out of a sense of self-efficacy (Palinscar & Klenk, 1992; Schunk, 1989; 1995). While low achievement on academic tasks cannot be attributed exclusively to metacognitive and strategy deficits, children who have trouble academically do appear to have great difficulty acquiring and displaying the strategic learning behaviours which promote intentional learning (Palinscar & Klenk, 1992).

**Developing Metacognitive Skills**

Most instruction offered to low and underachieving children is remedial in nature, seeking to reteach in a similar manner that which has already been taught in the classroom (Covington, 1992). Such instruction is frequently very specific to an area of perceived difficulty such as addressing decoding problems with the poor reader. Enhanced reading programs for example, which focus on word attack skills, often do so at the expense of more comprehensive instruction and as a consequence, many children receiving this type of remediation do not receive the same instructional opportunities as their normally achieving peers (Palinscar & Klenk, 1992; Garner, 1992). Low and underachieving children not only have less content knowledge, but may also have less opportunity to develop the strategic knowledge required for intentional learning. This may well be as a result of the approaches adopted to redress learning problems. Feuerstein, Rand, Hoffman, Egozi and Ben Shachar-Sergev (1991) in fact note that unless low achieving individuals
are specifically equipped with the cognitive prerequisites of thinking which will correct deficiencies, then their efforts to produce problem-solving behaviours and strategic and critical thinking will more than likely be in vain. Intervention programs therefore, which do not include training in these deficit functions are unlikely to be terribly effective (Feuerstein et al., 1991).

According to Palinscar and Klenk (1992), the cognitive and metacognitive demands associated with intentional learning are largely dependent on the motivation of the learner. Learners who value the goal towards which they are working and who expect to succeed following their efforts are most likely to achieve (Feuerstein et al., 1991). Alternately, Paris and Oka (1986) have suggested that negative attitudes towards learning have been found to not only inhibit learning but also to influence schoolwork difficulties.

Supportive school contexts are vital to low achieving children (Palinscar & Klenk, 1992). The use of other learning strategies such as reciprocal teaching, have also been found to be effective and indeed Palinscar and Klenk (1992) have suggested that the sense of playfulness which may be engendered by the use of reciprocal teaching strategies may encourage, especially young children, to see learning as fun rather than as a chore or a threat. Reciprocal teaching approaches actively promote task orientation, foster self-regulatory skills and aid motivation. Borkowski (1992, p.254) urges student/teacher interactions on learning tasks and says that the use of self-regulatory strategies have the potential to “reshape negative attributional beliefs” especially under the guidance of a sensitive teacher who is trained to diagnose and understand the complexities of individual behaviour and meet individual needs.
Although there are great benefits in providing effective strategy instruction for underachieving children, Paris and Oka (1989) believe however, that this is just one step in the process of developing metacognitive skills. Such given strategies must ultimately be modified by students to suit personal learning styles and to meet individual needs thereby enabling personalised and effective learning to take place. For this to occur with underachieving children, strategy instruction must include (a) a focus on process and content, (b) demonstrations of the use of specific strategies, (c) a recognition of the need to see strategies as useful, (d) student/teacher dialogues about strategies, (e) development of meaningful goals and, (f) instruction that promotes generalisation.

Effective teachers of low achieving children generally operate within an explicit, strategy-based teaching agenda which is designed to stimulate children’s learning through interaction. Competent teachers guide students in their choice of strategy which may be most effective for solving specific problems with the result that higher level problem-solving skills are demonstrated, discussed, internalised and finally adapted for future tasks through a process of “guided discovery” (Borkowski, 1992; Rogoff, 1990). Guided discovery includes the use of strategy instruction as previously discussed, and scaffolding appropriate to the needs of the individual child. Borkowski (1992) suggests that this process is unique and is dependent not on scripted behaviours but rather on spontaneous interactions which are determined by the teacher’s perceptions of a student’s progress. Individual guidance assists in the development of understanding and allows for personalisation and generalisation across subject domains.
Self-Verbalisations in Low Achieving Children

In Chapter 3, Vygotsky's (1978) notion of language as a critical medium for the transfer of knowledge between individuals was discussed. Vygotsky believed that when language was used in a cooperative learning situation, it enabled complex tasks to be accomplished which might otherwise have been impossible. Vygotsky, along with other researchers such as Berk (1992), Elliott (1995) and Rogoff (1990) believed that inner speech or private speech was as important as dialogue and action in planning and regulating cognitive activity. Berk (1992), and others (Englert, Raphael, Anderson, Anthony, and Stevens, 1991; Vygotsky, 1978) also believe that inner speech emerges first in the social dialogue occurring between adults or more knowledgeable language users and a learner, gradually becoming internalised and automatised over time. Englert et al. (1991) suggest that initially, adults model cognitive processes and largely complete problem based tasks while articulating salient features. Gradually, as a social and collaborative exchange, learners soon participate and assume responsibility for both the dialogue associated with thinking and the action following cognition as they are able. Eventually, the social dialogue becomes internalised as private speech which may be spoken aloud. However, with time, even this is finally replaced by covert, unconscious self-guiding behaviour (Englert et al., 1991).

Self-verbalisations, including self-praise and reinforcement, need to be encouraged amongst low and underachieving children, as research has shown that such verbalisations serve a self-guiding function, especially when tasks are difficult or when there is confusion about how or where to proceed (Berk, 1992).
Summary and Conclusion

This chapter has outlined some of the differences in cognitive processing, metacognitive strategy use, self-regulation and approaches to learning found amongst high and low or underachieving students. Whilst intelligence is undoubtedly a factor for some students, many children perceived as having reasonable or high academic potential, also show remarkable differences in their approach to learning and their use of strategies for successful task completion (Biggs & Moore, 1993). Whilst high achieving students generally adopt systematic and organised strategies to assist with their learning, low achieving students have been found to lack the ability, the motivation and an appreciation of their own worth and capabilities to do so (Borkowski & Thorpe, 1994).

Some of the antecedents of low achievement were highlighted, including socio-economic status, parent education and gender. Of greater interest to this study, however, are the learning conditions present in the classroom and student/teacher interactions (Covington, 1992), as well as self-esteem. Discussion also focused on the provision of support for low achievers, especially teaching of both an implicit and explicit nature where metacognitive strategies for improved academic performance are encouraged and modelled.

In the following chapter (Chapter 5) the content of the preceding chapters is reviewed, and the historical and contemporary literature relating to teaching and learning is discussed. It summarises the research on deep and surface understanding, the importance of sociocultural contexts for learning, teacher scaffolding, as well as metacognition and self-regulation. At the conclusion of the chapter, the purpose for this thesis is outlined.
Chapter 5

SUMMARY OF LITERATURE AND RESEARCH CONSIDERATIONS

In the preceding chapters, literature relating to both historical and contemporary teaching and learning theories, deep and surface learning approaches, metacognition and self-regulation, as well as the qualitative differences found amongst individual students has been discussed.

Summary of Literature

Specifically, Chapter 1 described some of the historical theories which have contributed to education along with some more contemporary theoretical perspectives which have drawn attention to the social and cultural environment as an important feature in learning. The shift in orientation from behaviourist to humanistic and cognitive perspectives which recognise the contribution that students themselves make in the learning process has been discussed, and the review has outlined the cognitive theories of Piaget and aspects of the information processing models (Berk, 1991; Clyde, 1995; Eggen & Kauchak, 1994; Eysenck & Keane, 1996; Kaplan, 1991; Santrock, 1995).

Chapter 2 reviews the literature regarding deep and surface approaches to learning (Biggs, 1987; 1988a; 1988b; Biggs & Moore, 1993; Entwistle, 1991; Marton, 1994; Trigwell & Prosser, 1991), and learning outcomes in terms of the development of qualitatively different understandings about learning and
its ultimate purpose. The chapter also focuses on the factors, both intrinsic and extrinsic to the learner which contribute to the adoption of specific learning approaches such as attention (Eysenck & Keane, 1996; Garcia & Pintrich, 1994; Pintrich & DeGroot, 1990; Wigfield, 1994), motivation (Borkowski & Thorpe, 1994; Dweck & Elliott, 1983; Meece, 1994; Zimmerman, 1994), self-concept (McCarthy & Schmeck, 1988; Sinclair, 1991), stage of development (Berk, 1991; Biggs & Collis, 1982; Eggen & Kauchak, 1994), and the learning environment (Biggs, 1988a; 1988b; Dweck, 1986; Dweck & Elliott, 1983; Gardner, 1994; Prosser, 1993).

Chapter 3 examines the literature pertaining to the social and cultural environment as a critical context for learning. It highlights the work of Vygotsky (1978) and other sociocultural theorists (Bronfenbrenner, 1979; Bruner, 1966; 1985; Gardner, 1994; 1996; Kozulin, 1990; Rogoff, 1990), who suggest that the transmission of knowledge from expert to novice occurs during shared interactions whilst engaged in meaningful problem-solving activities (Arenz, 1991).

Collaborative dialogue is essential for meaningful learning exchanges to take place and Chapter 3 has also discussed the notion of "scaffolding" or the use of strategic teaching behaviours which support students' cognitive problem-solving as they move toward self-regulation (Elliott, 1995; Gardner, 1994; Wood, Bruner & Ross, 1976). Literature relating to the ultimate goal of all teaching endeavours, that is, the production of self-regulating learners, has been reviewed along with information discussing the development and use of the metacognitive strategies necessary for deep approaches to learning.

Finally, Chapter 4 has looked more closely at the qualitatively different ways that students approach learning tasks. Some of the antecedents of low
and underachievement have been explored and it was noted that factors such as self-concept, poor motivation and skills and strategy deficits, often resulting from ineffective teaching practices, are more likely contributors to poor academic performance than intelligence or ability (Borkowski, 1992; Borkowski & Thorpe, 1994; Covington, 1992; VanLeuvan & Wang, 1991). Chapter 4 goes on to discuss the importance of explicit strategic training at designated times which may be additional to the metacognitive instruction which should be a regular component of classroom sessions in each learning domain. Metacognition, self-regulation, deep or surface approaches to learning and deficits in these learning characteristics may all be attributed in some measure at least to factors within the sociocultural environment of the classroom.

**Research Direction**

A central concern of this thesis, advanced throughout the preceding chapters, is to extend understanding about effective teaching and learning especially in the early school years. In particular, any teaching endeavour must be about imparting meaning and development of the ability to transfer information from the known to advance understanding of the unknown. In many classrooms, however, from the very earliest school years to the senior years and even beyond into tertiary institutions, the teaching of the higher-order thinking skills necessary for the manipulation of knowledge enabling full understanding has been subjugated. Instead of encouraging students to understand and use process strategies, these have been restricted in favour of lower-order routines for the reproduction of facts and skills to meet institutional requirements and for examination purposes.
Rogoff (1990, p.7) has suggested that students must be recognised as "apprentices in thinking". Like all apprentices, they should be active in their efforts to learn through observation, participation and dialogue with more "expert" members of society. The methods employed by teachers, therefore, to impart vital knowledge and their stated goals for learning are directly correlational with students' perceptions about how learning is accomplished and the purpose for which it is undertaken (Entwistle, 1991). This of course has critical implications for the way teachers teach, the importance given in the classroom to developing learning skills and the weight and value placed on assessment tasks (Marton, 1988).

While teachers have generally been viewed as "experts" regarding knowledge about facts and skills, higher level thinking processes have rarely been explicitly taught nor modelled in the classroom (Ghatala, 1986; Levin, 1986; Pressley, 1986; VanLeuven & Wang, 1991). For some children therefore, their ability to access the strategies required for successful knowledge transfer will be limited unless strategy use has been encouraged in other contexts such as the home. In many cases poor academic outcomes have been thought to be the result of reduced intellectual ability, laziness or immaturity. More recently, however, low or underachievement has been attributed not so much to personal immaturity, but rather to an immature ability to transfer knowledge and certainly significant differences in learning approaches of children have been discerned (Borkowski & Thorpe, 1994; VanLeuven & Wang, 1991).

The classroom in the early years is crucial to the novice learner and instruction at this time may well be the commencement point for the development of many of the critical behaviours which will impact thinking and learning in the years ahead. If the teaching environment does not reflect
and support meaningful learning, then students may be encouraged to adopt surface tendencies, characterised by metacognitive, self-regulatory deficits. Such behaviour is likely in turn, to influence attention, motivation and self-concepts and may ultimately contribute to low or underachievement in some children. Explicit instruction in those aspects of learning considered essential, is imperative therefore, if desired behaviours are to be acquired (Prosser, 1993). Prosser as well as Marton, Hounsell and Entwistle (1984), Marton and Saljo (1976) and others, suggest that within any learning environment students will experience substantially different teaching emphases, irrespective of the fact that the reality of the lesson will be identical for each. Phenomenographic studies have shown that students tend to understand, perceive, experience, conceptualise and apprehend aspects of the teaching phenomena in a number of qualitatively different ways (Marton, 1994). The way students experience teaching therefore, determines not only their future understanding about what is taught (content), but also how problems are approached (concepts and processes) (Prosser, 1993). Students who focus on meaning through the use of processes as well as content rather than on content alone, have been thought to gain different understandings from a classroom lesson to students whose focus is exclusively on task mastery and reproduction of learned facts.

Although, as this literature review has demonstrated, significant research into deep and surface approaches to learning often displayed through the use of metacognitive, self-regulatory strategies, has already been conducted with high school and university students, exploration in this important area is deficient amongst students in the early school years. While there are differences in the learning behaviours of high and underachieving students, some of these differences need to be explored more thoroughly if teaching
approaches which will reduce the disparity between children are to be encouraged.

**Focus Research Questions**

Given that many children are still not developing the thinking skills so crucial to effective school based learning, clearly there is a necessity for further research in this area and to address this need, this thesis investigates three major questions. Firstly, it seeks to determine whether very young children in their first year of school use metacognitive, self-regulatory strategies to assist them with learning and problem-solving tasks. Of significant importance is also the nature of the strategies used and the characteristics of the behaviours which comprise such strategies.

Secondly, as “what” has been learned in the classroom is inseparable from “how” the learning has been perceived by the child, the strategic behaviours displayed by students as they undertake problem-solving tasks are likely to be a reflection of the way they view learning in terms of its ultimate goal. The second question therefore seeks to determine whether or not the strategic behaviours displayed by children, coupled with numerous other factors such as attention, motivation and self-esteem, give any indication of the learning approach adopted by children, even in their first year of school. As previously noted, Prosser (1993) suggests that even amongst children from the same classroom, qualitatively different understandings are likely to develop. Students, however, from classrooms where “learning for meaning” or deep learning has been emphasised over “memory for reproduction”, should display a greater range of “deep” characteristics or the use of “metacognitive” strategies, possibly irrespective of their actual or perceived achievement.
The third question deals to a greater extent with these differences. In the first part, the study aims to determine the nature of the differences found in strategic behaviour amongst children who have been classified as either high or underachievers. It also seeks to explore variance in the strategic behaviours found between children whose learning environment has specifically taught, modelled and encouraged the use of metacognitive strategies for deep learning and those where “best practice” teaching methods were used.

It has been assumed that qualitative differences might be discernible in metacognitive behaviours between the students who had participated in an experimental program from an earlier study (designated Study 1 - refer to Chapter 6), and those whose teachers had not been instructed to teach “for deep understanding” irrespective of their overall achievement in the classroom. Rich sociocultural environments such as interactive, supportive, facilitative classrooms are valuable contexts for the transmission of higher-order thinking skills and domain specific instruction has been found to significantly increase students’ strategy use and their subsequent performance on a range of tasks, even amongst students experiencing difficulty (Borkowski, 1992; Borkowski & Thorpe, 1994).

**Summary and Conclusion**

To summarise, three questions are addressed in this study. Recognising that a strategy rich sociocultural environment is crucial for effective teaching and learning, the presence and nature of strategy use amongst children at the threshold of their schooling will be assessed. Whether or not such strategic behaviours are indicators of perceptions of learning as a deep or surface
endeavour are also explored, and the study also attempts to discern whether such perceptions are more characteristic of any particular group of children.

In the following chapter (Chapter 6), a detailed description of the methodology adopted for the study, including participants, protocols, instruments and procedures is given. Phenomenography, a methodological viewpoint which explores the qualitative differences in students’ perceptions of learning is introduced.
Chapter 6

METHODOLOGY

In Chapters 1 - 4, some of the literature regarding learning and teaching, especially the importance of the sociocultural context and the role of both students and teachers in the learning process, has been discussed. The previous chapter (Chapter 5) briefly summed up the research of the preceding chapters and defined the major lines of inquiry associated with this study. Chapter 6 now outlines the methodological considerations involved.

Introduction

The purpose of this study has been to explore the qualitatively different approaches to learning adopted by a number of children in their early school years. Marton (1988) notes that educational goals may be exemplified by three types of competence, namely skills, knowledge and understanding. More particularly, skills refer to the way things are done, knowledge relates to what is known about phenomena, while understanding refers to the way phenomena are discerned or conceived.

Specifically examined here are the precise characteristics of deep level understanding often acquired through the use of metacognitive, self-regulating strategies, in addition to the characteristics of surface level understanding, generally thought to be a reliance on learned facts and skills. Pramling’s research (1990), like Marton’s (1988), has concluded that understanding can never be described separately from the phenomenon that is being understood. Conversely, because of its highly relational nature,
phenomena cannot be described without recognising their importance to understanding.

In this study, the demonstrated metacognitive, self-regulatory behaviours of children from the same classroom (either experimental or control) are compared and their verbal and non-verbal problem-solving behaviour categorised into levels of meaning, indicative of surface or deep learning approaches. Because outcomes appear to be closely related to learning approaches, the type, range and frequency of strategy use were presumed to be different for high and low achieving students. Phenomenographic studies (Entwistle & Entwistle, 1991; Marton, 1994; Prosser, 1993) have suggested that the way material is taught in the classroom is likely to influence an individual’s approach to learning. From classrooms therefore, where metacognitive, self-regulatory strategies are explicitly taught, children are likely to display significantly greater strategy use, irrespective of their achievement level, than those where strategic skills have not been regularly taught or modelled.

**Qualitative Methodology**

The study explores the metacognitive, self-regulatory behaviours of sixteen, kindergarten-aged children. Metacognitive, self-regulatory behaviours not only enhance problem-solving, but they are thought to be characteristic of deep and surface approaches to learning. Illustrative case studies describing the behaviours of eight of these children have been included. Set within a qualitative research paradigm, case studies are an appropriate research tool when dealing with extraordinarily complex learning and problem-solving behaviours which are dependent on a range of variables not always identified by the use of quantitative methods.
Qualitative research has had a long and rich tradition in anthropology and sociology (Stainback & Stainback, 1984). In education, qualitative research is frequently called "naturalistic" because most data are gathered in situations where people are engaged in their natural activities by people who are also engaging in natural behaviours such as talking, listening and looking (Bogdan & Biklen, 1982; Stainback & Stainback, 1984). Much qualitative research in education is based on a theoretical position referred to as phenomenology which seeks to understand people’s perceptions of events in their environment. In recent years, qualitative research methods have held a valuable place in the work of many social science researchers and frequently address questions which delve beyond the scope of traditional research methods (Crowley, 1994-1995).

Qualitative and phenomenological research in education have emerged as valuable research methods, in part as a response to the limitations quantitative methods imposed. Cochrane and Dolan (1984, p.27) believed that "researchers became dissatisfied with solutions to problems which placed faith in a null hypothesis and in the idea that data were interesting and an hypothesis sound because they beat the laws of chance". According to Crowley (1994-1995), qualitative methods extend well beyond a unified set of principles which must be applied in a prescriptive manner and instead, focus on inquiry which leads to a greater understanding of the phenomena under study.

Qualitative researchers build on the insider’s perspective, frequently observing and even participating in the activities or experiences under review (Stainback & Stainback, 1984). Research undertaken qualitatively tends also to consider the changing, dynamic nature of reality by adopting a holistic approach using a wide variety of data gathered through numerous means.
This enables research procedures to be flexible, exploratory and discovery orientated, often allowing the researcher to gain a deeper, more valid understanding of the behaviour under investigation (Crowley, 1994-1995; Stainback & Stainback, 1984). The focus of qualitative research is on "subjective" data, or that which exists in the minds and behaviours of people and is expressed in natural language.

Qualitative research is "a social and cultural process with deeply rooted moral, political and personal overtones; a process where researchers frequently ask what, how, when and with whom" (Cochrane & Dolan, 1984, p.27; Crowley, 1994-1995). Strauss and Corbin (1990) note that in this social and cultural milieu, qualitative research may detail aspects of personal lives, tell individual stories and recount aspects of behaviour, findings about organisational functioning, social movements or interactional relationships. According to Strauss and Corbin (1990, p.19), as qualitative methods are most effective in dealing with "phenomena not yet fully understood", their use is most appropriate for educational researchers who frequently seek answers to subjective issues which relate to non-measurable aspects of teaching and learning.

**Case Studies**

Some of the most frequently used qualitative methods for research include ethnography, participant observation, cross case analysis, evaluation and case study (Crowley, 1994-1995). Although qualitative research gives the flexibility to either select from or integrate these methods or create new methods to address specific research questions, Crowley (1994-1995), suggests that it is frequently the research questions themselves which will guide methodological decisions.
Case studies used either alone or sometimes as part of larger scale quantitative studies are often a preferred method of choice when studying interventions or innovations in educational contexts (Lancy, 1993), and are a particularly appropriate methodology for educational investigation as they provide in-depth portrayals of aspects of people's lives. The subject of each case study is unique with a genetic makeup and experience shared by no other individual (Santrock, 1995). Bell (1992, p.6) describes case studies as "an umbrella term for a family of research methods having in common the decision to focus on inquiry around an instance". When ascertaining the qualitatively different approaches that students adopt to learning and problem-solving in this study, case studies and cross case analyses based on teacher discussions and participant observation have therefore been chosen as an appropriate methodology.

Additionally, a look at phenomenography, which suggests that students interpret events in qualitatively different ways, has also been valuable for this study. Phenomenographic studies focus on what is learned rather than how much is learned and examine phenomena from the participant's perspective rather than the observer's (Gerber, Bolton-Lewis & Bruce, 1995).

**Phenomenographic Approaches**

While case studies have been selected to illustrate in detail the nature of the specific learning approaches used by high and low achieving children when presented with a problem-solving task, phenomenography as a method of investigation has been adopted to give an insight into the world as the learner sees it (Marton, 1994; Pramling, 1990). Phenomenography in this case, seeks to determine whether students approach learning at a deep or surface level; it seeks to determine whether education is seen in terms of understandings about "how" tasks should be approached or "what" should be remembered
for eventual reproduction. Based on the relationship which develops between children and their experiences in the classroom, Pramling (1990) argues that children's thinking cannot be separated from those experiences as thinking must always be directed toward something!

According to Marton, in the *International Encyclopaedia of Education* (1994, p.4424), phenomenography is “the empirical study of the limited number of qualitatively different ways in which various phenomena in and aspects of the world around us are experienced, conceptualised, understood, perceived and apprehended”. From a phenomenographic perspective, differences are characterised in terms of 'categories of description' which are logically related to one another and form hierarchies in relation to given criteria (Entwistle, 1984; Entwistle & Entwistle, 1991; Marton & Ramsden, 1988; Marton & Saljo, 1976; Marton, 1994).

Emerging from studies in learning at the University of Goteborg, Sweden in the 1970s, phenomenography seeks to inform research as to differences in what it *means* to say that some people are better at learning than others and also *why* some are better at learning than others. The characterisation of the qualitative differences in the outcome of learning has been based on students' personal accounts of their own understanding, a move away from an exclusive interpretive view by the researcher, of learning phenomena (Prosser, 1993). Marton (1994) and others (Marton & Saljo, 1976; Prosser, 1993) found that students who focused on meaning tended to adopt a deep approach to their learning while students who had focused more simply on reproduction of task elements adopted a surface approach. In other studies, Marton and Saljo (1976) and Marton, Hounsell and Entwistle (1984) found that deep approaches to learning were closely associated with higher categories of outcome while surface approaches were associated with shallow
understanding which led to lower categories of outcome. From this viewpoint, it was therefore, determined that some students were better at learning because they differed in their approach to learning tasks. Children’s perceptions of certain phenomena for example, their approach to mathematical concepts such as numbers, may be seen as vitally important to the way they will deal with arithmetic problems; perceptions which may ultimately affect mathematical outcomes on given tasks.

Crawford, Gordon, Nicholas and Prosser (1994), in a study exploring students’ perceptions of mathematics and how it is learned, adopted phenomenographic techniques to analyse their data. Phenomenographic approaches in their analysis were based on the premise that acting, thinking and feeling are all inextricably linked and that the social context for these activities is important with collective external activity preceding individual internal activity (Crawford et al., 1994; Prosser, 1993, Vygotsky, 1976; 1978; Wertsch, 1991). To this end, they adopted a framework proposed by Marton (1988), to describe students’ experiences of learning in terms of what learning is (a conception of learning) and the structural aspects of learning which look at processes (how learning is achieved).

Pramling’s (1990) research has focused on the perceptions of learning held by young children, concluding that even six, seven and eight year olds have views about how their knowledge has been acquired. She notes that many young children in their early school years tend to connect knowledge and knowing with adult instruction, viewing themselves as passive receivers rather than as active participators in the learning process. Children therefore, in the earliest school years often perceive learning in a traditional manner, that is as a consequence of external influence, acquired by listening to the teacher. This, according to Pramling (1990) is in marked contrast to the
preschool years where the emphasis is frequently on interactive dialogue and personal concrete experience.

Prosser (1993), as well as Walsh, Dall’Alba, Bowden and Martin (1993) have noted that individual students within the same class will experience substantially different teaching emphases and therefore, the phenomenon of any lesson is consequently different for each student. This study therefore, assumes that while the reality of teaching for student participants from the same class will be identical, from a phenomenographic point of view, each will invariably demonstrate their understanding of concepts such as number and space in qualitatively different ways. Based on the work of Walsh et al. (1993) and Prosser (1993), it is likely that from any class, one student will have understood mathematics as the development of understandings about facts, knowledge and skills for future reproduction (the “what” of the experience), while another will have viewed the same session as focusing on the concepts and processes (the “how”) of doing mathematics problems. Within the same classroom, although the reality of a lesson may be identical for all children, “what” and “how” that reality is experienced and perceived will be qualitatively different for each individual.

**Phenomenographic Analysis**

In their study on mathematics understanding, Crawford et al. (1994) argued that students’ conceptions of learning and how learning occurs could be determined by analysing data in terms of deep and surface activity. Surface approaches to learning are demonstrated when attention and activity are centred on short term, instrumental goals often seen as the mandatory reproduction of knowledge acquired through transmission by experts such as the teacher. Conversely, deep approaches to learning indicate a more global perspective in which existing conceptions and understandings are revised,
internalised and applied when confronted by new information (Entwistle & Marton, 1984).

The type of approach employed to learning closely relates to the academic outcome (Marton & Saljo, 1976). Surface approaches almost inevitably rule out the possibility of a deep outcome, although the reverse is not necessarily inevitable. Entwistle and Marton (1984) suggest that while a deep approach to learning is necessary for full understanding, it does not always appear to be solely sufficient as previous knowledge as well as cognitive skills will affect the degree to which deep intention is converted into a deep outcome. It even appears to be possible to move within a single task between surface and deep approaches (Laurillard, 1984; Ramsden, 1988a). Both Laurillard and Ramsden have found that variations in approach are consistent with students’ perceived thoughts on task purpose, the nature of the task, their relationships with the tutor and their interest in and considered importance of the proposed task. What appears to be important from the phenomenographic perspective is the way students experience teaching, having regard to both the “what” (the content) and the “how” (concepts and processes) (Prosser, 1993).

Prosser and Webb (1994, p.125), as previously noted, suggest that phenomenographic research is conducted from within a “second order perspective” where descriptions of the experience of learning from the student’s viewpoint are sought. Recognising that the individual and the environment must be seen as a whole (Marton, 1994; Rogoff, 1990; Vygotsky, 1978), the viewpoint of the students in this study as they work on a range of tasks have been explored, even though the “voices” through which their perceptions of learning are discerned are as frequently non-verbal as they are verbal. A phenomenographic approach has been adopted because the individual behaviours observed during engagement in problem-solving tasks.
clearly speak, giving unmistakable clues to the learning approach adopted by each child.

From a phenomenographic perspective, the way children perform learning and problem-solving tasks ("how") is likely to reflect "what" has been experienced in the classroom. Marton (1988), Marton and Ramsden (1988) and Prosser (1993) say that, "how" we go about experiencing and understanding the world is inseparable from "what" we experience and understand. If therefore, teachers' efforts to change concepts of the phenomena being taught in the classroom from surface to deep experiences of learning are successful, then this is likely to be reflected in the behaviour of children undertaking simple problem-solving tasks. By categorising the deep and surface characteristics of problem-solving demonstrated through the dialogue and action of children engaged in mathematical tasks, student perceptions of the teaching focus can be determined.

**Research Design**

The study has been completed in two stages (Study 1 & Study 2). Some of the data for this thesis were gathered during the first stage (Study 1), where changes on mathematics pre and posttest scores were anticipated following a six week period of specialised teaching intervention. Study 1 was an Australian Research Council (ARC) funded project which established experimental and control groups with the intention of investigating differences in mathematics outcomes following the explicit teaching and modelling of a range of metacognitive, self-regulatory strategies in a classroom context. The pre and posttest scores of a standardised mathematics test, along with a measure of self-esteem, collected during Study 1 have been recorded in the results and case studies. For Study 2, these scores provide
background information and support the findings relating to metacognitive, self-regulatory strategy use, thought to be characteristic of deep approaches to learning.

Study 2 comprises the major aspect of this research thesis and looks at micro issues implicit but not discussed in Study 1. Individual children were selected from the experimental and control groups and their metacognitive, self-regulatory behaviours on a range of tasks were observed and analysed. Illustrative case studies give voice to the discernible behaviours of some of the children and enable a thorough exploration of the cognitive and affective differences which influence perceptions of learning.

Context of the Study - Study 1

Study 1: Setting the Scene

Study 1, a project undertaken in conjunction with my major supervisor, looked at changes in test scores following a period of instruction thought to impact on the development of metacognitive, self-regulatory skills in children in their first (kindergarten) year of school within a whole classroom context. A pre and posttest design with experimental and control groups was used to determine variables of change (see design model-Table 6.1). Following pretests to measure mathematical outcomes, teachers in experimental groups

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1 This project involved assistance in the preparation of a document for the Ethics Committee of the University, and the initial selection of and verbal and written contact with the participating schools. I attended all interviews with the principals and participating teachers, wrote letters to parents and organised and delivered training sessions for the teachers of students in the experimental groups. As pre and posttests were to be conducted by qualified teachers, I organised and supervised a team to test all children (experimental and control groups). The study also necessitated several visits to each classroom to observe and videotape teacher/pupil interactions during mathematics lessons. Following data collection, pre and posttest TEMA 2 and self-perception scores were analysed. Some of the findings of Study 1 are discussed in the results section Chapter 7) of this thesis. A more detailed discussion of the findings however, are found in Ashton & Elliott (in press).
were given comprehensive instruction in how to encourage students to adopt deep approaches to learning through the explicit teaching of metacognitive, self-regulatory skills in a mathematics problem-solving context. Teachers therefore, in experimental groups taught about and were encouraged to model a range of cognitive strategies designed to increase mathematics understanding. The teachers in the control groups were instructed to teach mathematics as they had always done using "best practice".

Table 6.1
Study 1: Experimental Design Model

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<tr>
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<th>Group A (n=133)</th>
<th>Group B (n=86)</th>
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<tbody>
<tr>
<td><strong>TEMA 2</strong></td>
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<tr>
<td>Pretests</td>
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<tr>
<td><strong>TEMA 2</strong></td>
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<td>Posttests</td>
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<tr>
<td><strong>Self-concept</strong></td>
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</table>

Following completion of the experimental sessions, children in both groups were posttested and the scores analysed for significance. Encouraging the use of metacognitive skills by classroom teachers had previously been found to be extremely effective with single children or groups of two or three (VanLeuvan & Wang, 1991; Winne, 1982). Considerably less research however, has been attempted to determine the efficacy of teaching for metacognitive enhancement within the total classroom environment.

**Study 1: Participants**

**Experimental and Control Groups**

Study 1 involved students from five experimental classes comprised of 61 girls and 72 boys, and four control classes comprising 39 girls and 47 boys, located in five schools in middle class areas of Sydney and Canberra.
Obviously constrained by the gender of children enrolled, participants were nonetheless quite closely matched in this respect. The schools drew children from families with relatively comfortable income levels and socioeconomic status was presumed to be similar. Although marital breakdown is an increasing phenomenon within all socioeconomic groups, a large percentage of the children from these schools lived at home with both parents. The children, all in their kindergarten year, were either five or six years of age. As these studies were conducted in the final term of the year, all children had previously experienced regular mathematics tuition within the classroom, four or five times per week, over the first three terms.

**Protocol**

Prior to commencement of the studies, ethics permission was obtained from the University and meetings were conducted with the principals and classroom teachers of the participating schools. Letters seeking parental permission, expressing the intent of the researcher to work with children for the purpose of determining metacognitive, self-regulatory gains following the experimental (or control) teaching program and an explanation of the study (Study 1) were distributed. Parents were also informed of the intention to videotape interactions between staff and children and, in the case of the Sydney schools, in some circumstances to videotape individual children engaged in a range of specific tasks (for Study 2). Confidentiality was guaranteed and parents were assured that their children could be withdrawn without penalty from the study at any stage. Videotaped material was to remain the property of the researcher(s) until completion of both Study 1 and Study 2. It was guaranteed that the identity of children, teaching staff and schools would not be revealed either by name or photograph. To this end pseudonyms were used to ensure complete confidentiality.
Study 1: Instruments

The TEMA 2 (Test of Early Mathematical Ability - Edition 2) (Ginsburg & Baroody, 1990) (see examples-Appendix A) was used to determine students’ mathematical scores prior to and following the six week intervention period. Scores were recorded using a prescribed format (see example-Appendix B). The TEMA 2 consists of a series of tasks designed to measure children’s informal and formal mathematic skills. Informal skills are those involving concepts of relative magnitude, counting and calculational skills, and formal skills measure children’s competence in knowledge of convention, number facts, calculation and base ten concepts. The tests employed a variety of expressive forms such as written representation where children were shown a picture and asked to write down the number of items displayed, for example,

"Here is a picture of some dogs [show card]; use this paper and pencil to show me how many dogs there are".

Children were also asked to demonstrate their competence by performing concrete tasks, for example,

"Here are some counters. Can you please give me exactly nineteen counters?"

by testing concepts, for example,

"Suppose I have ten counters and you have only one. Who has more? I do, don't I? Now I want you to tell me which is more, six or five? nine or ten? seven or six? four or five?"

and by mental calculation, for example,
"I have two counters in this hand [close hand] and one counter in this hand [close hand], now I put the counters together. How much are two and one altogether?"

The TEMA 2 has been found to be a highly reliable instrument for use with children aged three to eight years (Ginsburg & Baroody, 1990).

Students’ Self-Esteem was assessed using the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children (Harter, 1982; Harter & Pike, 1983) (Appendices C & D). The Harter pictorial scale is a 24 item test with four separate subscales which explores students’ perceptions of themselves in relation to cognitive competence, peer acceptance, maternal acceptance and physical competence (Harter & Pike, 1983). Harter and Pike (1983) have found their test useful for both group data measurements as well as with individual children. The test invited children to respond to statements such as:

“Good at numbers”, “Has lots of friends”, “Good at climbing”,
and “Mum takes you to places you like”.

Each participant was shown two pictures which corresponded with the statements (Appendix D), one showing a happy confident child successfully performing the task mentioned in the statement and the other showing a similar, but sad child, not performing successfully. Participants in the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children (Harter, 1982; Harter & Pike, 1983) were asked to state whether they were “a lot” like one of the children in the pictures or “a bit” like them. Scores were given for each response with four (4) being the highest (a lot like the successful child), three (3), a bit like the successful child, two (2), a bit
like the unsuccessful child and one (1) being the lowest (a lot like the unsuccessful child).

**Study 1: Testing Procedures**

Both the pre and post TEMA 2 tests (Ginsburg & Baroody, 1990), and the *Pictorial Scale of Perceived Competence and Social Acceptance for Young Children* (Harter, 1982; Harter & Pike, 1983) were conducted by both the researcher and a group of qualified teachers familiar with kindergarten aged children and testing procedures who acted as research assistants. All children, irrespective of their experimental or control group status were withdrawn on an individual basis from their classrooms over a period of several days to a quiet room ensuring minimum distraction and maximum concentration during testing. Although there were no specified time limits imposed, each child took between 20 and 40 minutes to complete the pre TEMA 2 test and the *Pictorial Scale of Perceived Competence and Social Acceptance for Young Children*. As the latter test was administered only once, in most cases completion time for the post TEMA 2 was considerably less. Children were always allowed reasonable time to complete questions, however, if it became apparent that the concepts being examined were outside their range of ability and understanding, the questioning time was drawn to a close. Nevertheless, throughout the testing period all children were encouraged to clarify unfamiliar concepts and look carefully at items of difficulty.

The Pretests were conducted with children in the experimental groups to determine their understanding of mathematical concepts at the commencement of the six week intervention period. Pretests were also conducted with children in the control group whose tuition in mathematics throughout the intervention would continue to employ "best teaching practice".
Following completion of the intervention period, Posttests, again using the TEMA 2 instrument, were conducted on children from both experimental and control groups.

**Study 1: Teacher Training**

Guidance of metacognitive, self-regulatory activity involves the conscious support of children’s efforts within the zone of proximal development (Vygotsky, 1978). While most teachers have been trained to positively reinforce effort, not all feedback given in the classroom is academic, encouraging the process of thinking and problem-solving, nor is it designed to encourage critical evaluation. Teachers from classrooms participating in the experimental programme were therefore, given a three (3) hour comprehensive training session during which time metacognitive teaching behaviours were discussed and modelled. The session followed a training programme devised and tested in numerous studies by Elliott (1991; 1993; 1994a; 1994b; Hall & Elliott, 1992; Elliott & Hall, 1994; 1997; Walker, Elliott & de Lacey, 1994), which was designed to encourage the use of specific teaching strategies and increase teachers’ awareness of the benefits of teaching metacognitively for self-regulation. In some cases deviating markedly from regular teaching practices, the ideas discussed in the training programme enabled teachers to gain some understanding about how deep and surface approaches to learning are developed. This occurs when higher-order cognitive processing is verbalised by the teacher as she or he scaffolds a student’s problem-solving through student/teacher dialogue (see examples of training agenda - Appendix E).

Throughout the training, teachers were shown how to initially engage children in problem-solving activities by helping them to focus on the end goal,
"let's decide what we have to do, where do we have to end up?"

to identify and clarify stated problems,

so..."we have to find a path through each door...."

to plan their actions,

"where should we start?"

to be mindful and purposeful in their problem-solving and to keep children 'on-task' with comments such as,

"have another look... does that look right?... thoughtful move!"

and to evaluate their actions as the task proceeded, for example,

"what made you do it that way....is there another way it could be done?"

Some of the support techniques suggested included direct guidance (telling or showing a child what to do in a particular situation), explanation of tasks (especially used in conjunction with demonstrations and modelling), the use of verbal and non-verbal cues,

"should you try the green piece here?" or [a nod of the head],

direct questioning to clarify thinking,
"are you sure that is where it should go?"; "why did you put the piece over there?",

and demonstrations and modelling, for example,

"look I'll show you where I put mine". "I put it here because it will not balance properly anywhere else".

Instruction enabled teachers to understand that metacognitive thinking is reflective and that development of reflectivity can be enhanced by encouraging children to talk about the work they are undertaking, by linking current problems to activities undertaken in the past and by helping the learner clarify actions and explanations of work at hand. Teachers learnt that when completed tasks are correct, any accompanying praise should be academic and based on the child's explanation and elaboration of the process as well as the finished product. Approximately correct tasks should also be accompanied by positive statements such as:

"almost right", "let's try that again",

but then followed by demonstration of the correct procedures and assistance, finally ensuring successful completion. Unsuccessful attempts must be accompanied by sympathy, encouragement and a clear demonstration of correct procedures before working collaboratively with the child to ultimately complete the task successfully (Elliott, 1991; 1993; 1994a; 1994b; Hall & Elliott, 1992; Elliott & Hall, 1994; Walker, Elliott & de Lacey, 1994).
Study 1: Teaching Sessions

Experimental Group
Following training, the classroom teachers in the experimental groups taught about a variety of mathematical concepts within their regularly programmed mathematics teaching periods. Such concepts however, like number, space and measurement, were taught, experienced and challenged within the classroom using the skills and strategies acquired through the “metacognitive” training sessions. Within every mathematics period programmed students were given strategic instruction where the process of tasks were emphasised and students were encouraged to challenge their own thinking. Over the period of experimentation, mathematics lessons were conducted almost each day.

Control Group
As with the experimental groups, the teachers in the control groups continued to teach a variety of concepts within their regular programmed mathematics classes but without the benefits of “metacognitive” instruction. Instead, these teachers employed "best (teaching) practice" which recognises and caters for the individuality of the child, thereby ensuring professionalism through an understanding of developmental issues pertinent to each child through a developmentally appropriate learning environment. As with the experimental groups, mathematics was generally taught on a daily basis.

Study 1: Data Collection
Study 1 examined changes in students’ performance following a period of experimental teaching where metacognitive, self-regulatory strategies were explicitly demonstrated and used in a whole classroom context. It also explored the nature of teaching “metacognitively” with large groups of children and looked at differences in teaching methods adopted by teachers
following instruction to those adopted by teachers using “best practice”. Both qualitative and quantitative methodologies were used in Study 1, the results of which are currently in press (Ashton & Elliott, in press).

Some of the interesting outcomes of Study 1 have been mentioned because eight of the sixteen children whose behaviours are closely scrutinised to inform the results of Study 2 (four of whom have been discussed in the illustrative case studies), were participants in the experimental teaching program. Participation in such a program is likely to have some bearing on the metacognitive, self-regulatory behaviours of these children. In addition to this, the pre and posttest TEMA 2 (Ginsburg & Baroody, 1990) (Appendices A & B) scores of each child have been examined along with the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children (Harter, 1982; Harter & Pike, 1983) (Appendices C & D).

**Thesis Research - Study 2**

The second study undertaken and reported upon has been for the purpose of this thesis. Study 2 involved the selection of sixteen (16) children from the Sydney schools, whose metacognitive behaviours have been observed and analysed in an attempt to address the three focus research questions noted in Chapter 5. In addition to this four (4) illustrative case studies which describe in considerable detail the behaviours of two (2) pairs of children from the experimental and control classrooms have been prepared. Illustrative case studies have allowed me to present a detailed picture of the type and the frequency of metacognitive, self-regulatory behaviours displayed when undertaking problem-solving tasks. From these behaviours, differences in
learning approaches have been explored and the learning environment of each child compared.

**Study 2: Participants**

Participants comprised eight (8) boys and eight (8) girls, aged five and six years, in their first year of school who had been drawn from the ARC study. Four (4) girls and four (4) boys had previously participated in the experimental aspects of Study 1, while the remaining four (4) girls and four (4) boys had been part of the control group.

**Differences in Achievement**

Furthermore, in order to understand more fully, differences in the achievement levels of these sixteen (16) students which appear to be linked with differences in metacognitive, self-regulatory strategy use, half were selected because of their high achievement and half were underachieving. To control the variables which may influence achievement as much as possible, no child with any discernible physiological or psychological explanation for these differences was chosen to participate in Study 2. In spite of his or her classroom performance up until that time, each child selected had been perceived by the teacher as having similar intellectual potential. Moreover, all children selected were from an Anglo-Celtic or other mainstream cultural background where English was the language spoken in the home. Given the nature of the schools selected for the study and their geographic location, it can be assumed that all children were from a similar socioeconomic background. Nonetheless, students selected as underachieving at the time of the study showed deficits in their academic performance over all subject domains and this was reinforced when the individual results of the TEMA 2 test were reviewed.
Protocol

As previously mentioned, permission to engage selected children in a range of problem-solving tasks for Study 2 was sought and granted concurrently with Study 1. At that time, the nature of the research to be conducted in Study 2 was outlined. Parents were assured that any videotaped segments which detailed the behaviours of individual children would be used exclusively by the researcher for the purposes outlined in this study. Similarly, assurance was also given that transcripts of the dialogue between me (the researcher) and each participant which may be used to illustrate the metacognitive, self-regulatory behaviour observed, would bear pseudonyms, although my identity has obviously not been suppressed. Confidentiality was absolutely guaranteed and children could be withdrawn without penalty from Study 2 at any stage. Within a reasonable period of time following the study, all videotaped data would be erased.

Study 2: Instruments

To discern the type and the frequency of displayed metacognitive, self-regulating strategies as demonstrated by the individual participants in this study, a series of math related tasks, previously devised (DeMestre & Duncan, 1980), and tested by numerous researchers (Amato, Bana, Hughes, Hurst, Penter, & Smith, 1981; Hall, 1983; 1997) in studies dealing with mathematics problem-solving in the early primary years was used.

Firstly, space concepts were assessed using a maze (Appendix F), with a number of openings in both internal and external walls. Children were instructed to find a path through the maze which took them, once only, through every opening. Space concepts were also measured using ten toothpicks, which when laid out, formed three connecting squares (Appendix
G). This problem required children to finish with two squares intact after removing just two toothpicks.

In order to ascertain an understanding of number concepts, children were asked to write in the missing numbers in a numerical triangle (Appendix H) or a numerical sequence chart (for example, 2,4, _,8,10,) or (1,3,5,_,9,) (Appendix I), and to assess mental calculation of number, children were given word puzzles to solve such as,

"If I went for a walk with my dog and my cat, how many legs altogether would we have?" "If my dog only had three legs, how many legs would we have altogether?" (Appendix J).

Measurement concepts were tested by asking children about their own height in relation to others and by asking what might be required to take measurements, how these could be compared with other people and objects familiar to them (Appendix K). Another task required students to complete the mirror image of a one-sided pattern (Appendix L), and finally, students could also have chosen to explain the meaning of a simple graph made up of rows of shapes (Appendix M).

Although students were offered several different tasks from which to choose, in reality some were obviously more appealing than others. While all tasks were attempted at least by one child, only one task (the Maze-Appendix F), was attempted by all sixteen participants. The toothpick task (Appendix G) was the next most popular, attempted by fourteen of the students, and the number triangle (Appendix H) was attempted by eight of the students.
**Study 2: Data Collection**

Qualitative research, especially case studies, most frequently include the use of observation and interview, although no method is necessarily excluded (Bell, 1992; Mc Knight & Sutton, 1994; Santrock, 1995). In this instance data collection methods have included the use of standardised tests, informal discussion with classroom teachers, field notes, videotaped sessions with individual children and observations of videotaped behaviours displayed as children complete a range of mathematical problem-solving tasks.

Several data collection methods have been used in order to provide a comprehensive account of the metacognitive or self-regulatory characteristics of the individual learner. Data on learner characteristics (Study 2), as well as on teachers’ instructional methods (Study 1), were collected in the final term of the 1994 school year. The procedures for obtaining field notes and videotaped data were obviously different in classroom sessions from those with individual students. Students’ use of metacognitive or self-regulatory processes were documented throughout the period of the study using videotapes to record both naturalistic classroom sessions (Study 1) as well as individualised controlled sessions (Study 2).

**Standardised Tests**

The pre and post TEMA-2 test (Ginsburg & Baroody, 1990) (Appendices A & B) raw scores of the sixteen students were prepared and examined (see model in Table 6.1), as were the raw scores measured by the *Pictorial Scale of Perceived Competence and Social Acceptance for Young Children* (Harter, 1982; Harter & Pike, 1983) (see Appendices C & D). The latter test was used to identify students “self” perceptions in a range of areas; namely cognitive competence, physical competence, parental acceptance and peer acceptance.
In order to ascertain the specific characteristics of higher-level thinking which may be indicators of deep or surface learning, the videotaped behaviours of the sixteen participants were analysed using phenomenographic methodologies.

Table 6.2
Study 2: Pre and Posttest TEMA 2 and self-concept recording model:
4 x high achievers plus 4 x low achievers - Experimental & Control groups.

<table>
<thead>
<tr>
<th>TEMA 2</th>
<th>Group A - (n=8)</th>
<th>Group B - (n=8)</th>
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<tbody>
<tr>
<td></td>
<td>Experimental</td>
<td>Control</td>
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<td>Posttest</td>
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<td>Self-Esteem</td>
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_Informal Discussions with Classroom Teacher_

Drawing upon their background knowledge and experience over the previous three terms, informal discussions with classroom teachers allowed a comprehensive picture of each child to be formulated. Although it is the observable learning and problem-solving behaviours of each student that are the subject of examination in this study, it was also helpful to learn a little about their family backgrounds. All but one of the sixteen children for instance came from a two parent family, most parents held professional positions and some were actively involved in their children’s school. Such involvement ranged from leadership positions on the School Council and Parent and Friends Association, to support with reading in the classroom and help at the canteen.
**Videotaping**

Qualitative studies frequently focus on experiences carried on during the normal course of daily events. They are fundamentally concerned with the natural happenings which may impact on social situations, but which are outside the range of variables often identified as being key factors determining educational experience.

Mehan (1993) has stated that because qualitative researchers are interested in “listening” and “watching”, videotape is a most effective medium, enabling an insight into a different version of social life than would otherwise be possible. Mehan goes on to note that videotape allows for a more thorough examination of a range of critical factors which may play a dominant role in the explanation of school performance, an examination which would not be possible through the use of simple observation and recording methods.

Boulton and Smith (1989), have also noted that reliability can also be enhanced through the use of videotaped material as absolute frequency scores and duration scores are readily discernible. Lancy (1993) goes on to note that videotape allows for constant reworking of coding definitions, so that particular elements of behaviour can reliably be coded as one thing and not another. Given that the nature of this current study is to focus on demonstrated metacognitive and self-regulated problem-solving behaviours, the use of videotape to pinpoint specific cognitive behaviours as they relate to problem-solving tasks was an obvious choice.

**Videotaping Individual Children**

The sixteen students who had been selected to participate in Study 2 were videotaped as they engaged in the formerly detailed problem-solving tasks. Each child, whether a previous participator in the experimental or control
group and irrespective of their high or underachieving status, was videotaped for the length of the tasks they completed. Although the number of tasks completed and the length of time taken to complete tasks varied considerably, the average total length of videotaped data for each child was approximately half an hour.

**Videotape Transcriptions**

More than twenty five (25) transcripts of videotaped classroom interactions between teachers and their students (Study 1) (Appendices N & O), and approximately thirty (30) transcripts of videotaped interactions between the sixteen participants and the researcher (Study 2) (Appendix P) provide a significant part of the first-hand data. To obtain the transcripts, videotapes were initially viewed several times in order to select the most relevant sections and the "recording section" times were noted. Once identified, the relevant videotaped sections were then selected by their times and each section was again viewed repeatedly while the information from the dialogues was transcribed.

Approximately 30 hours of videotaped classroom interactions were recorded during the period of Study 1. While some sections of this data were unsuitable for use and were therefore, not selected for transcription, and other sections were only of minimal value, approximately eight (8) hours of videotaped information was transcribed. Such viewing and recording procedures were extremely time consuming and frequently tedious, often taking up to five hours to transcribe just ten (10) minutes of running tape.

Much of the classroom material transcribed has been used to inform the qualitative aspects of Study 1 and has been used to ascertain the differences in teaching approaches adopted by the teachers in the experimental and
control groups, an important consideration of Study 2. Like the classroom interactions, the videotaped behaviours of the sixteen (16) focus students (Study 2) as they engaged in numerous problem-solving tasks were also transcribed. Although all but one student completed numerous tasks, transcriptions were completed for the dialogue displayed on just two (2) of these tasks per student. Even so, each child took between five (5) and ten (10) minutes to work on each task, from the time it was introduced to the students until it was either completed or abandoned due to difficulty or loss of interest. Again, approximately ten (10) minutes of videotape took between four and five hours to transcribe.

*Field Notes*

As the videotaping procedures demanded total concentration during classroom sessions, very few field notes were taken during the data collection of Study 1, although some anecdotal notes were recorded at the end of each day’s observation. As each child undertook the various tasks he or she selected (Study 2), items of interest regarding strategic or affective behaviours were noted (see example - Appendix Q).

*Observations*

Research suggests that detailed observations conducted on individual children over time, enable the compilation of a comprehensive picture of aspects of behaviour and skills (Arthur, Beecher, Dockett, Farmer & Richards, 1993; Beatty, 1990). The purpose of this study has been to observe the cognitive behaviours of children as they engage in a range of problem-solving tasks and to determine, if possible through these observations, the way students perceive learning. Unfortunately, because of their internal nature, "thinking", "wondering" and "reasoning" cannot be directly observed. However, the outward manifestations of these actions can be carefully assessed and
inferences based on theoretical knowledge, can be made from them (Arthur et al., 1993; Beatty, 1990). Although there are numerous ways of conducting observations, chart methods, specifically a checklist, based on established criteria (note Chapter 7, Table 7.3), has been used. By marking a rating matrix (Appendix R) devised from this checklist, the type and range of behaviours over the course of the given task have been established.

Videotaped observations of the focus children (Study 2) engaged in problem-solving activity have allowed their cognitive and metacognitive behaviours to be captured and frozen for repeated viewing. These viewings, together with the transcribed data have meant that both verbal and non-verbal indicators of learning and problem-solving behaviour have been able to be discerned.

**Study 2: Analysis**

Peter Woods (1986), discussing the analysis of ethnographic data for educational research, suggests that some analysis almost invariably occurs concurrently with data collection and that indeed there should be interplay between techniques and stages of gathering research data. Woods argues that while sophisticated analytical theories may have been formulated, some aspects of the behaviour under question may need supportive data to give a more complete picture. Crowley (1995, p.63) believes that “the analysis of qualitative data is a three-step, labour-intensive, ongoing and at times, daunting process, comprising data reduction, data display and an attempt to communicate meaning by showing categories, comparisons, contrasts, interpretations, patterns and themes”.

Similarly, Woods (1986) believes that there are certain aspects of analysis which seem more prominent than others and include speculative analysis, classifying and categorising and theories.
Speculative analysis, according to Woods (1986) and Crowley (1994-1995) is the initial reflection on the behaviours being examined throughout the data collection. With varying degrees of sophistication, recording methods can be formal, involving the use of extensive notes, or more ad hoc, based on an occasional jotting which may be used for example, as a memory trigger. Although these will not comprise the entire analysis, they do connect with other data and with the literature and may indicate a direction for future inquiry.

Classifying and categorising on the other hand, forms the major analysis technique for reading and interpreting the data. Indeed the determination of categories and classifications determined through close examination of children’s learning behaviours, both in the classroom and when undertaking problem-solving tasks with the researcher have been a major focus of this study. Crowley’s (1994-1995) and Woods’ (1986) suggestion that the first step was to identify major categories of behaviour was adopted. Crowley (1994-1995) refers to this as taxonomic analysis which is followed by a componential analysis which may involve the search for attributes in a particular domain. For example, it was hypothesised, given the experience of other cognitive researchers (Brown, 1978; Sternberg, 1990), that students’ problem-solving behaviours could be classified in a similar manner to that displayed in the example which follows:

(1) Identifies problem and determines end goal
   (a) Questions the given instruction
   (b) Clarifies unclear instruction
   (c) Repeats instruction
   (d) Points to start (maze) and finish
   (e) Others
Finally, as Crowley (1994-1995) notes, a thematic analysis which involves the search for relations among domains and how they are linked across the data has also been used. One test of the appropriateness of classifying material in this manner was to determine whether every aspect of displayed behaviours could be accommodated. This was determined by a thorough reading of transcripts and repeated observation of the videotaped material. This study has also sought to investigate the frequency and distribution of behaviours, especially between differing categories of students. For example, underachieving children use some of the problem-solving strategies that higher achieving children do, however they do so far less frequently and with far less consistency.

According to many researchers (Marton, 1988; Prosser, 1993; Ramsden, 1988a) the analysis of specific learning strategies needs to encompass the real actions of learners and may be best detailed under a number of headings. Important to this study are factors such as the (a) quality of the student's performance for example, is the search for information active, or is it rather a passive request for help? (b) the way students structure their actions for example, assessing the number of steps and the time taken to move through a task; and (c) the results of an action or the relationship between actions and the final result for example, the self-evaluation and reflection on methods of task completion and the final outcome.

Encompassing numerous aspects of qualitative analysis, a phenomenographic approach (Prosser, 1993), has been adopted. This suggests that learning is conceived of as a relational phenomenon, that is, "how" learning takes place is inseparable from "what" is actually learned, and through this we can begin to determine the nature of the classroom teaching culture as well as how individuals within the classroom respond. A phenomenographic approach
will enable examination of the extent to which strategies modelled and discussed in the classroom for the explicit purpose of promoting deep learning, are encouraged and displayed by individual children.

The first task of phenomenographic analysis is to reduce data to that which is immediately relevant and distinguishable from that which is not (Marton, 1994). Secondly, ways of understanding (or seeing) need to be explored for similarities. Although there may be varying methods of expression, they may however, reflect a similar way of understanding the same phenomenon. Marton suggests that the most effective way to do this is to take excerpts from transcribed interviews (or videotapes) and to put them into various categorical groups. From the established groups, Marton (1994) then suggests that it is necessary to establish the critical attributes of each group as well as their distinguishing features. In this manner, it becomes possible to relate each attribute and feature to a given criterion in an hierarchical order.

Marton (1994) goes on to say that the categories of description as well as the outcome are the main result in a phenomenographic study and once they are established, they can be reapplied to the data from which they come.

**The Reliability** of phenomenographic analysis is often seen as being questionable and indeed Marton (1994) has raised this issue, arguing that such a question implies that analysis, when viewed in this manner, is seen as a procedure of measurement rather than a procedure of discovery. He does concede nonetheless, that although discovery does not have to be replicable, another researcher should be able to apply in a similar manner, some of the categories of description into a similar hierarchy. Huber and Garcia (1993, p.144) have suggested that during the process of coding, a number of questions must frequently be posed. These might include: “Are the
interpretation rules being used consistently?"; "Are we staying within the limits of our codes or are there overlaps of meaning during interpretation?"; "Are the meanings represented by particular codes found in other text passages?" By using such questioning techniques, Huber and Garcia (1993) argue that not only is the material being interpreted systematically, but the reliability and (content) validity of the study is also likely to be more rigorously maintained.

Despite training, Lancy (1993) notes however, that different observers will still see different things. Consequently, he argues all studies that involve the analysis of observational data must be rated by multiple observers. In most cases observers have been found to agree on most items, although there will inevitably be areas of disagreement in which case definitions may need to be refined to eliminate ambiguity. The level of agreement or concordance between raters is considered satisfactory if it is found to be above .70.

Although some researchers consider reliability and validity to be questionable in qualitative studies, the hierarchical categories established from the data gathered for this study were thoroughly explored and finally determined only after extensive modification following several applications of the criteria upon the data.

When analysing and interpreting information, it is essential to remain objective and to avoid interpreter bias (Arthur et al., 1993; Beatty, 1990). Twenty percent of the collected data were observed by two additional researchers to establish reliability in respect of the strategic behaviours identified. After repeated viewings of the videotaped data, it was finally agreed that four strategic behavioural categories were most frequently displayed, each one characterised by a number of actions. Initially, each time
an action was displayed it was noted, indicating that students may in fact demonstrate in many ways their use of a specific strategy. For example, it is possible that one child may ask a question, nod, concentrate, appear to think, clarify and confirm, three or four times to establish clear understanding (Strategy 1) before proceeding with the next step of a task. Even following several repeated viewings by the observers however, and many attempts to eliminate ambiguity, the results of this method of scoring were ultimately too subjective and reliability was compromised. It was finally decided therefore, that a strategy would be deemed to have been used if one or more of the actions which characterised the strategies were displayed. Reliability was then established with a number of raters and the concordance rate was found to be .85.

**Rating Matrices**

For clarification and recording of hierarchical categories, Miles and Huberman's (1984) suggestions of the use of matrices techniques for conducting data analysis have been adopted. As previously noted a specific matrix has been devised displaying the data identified in the study (Appendix R). These matrices are simple charting techniques which cluster observations during systematic analysis and display the type of use and the frequency of use of specified behaviours.

**Summary and Conclusion**

This study has been conducted in two stages: Study 1, an experimental research project which looked at delivering instruction in the classroom to enhance the use of metacognitive, self-regulating learning strategies; and Study 2, a micro analysis of the metacognitive, self-regulatory behaviours
indicative of deep or surface learning approaches as they are displayed by eight underachieving and eight high achieving students, half of whom participated in the experimental program of Study 1.

The chapter details information regarding participants, protocols and instruments, and regards the way the study has been conducted, providing a rationale for the use of qualitative methodology and in particular, the use of phenomenography and case studies as research tools. Methods of data collection have also been outlined and include testing, discussion with teachers, videotaping and observation. The chapter concludes with information regarding analysis of the data.

In the following chapter (Chapter 7), aspects of Study 1 are noted and the results of Study 2 are recorded, specifically addressing the three research focus questions outlined in Chapter 5. Following that, Chapter 8 looks closely at the metacognitive, self-regulatory behaviours of four pairs of students (2 pairs from each of the experimental and control groups) and details their learning pathologies in illustrative case studies.
Chapter 7

RESULTS

In the previous chapter (Chapter 6) the methodology employed in this study was outlined and phenomenography as a method of investigation was introduced. Phenomenography assists the researcher identify “what has been learned” rather than “how much has been learned” and has been described as “the empirical study of the limited number of qualititative ways in which various phenomena in, and aspects of, the world around us are experienced, conceptualised, understood, perceived and apprehended” (Marton, 1994, p.4425).

In this chapter, “what has been learned” has been assessed by exploring the qualitatively different experiences and understandings of the world, held by and displayed in the behaviours of a number of individual students in their first year of school. Differences in understanding regarding “how the learning has occurred” and “what has been learned” are discernible in the strategic behaviours of individuals when engaged in problem-solving activities and when these have been identified, they have been categorised to form hierarchies related to given criteria.

Recognising that how an individual learns is inseparable from what is experienced and finally understood in the classroom has implications for the way teachers teach and the emphasis or direction given to learning (Gerber, Bolton-Lewis & Bruce, 1995). By adopting a phenomenographic approach, the perspective of the learner in respect to how phenomena have been
interpreted, either as critical points to be memorised for reproduction or as concepts which enhance meaning, has been discerned.

This study has focused on the learning approach and problem-solving behaviours displayed by sixteen children. It is essential however, to place this small sample group within the broader context of the original study from which they were drawn. As discussed in the methodology (Chapter 6), that original study (Study 1) was essentially a quantitative, experimental project which explored possible measurable differences in mathematics scores following a period of specialised teaching intervention. It also sought to determine whether children's use of metacognitive strategies could be successfully enhanced by regular teachers in naturalistic classroom settings.

In Study 1, students from five kindergarten classes (the experimental group, n=133), experienced mathematics instruction using a collaborative teaching/learning model which emphasised the importance of higher-order metacognitive thinking strategies for increased interest, self-monitoring and improved outcomes. A control group was established with four additional kindergarten classes (n = 86), in which mathematics was taught in a more traditional fashion employing “best practice” but without the benefit of the specialised teaching program.

Results of Study 1

While an analysis of the TEMA 2 (Ginsburg & Baroody, 1990) and the *Pictorial Scale of Perceived Competence and Social Acceptance for Young Children* (Harter, 1982; Harter & Pike, 1983) scores for individual children clearly display the uniqueness of students in terms of their mathematical performance and self-concepts, discerning differences on a whole group basis however, is a more complex task. Analysis of the data following the
experimental program of Study 1 shows some difference between pretest and posttest mathematics scores amongst the experimental and the control groups, and between high, average and low achievers. Nonetheless, the overall learning outcomes measured by the TEMA 2 test performance scores after almost one school term of instruction are relatively small.

The descriptive statistics for both the pretest and posttest administrations of the TEMA 2 test are presented in Table 7.1. As can be seen, the mean scores for the TEMA 2 test increased for children in both the metacognitive and the best practice groups following intervention.

Table 7.1
Study 1: Pretest and Posttest Results of TEMA 2 for high, average and low achieving students - Experimental and Control Groups.

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Metacognitive group)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (all students)</td>
<td>133</td>
<td>27.8</td>
<td>6.5</td>
<td>31.5</td>
<td>6.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Achievers</td>
<td>40</td>
<td>35.3</td>
<td>3.6</td>
<td>37.4</td>
<td>4.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Achievers</td>
<td>51</td>
<td>27.9</td>
<td>2.4</td>
<td>31.8</td>
<td>3.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Achievers</td>
<td>44</td>
<td>20.6</td>
<td>2.6</td>
<td>25.6</td>
<td>3.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Best Practice group)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (all students)</td>
<td>86</td>
<td>26.8</td>
<td>5.1</td>
<td>29.6</td>
<td>5.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Achievers</td>
<td>18</td>
<td>33.8</td>
<td>1.5</td>
<td>35.3</td>
<td>5.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Achievers</td>
<td>44</td>
<td>26.95</td>
<td>2.4</td>
<td>29.8</td>
<td>4.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Achievers</td>
<td>23</td>
<td>20.7</td>
<td>2.1</td>
<td>24.6</td>
<td>2.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results of the analysis of covariance shown in Table 7.2, with pretest scores as the covariate, indicates that the difference in learning outcomes between teaching groups was statistically significant \((F= 5.946, p=.01)\).

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>(df)</th>
<th>(SS)</th>
<th>(F)</th>
<th>(Prob&gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Approach</td>
<td>1</td>
<td>63.515</td>
<td>5.946</td>
<td>.01</td>
</tr>
<tr>
<td>Pretest</td>
<td>1</td>
<td>5033.4</td>
<td>417.196</td>
<td></td>
</tr>
</tbody>
</table>

The mean and standard deviation scores for the TEMA 2 pretest and posttests at each achievement level as shown in Table 7.1 indicate increased scores as a result of the six weeks of mathematics teaching, with higher scores evident amongst children in the experimental, metacognitive teaching groups.

The effects that the teaching approach had on the learning outcomes for children of differing levels of academic achievement can be seen in Table 7.3. Data from the 2 x 3 ANOVA indicated a significant main effect for achievement level \((F = 113.90; p < .01)\), and for the teaching approach \((F = 9.21; p < .01)\). The analysis shows however, that interaction between levels of achievement and mode of instruction does not lead to statistically significant differences in learning outcomes.
Table 7.3
Study 1: Learning outcomes by group and achievement level

<table>
<thead>
<tr>
<th>Source of variance</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
<th>Prob&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement</td>
<td>2</td>
<td>3514.45</td>
<td>1757.22</td>
<td>113.</td>
<td>.000</td>
</tr>
<tr>
<td>Teaching App</td>
<td>1</td>
<td>142.16</td>
<td>142.16</td>
<td>9.21</td>
<td>.002</td>
</tr>
<tr>
<td>Approach by ach level</td>
<td>2</td>
<td>8.86</td>
<td>4.43</td>
<td>0.29</td>
<td>.750</td>
</tr>
<tr>
<td>Error</td>
<td>213</td>
<td>3286.05</td>
<td>15.427</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

An examination of the posttest means for children at each level of achievement as displayed in Table 7.1 provides clearer indications of the differences in learning outcomes. In both the best practice and the metacognitive teaching groups, the mean for the High Achieving children is greater than the mean for the Average Achieving children, and the latter group is greater than the mean for the Low Achieving children.

Examinations of the effects of students’ total self-concept (measured by the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children - Harter, 1982; Harter & Pike, 1983) on achievement levels in mathematics, on posttest scores and on interactions between teaching approaches, achievement levels and learning outcomes revealed no significant effects. Furthermore, statistical analysis indicated that there were only very weak or no correlations between perceived academic self-competence and pretest \((r = .1213)\) and posttest \((r = .0903)\) results and no effects of perceived academic self-competence on children’s achievement in pre or posttest mathematics performance as measured by the TEMA 2 test, and no interactions between academic self-concept and teaching approach or learning outcome. In other words, children’s total self-concept and academic
self-concept did not appear to be related to or impact on learning outcomes in mathematics either before or after the instructional period.

As was expected after a six week period of mathematics instruction, there was an overall increase in students’ performance on the TEMA 2 test. Also as predicted, this increase was slightly greater for children in the metacognitive teaching group and there was some tentative support for the contention that lower achieving students benefit most from a metacognitive teaching approach.

In the light of the theoretical base of the study which notes the importance of self-regulatory (metacognitive) mechanisms for enhanced learning, there are two main points of interest in interpreting the results. Firstly, the overall impact of the teaching approach and its apparent differential influence depending upon children’s achievement level, and secondly, the lack of influence of self-concept on performance. Both the influence of the teaching approach and academic self-concept are further discussed in Study 2. Thirdly, an additional matter of interest is the relatively small increase in learning outcomes as measured by the TEMA 2 test performance scores after a considerable period of instruction.

There are several explanations regarding the third point, the relatively small increase in mathematics learning outcomes. Firstly, although consistent with relevant Kindergarten grade curriculum guidelines the content of the mathematics lessons offered during the period of the study may not have offered experiences of the type measured by the TEMA 2 instrument. Monitoring of selected teaching sessions over the study period however, suggested that this was not the case.
A second possible explanation for the relatively small increase proposed by Elliott and Hall (1994) and discussed more recently by Elliott (1997), Macmillan (1997) and Aubrey (1997) suggests that mathematics teaching in the first year of school does not necessarily utilise knowledge of children’s existing performance as a basis for planned learning. Rather, mathematics activities are frequently planned on the basis of the content and sequence of activities in mathematics curriculum documents or guidelines or possibly textbooks. Elliott (in press) reports that teachers in the first years of school (kindergarten and Year 1) in New South Wales, base their teaching on analyses of perceived subject content rather than on clear analyses of children’s knowledge of concepts, skills and processes. Similar findings have been noted by Aubrey (1997) in her study regarding mathematics teaching in kindergarten classrooms and also by HMI (1991; 1992) following the introduction of the national curriculum in United Kingdom schools.

A further explanation has been offered by Pramling (1990) who argues that while learning should focus on children’s conceptions of various phenomena through teaching which aims to determine how children think in order to use this insight as a basis, this type of teaching is rare. She goes on to note that teachers make assumptions and take numerous things for granted, something which (as it turns out) they should not do. For example, teachers often assume that repeated work on different occasions is training in the same skill, albeit given at different times. They see such instruction as contributing to changes in perception, changes which occur gradually over time. Pramling (1990) believes, however, that the purpose of having repeated sessions of connected events is not at all obvious from the child’s point of view, and that to gain knowledge by such teaching sessions, children must be aware of the process of learning, something which rarely happens without training and maturity.
If the assumptions made by the teacher within the classroom are not made the subject of reflection by the children, then the possibility of their understanding is likely to be limited (Pramling, 1990). Children need to develop the conceptions upon which teaching is based, and without which learning problems are almost inevitable, since the most fundamental concepts and types of insight will never have been established.

Although researching within a quantitative paradigm has been deemed an appropriate methodology for Study 1, quantitative analysis has not readily been able to identify great differences, nor indeed where there are differences, their nature and their importance to individual children. From such a study, the antecedents of change and whether or not changes in scores might be the result of self-regulatory activity, gains as a result of maturation, or due to varying teaching emphases given by individual teachers remain unknown. From a quantitative perspective therefore, the precise nature of any learning which may have taken place and possibly contributed to increased scores is problematic. Even when teaching practices include intentional instruction in the use of higher-order thinking strategies, the determination of strategy understanding is imprecise, and such all encompassing results may not be conclusive.

This is not a new phenomenon as Mayer McLain, Gridley and McIntosh (1991) have indicated. They too encountered problems when trying to ascertain the precise nature of metacognitive strategy use on reading tasks. In their studies, the standardised instrument used (the Index of Reading Awareness [IRA]), devised by Jacobs and Paris (1987) was found to be less than adequate as a measure of metacognition and they determined that the
results obtained from it should be considered as but one measure of a portfolio of assessments.

It might of course be assumed that if similar gains were recorded by both groups in this study, then teaching 'metacognitively' in a whole classroom context has, at best, failed to address the personal learning styles of individuals, and is therefore, unlikely to have instilled any metacognitive understanding. An alternative view is that metacognitive understanding, the encouragement of deep learning approaches and self-regulation of the learning process is far too cognitively complex to be acquired within the context of the regular classroom irrespective of the teaching styles adopted. Too much previous research however, (Anderson, 1989; Borkowski, 1992; Palinscar & Klenk, 1992; Pressley, 1995; Rogoff, 1990; Zimmerman, 1994), indicates that a learning environment, rich with the cognitive supports to facilitate higher-order thinking, must facilitate understanding. A more likely assumption, therefore, is that significant understanding about metacognition has been acquired during the course of this experimental programme, especially in classrooms where students were encouraged to perceive the use of such skills as beneficial, relevant and contributing to more successful outcomes. Notwithstanding, it must also be recognised that such cognitive understandings frequently develop steadily over weeks and months of instruction during which time measurable outcomes may initially be slow to reflect the change. While only assumed to be present therefore, in large scale quantitative measures, if an understanding about metacognitive strategies which leads to self-regulation has been gained, it is most likely to manifest itself in the micro actions and discourse of individual children as they engage in learning and problem-solving tasks.
Given then that a single instrument (TEMA 2 experimental/control design) may be insufficient to assess the complexities of higher-order thinking, as Mayer McLain, Gridley and McIntosh (1991) have suggested, a range of procedures have been used to determine children’s use of strategies and these inform the results of Study 2.

**Results of Study 2**

This thesis has explored three major issues relating to the usage of metacognitive, self-regulatory strategies (refer to Chapter 5). Firstly, it has sought to determine whether children in their first year of school actually use strategies to assist learning and if so, the type and nature of strategies used. Secondly, a range of internal and external factors such as attention, motivation, self-concept and the learning environment, coupled with strategic problem-solving behaviours have been carefully explored. By linking a range of characteristics, students’ perceptions about learning as a deep or surface endeavour have in some cases been revealed. Thirdly, the study has sought to ascertain differences in the learning and problem-solving behaviours between high and low achieving children and between children who had previously participated in the experimental teaching sessions (Study 1) and those from the control groups.

Irrespective of their current performance outcome, each child selected for Study 2 was perceived to have the potential ability to achieve academically at an average or above average level. Nonetheless, as is characteristic of all students, the children in this study were more dissimilar in personality and behaviour than they were similar, a fact displayed in their actions and dialogue. As students’ behaviours and problem-solving dialogues were examined and categories suggestive of self-regulation were determined, some
commonalities in behaviour also emerged. Examination of the raw data gathered on each child during Study 1 confirms the differential nature of the performance outcomes of the students selected for Study 2 (Table 7.4), especially the scores of the high and low achievers on the TEMA 2 test.

Table 7.4
Study 2: Pre and posttest scores of TEMA-2 test and Self-concept means for High and Low achieving students

<table>
<thead>
<tr>
<th>TEMA 2</th>
<th>Group A (n=8) Experimental</th>
<th>Group B (n=8) Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 1</td>
<td>44</td>
<td>L 2</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Pretest</td>
<td>44</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>39</td>
<td>23</td>
</tr>
<tr>
<td>S-Esteem (total 96)</td>
<td>79</td>
<td>82</td>
</tr>
</tbody>
</table>

Determining Strategic Behaviours

Introduction

While all students (8 high and 8 low achievers) observed in this study displayed some strategy use, there were significant differences in the understandings of individual children about their use and efficacy, some of which are detailed further in later case studies. When examining learning from a phenomenographic perspective or determining what has been learned rather than how much has been learned, it was important to first identify the type and range of strategies used most frequently by the participants along with the behaviours typical of each (Table 7.5). Although many strategic behaviours require only low-order cognition (for example, the use of mnemonics and rote memorisation), more complex strategic behaviours require the use of higher-order, metacognitive understanding. The frequent use of such strategic behaviour is believed to be a clear indicator that learning is perceived as an important activity worthy of any extra effort involved (Paris & Byrnes, 1989; VanLeuven & Wang, 1991).
Secondly, a hierarchy was conceived indicating the degree to which strategic behaviours contributed to academic outcomes, self-regulation and learning approaches. In conjunction with this, a range of other factors both intrinsic as well as extrinsic to the learner was determined. Some of these factors such as motivation, self-esteem and the teaching environment have been deemed to be crucial in the development of higher-order thinking skills and approaches to learning (Biggs & Moore, 1993; McCarthy & Schmeck, 1988; Pintrich & DeGroot, 1990). From a phenomenographic perspective therefore, students displaying positive attributes such as high strategy use, self-regulation, intrinsic motivation and strong self-concepts were understood to perceive learning as a pursuit for meaning (deep learning approach). Students displaying less positive attributes were frequently perceived as adopting quite a different approach to learning, perhaps as the means to completion of a set of skills or tasks to meet institutional requirements (surface approach).

Following observation of the videotaped data gathered over several weeks in both classroom and individual sessions, the strategic behaviours used by the students were discerned. Subsequent to this, the videotapes were again viewed and each students' self-regulatory actions were checked and categorised using the hierarchical criteria set out in Table 7.9.

**Basis of Task Analysis to Determine Strategy Use**

Numerous researchers (Brown, 1978; Brown & Campione, 1984; Sternberg, 1990) have previously identified many of the major metacognitive processes believed to be of particular importance to successful learning and problem-solving. Brown (1978) for example, nominated five processes, namely: (a) planning the next move; (b) monitoring the effectiveness of steps in a strategy; (c) testing the strategy as it is performed; (d) revising the strategy when necessary; and (e) evaluating to determine effectiveness. Sternberg
(1990, p.121) determined that there were ten higher-order control processes or *metacomponents*. According to Sternberg these metacomponents are: (1) recognition of the problem; (2) definition of the problem; (3) selection of lower-order, non executive components; (4) selection of a strategy for task performance; (5) selection of one or more mental representations for information; (6) decisions about material to be attended to; (7) monitoring or keeping track - what has been done, what needs to be done; (8) understanding internal and external feedback concerning the quality of task performance; (9) knowledge of how to act on that feedback; and (10) implementation of action as a result of the feedback.

While detailed and specific, Sternberg’s (1990) metacomponent list was inappropriate for use with the very young children in this study. Five and six year olds are unable in most cases to articulate how they have been able to arrive at a conclusion and why certain actions have been performed. Therefore, in order to determine the character of the metacognitive, self-regulatory strategies employed by the participating students in this study, Brown’s (1978) less detailed list was preferred and employed as a guide, although consideration of Sternberg’s (1990) metacomponents has also been given.

As noted in the methodology (Chapter 6), videotaped data of children undertaking problem-solving tasks were repeatedly viewed to ascertain the range of metacomponents or types of metacognitive strategies most frequently used and from which the recording matrix was developed (Appendix R). Several strategic behaviours were identified but after conferring with two other observers, it was decided that four rather than Brown’s (1978) five metacomponents or metacognitive strategies most typified the behaviours of the children in this study (Table 7.5). Rather than
being represented by just one action however, each of the metacomponents were characterised by several verbal and non-verbal actions or components.

These four strategies (Identifying the problem; Planning the task; Self-monitoring activity; and Reflection or Evaluation) were deemed to be representative of the self-regulatory behaviours displayed by the kindergarten-aged students in this study. Although appearing to logically follow one another, such behaviours of course are frequently not sequential at all. One of the features of self-regulation is that behaviours such as questioning, clarifying, planning and self-monitoring may be present at any point during the undertaking of a task. After repeated observation of the videotaped problem-solving behaviours of each of the sixteen participating students, the presence of any verbal or non-verbal strategic action was noted on the matrix check list (Appendix R), and calculated as frequencies of metacognitive, self-regulating strategy use.
Table 7.5
Study 2: Strategies and Strategy Components

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Strategy Components</th>
</tr>
</thead>
</table>
| 1. Identifies and Clarifies the Problem | (a) Questions teacher about problem  
(b) Clarifies objectives with questions or comments  
(c) Seeks confirmation by questions or comments  
(d) Attends to explanation and direction when task explained |
| 2. Establishes End Goal & Plans Task | (a) Points or moves finger or pencil when planning moves  
(b) Verbally outlines plan e.g. I'll go there!  
(c) Verbally or non-verbally considers alternatives  
(d) Questions, states, confirms or indicates non-verbally the final goal |
| 3. Self-Monitors Performance     | (a) Non verbal - thinks about problem  
(b) Self-questions  
(c) Discusses problem  
(d) Concentration to meet task demands  
(e) Attends to task  
(f) Changes strategy if necessary  
(g) Checks previous move, assesses next move  
(f) Retraces steps when error found |
| 4. Reflects on Task              | (a) Reviews elements or entire task  
(b) Challenged to consider performance - may review strategy |

Strategic behaviours were observed from the point at which the researcher began to explain the objectives of the task to the student. A strategy was deemed to have been present if one or more of its components were evident over the entire course of the task. An initial analysis calculating the precise number of times an aspect or component of each strategy was used over each task proved to be too subjective even when examined by a team of independent raters (refer to section on reliability - Methodology, Chapter 6).
Strategy 1 - Identifying the Problem

Four components thought to be representative of this strategy were identified as: (a) questioning, (b) clarification, (c) confirmation, and (d) concentration. The questioning component of the strategy was thought to have been used if for example, students asked questions such as;

"Do you mean I should go here?"

Examples of the clarification component might have included;

"That way?" or "Did you say over there?"

and the confirming component may have been deemed to be evident if statements such as;

"So I have to go through there!" were used.

If the child attended with concentration as the task was explained perhaps alternately looking at the task and the researcher, perhaps nodding the head or indicating concentration by some other clarifying gesture, then the strategy was deemed to have been used.

Strategy 2 - Planning the Task

As with Strategy 1, four components were identified for Strategy 2. These were (a) pointing to indicate direction where the child possibly moved a finger through task or hovered over aspects of task, (b) verbally planning moves for example discussing with self saying:

"if I go there...perhaps I should..."
(c) verbal or non-verbal consideration of *alternatives* for example, by saying:

"should I go there or over there?"

or possibly exploring different avenues of the problem with the finger or pointer, and (d) questioning, stating, confirming or otherwise indicating non-verbally that a plan had been formulated to move toward the final *goal*.

**Strategy 3 - Self-Monitoring the Task**

Self-monitoring a task requires the meeting of a range of cognitive demands and this was distinguished by eight strategic components, either verbal or non-verbal, or a combination of each such as (a) *thinking* about the task as it proceeds, (b) *attending* to the task demands, (c) *self-questioning* to clarify or confirm issues pertinent to the task, or using egocentric or inner speech, (d) *discussion* of the task as it proceeds with the researcher, (e) intense *concentration* on aspects of the task demands, (f) *changing* actions as task proceeds if a previous action proves to be unsuccessful, (g) *checking* previous moves and assessing future moves, and (h) *retracing* steps to the point of error if mistake was identified.

**Strategy 4 - Reflection and Evaluation**

Self-regulation of the learning/problem-solving process also needs to contain a reflective or evaluative element if students are to move forward in their metacognitive understanding. Just two components were observed as being characteristic of the final strategy; (a) a *review* of elements of the completed task, either verbally or non-verbally, and (b) a *challenge* to previous ways of thinking, reflecting on what might be possible on future occasions. Children
who challenged their performance stated how they might change or modify the behaviours performed on the last task completed.

**Observable Strategic Behaviour**

The results suggest that most young children in the first year of school, irrespective of their performance outcomes, show a complex range of cognitive behaviours some of which appear to be used to facilitate problem-solving and possibly learning. Of significant interest to this study is that while all children displayed some metacognitive activity, just a few of the children participating in the study used them to full advantage. Only two of the sixteen participants in Study 2 attempted to fully regulate their own learning and problem-solving however, it is hardly surprising that a greater number had not yet acquired a measure of self-regulation given that self-regulation takes time to develop and is enhanced with maturity. The children who did attempt to manage their own learning and problem-solving demonstrated extraordinarily well their ability to regulate their thinking and actions. Others displayed a combination of self- and teacher-directed behaviours to accomplish the given tasks.

While it was evident that some children used the full range of strategies to effect a successful outcome, others were successful with little *apparent* strategy use at all. In a similar manner, while some children appeared to apply a range of strategies, their outcomes were as unsuccessful as those students who appeared to use very few strategic behaviours. Caution should be exercised however, when making assumptions about observable strategy use, noting that *appearance* is a key word when discussing such behaviours. Cognitive and metacognitive thinking and processing are in fact not observable at all unless they are accompanied by action or verbalisation, some of which is contingent upon the personality of the individual. Children
who by nature or training are expressive may be more likely to discuss and question aspects of a task, while others more reserved, may nonetheless apply strategies which do not appear to have any accompanying discourse or observable action. Therefore, while the following results (Table 7.6) on the one task attempted by all children (the maze) show observable strategic behaviours, other hidden responses may also exist.

**Table 7.6**
**Study 2: Observable Frequencies of Strategy Use on Maze Puzzle for High and Low Achieving Students**

<table>
<thead>
<tr>
<th>Strategy 1 - Establish Problem</th>
<th>Experimental (n=8)</th>
<th>Control (n=8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questions</td>
<td>Hx4: 2, Lx4: 1, Hx4: 2, Lx4: 1</td>
<td></td>
</tr>
<tr>
<td>Clarifies</td>
<td>Hx4: 3, Lx4: 1, Hx4: 2, Lx4: 1</td>
<td></td>
</tr>
<tr>
<td>Confirms</td>
<td>Hx4: 2, Lx4: 1, Hx4: 1, Lx4: 1</td>
<td></td>
</tr>
<tr>
<td>Concentrates</td>
<td>Hx4: 2, Lx4: 2, Hx4: 3, Lx4: 2</td>
<td></td>
</tr>
<tr>
<td><strong>Total Strategy 1</strong></td>
<td>9</td>
<td>5</td>
</tr>
</tbody>
</table>

**Strategy 2 - Planning Task**

| Points                        | Hx4: 2, Lx4: 1, Hx4: 1, Lx4: 1 |              |
| Plans move                    | Hx4: 2, Lx4: 2, Hx4: 2, Lx4: 1 |              |
| Alternatives                  | Hx4: 2, Lx4: 1, Hx4: 1, Lx4: 1 |              |
| Goal                          | Hx4: 3 |              |
| **Total Strategy 2**          | 9                 | 4            |

**Strategy 3 - Self-Monitoring**

| Thinks                        | Hx4: 3, Lx4: 1, Hx4: 2, Lx4: 1 |
| Attends                       | Hx4: 3, Lx4: 1 |              |
| Self Questions                | Hx4: 3, Lx4: 1 |              |
| Discusses                    | Hx4: 3, Lx4: 3, Hx4: 1, Lx4: 1 | |
| Concentrates                  | Hx4: 3, Lx4: 1, Hx4: 1, Lx4: 1 | |
| Change                        | Hx4: 3, Lx4: 1, Hx4: 1, Lx4: 1 | |
| Checks                        | Hx4: 2, Lx4: 1, Hx4: 2, Lx4: 1 | |
| Retrace                       | Hx4: 3, Lx4: 2, Hx4: 1, Lx4: 1 | |
| **Total Strategy 3**          | 21                | 10           |

**Strategy 4 - Reflection**

| Review                        | Hx4: 3, Lx4: 3, Hx4: 3, Lx4: 1 |
| Challenge                     | Hx4: 1, Lx4: 2 |              |
| **Total Strategy 4**          | 4                 | 3            |
| **Total Strategies Overall**  | 43                | 22           |


Similar results have been found when examining the findings on the toothpick tasks, although only fourteen (seven from each group) of the children attempted this puzzle (see Table 7.7).

Table 7.7
Study 2: Observable Frequencies of Strategy Use on Toothpick Puzzle for High and Low Achieving Students

<table>
<thead>
<tr>
<th>Strategy 1 - Establish Problem</th>
<th>Experimental (n=7)</th>
<th>Control (n=7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questions</td>
<td>Hx4</td>
<td>Lx3</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Clarifies</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Confirms</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Concentrates</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Strategy 1</strong></td>
<td><strong>7</strong></td>
<td><strong>5</strong></td>
</tr>
</tbody>
</table>

Strategy 2 - Planning Task

<table>
<thead>
<tr>
<th></th>
<th>Experimental (n=7)</th>
<th>Control (n=7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Plans move</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Alternatives</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Goal</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total Strategy 2</strong></td>
<td><strong>6</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

Strategy 3 - Self-Monitoring

<table>
<thead>
<tr>
<th></th>
<th>Experimental (n=7)</th>
<th>Control (n=7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thinks</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Attends</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Self Questions</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Discusses</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Concentrates</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Change</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Checks</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Retrace</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Strategy 3</strong></td>
<td><strong>16</strong></td>
<td><strong>10</strong></td>
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</tbody>
</table>

Strategy 4 - Reflection

<table>
<thead>
<tr>
<th></th>
<th>Experimental (n=7)</th>
<th>Control (n=7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Challenge</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total Strategy 4</strong></td>
<td><strong>4</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>

**Total Strategies Overall**

<table>
<thead>
<tr>
<th></th>
<th>Experimental (n=7)</th>
<th>Control (n=7)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>33</strong></td>
<td><strong>20</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

The results on the maze and toothpick tasks show that more strategic behaviours have been used by the high achieving students overall. They also
indicate that the students from the experimental group, irrespective of their achievement level, tend to use strategic behaviours more consistently over the same tasks than the students in the control group.

Table 7.8  
Study 2: Observable Frequencies of Strategy Use on Number Triangle for High and Low Achieving Students

<table>
<thead>
<tr>
<th>Strategy 1 - Establish Problem</th>
<th>Experimental (n=4)</th>
<th>Control (n=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hx3</td>
<td>Lx1</td>
</tr>
<tr>
<td>Questions</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Clarifies</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Confirms</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Concentrates</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Strategy 1</strong></td>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>

Strategy 2 - Planning Task

<table>
<thead>
<tr>
<th></th>
<th>Hx3</th>
<th>Hx2</th>
<th>Lx1</th>
<th>Lx2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Plans move</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternatives</td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Goal</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Strategy 2</strong></td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Strategy 3 - Self-Monitoring

<table>
<thead>
<tr>
<th></th>
<th>Hx3</th>
<th>Hx2</th>
<th>Lx1</th>
<th>Lx2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thinks</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Attends</td>
<td>2</td>
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<tr>
<td>Self Questions</td>
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<tr>
<td>Discusses</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Concentrates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>1</td>
<td></td>
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<tr>
<td>Checks</td>
<td>2</td>
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<td>1</td>
<td></td>
</tr>
<tr>
<td>Retrace</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Strategy 3</strong></td>
<td>11</td>
<td>3</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

Strategy 4 - Reflection

<table>
<thead>
<tr>
<th></th>
<th>Hx3</th>
<th>Hx2</th>
<th>Lx1</th>
<th>Lx2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Challenge</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Strategy 4</strong></td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Total Strategies Overall        | 27  | 6   | 11  | 8   |
Although the results from the third most frequently attempted task, the Number Triangle (Table 7.8), are not quite so supportive of this trend, they are discussed later in the results.

As can be seen from the preceding tables (Table 7.6, 7.7 and 7.8), of the eight (8) students (four experimental, four control) who had formerly been identified as high achievers, most demonstrated considerably greater use of metacognitive strategies and self-regulatory behaviours, than their lower achieving peers. This of course is consistent with the research (Borkowski, Weyhing & Turner, 1986; King, 1989; Pressley & Ghatala, 1990) which suggests that two of the most significant factors in the academic outcomes of students appear to be a knowledge about as well as the consistent use of higher-order learning and problem-solving strategies.

Given that expert learning is most likely to occur under the guidance and direction of someone with superior knowledge and transfer skills, it is conceivable that these children have developed as proficient early learners either at home or possibly at daycare or preschool within a sociocultural milieu which has supported higher-order mental functioning. While it does appear that some students almost inherently develop the ability to function cognitively at a higher level than others, Biggs and Moore (1993) argue that the antecedents of higher-order thinking like lower-order thinking are more conceivably found in a student’s environment.

Nevertheless, successful academic performance is just one of a range of outcomes evident amongst children who frequently use metacognitive strategies for learning and problem-solving. Pramling (1990) notes that understanding about tasks cannot be separated from performance on tasks, therefore, the perception of learning held by each student regarding its
purpose and relevance may be equally as important as current outcomes. Students who employ complex cognitive strategies as tools to monitor their thinking for personal meaning and understanding tend to perceive learning in a qualitatively different manner to students who adopt simple lower-order strategies. Efficient self-monitoring students, it may be assumed, function at a deeper cognitive level to incorporate newly acquired knowledge into existing schemata which when required, is able to be sought and retrieved. By understanding the nature of the strategic behaviours used by the children in this study in conjunction with a number of other factors, it is possible to explore a little more the pathology of deep and surface learning.

**Deep and Surface Learning Approaches**

**Strategic Behaviours**

Students who only hold a modest repertoire of strategies also tend to use them infrequently and often without significant effect according to Biggs (1988b). Biggs also suggests that for many of these students, strategic behaviour is usually directed toward remembering facts rather than for the transfer of information for new insights and meaning. From a phenomenographic perspective, if the learning outcome or learning’s perceived objective is expressed in problem-solving behaviours, then in all likelihood these students are probably developing surface views of learning. Conversely, Biggs (1988b) notes that students who approach problem-solving situations armed with a range of self-regulating strategies which ensure maximum task engagement for enhanced understanding and meaning, may well hold or be in the process of developing as deep learners. Competent strategic behaviour alone however, is rarely enough to transform a child’s learning orientation from a surface to a deep approach. There are numerous other factors inherent in the behaviour of effective and poor learners alike which this study has sought to explore.
Other Factors Inherent in Determining Learning Approaches

Although the nature and frequency of strategy use is important there are numerous other variables present in the pathology of the learner which consistently contribute to a hierarchy of learning behaviours and are indicative of deep or surface learning. Some of these factors are inherent within children and include attention, motivation, self-concept and levels of development (Biggs & Collis, 1982). Added to this however, are factors external to students like the teaching environment and classroom instruction which activate interest at a deep or superficial level.

Pressley (1995), Rogoff (1990) and others suggest that instruction must always be matched with students’ current levels of understanding, and then moved beyond that point through the zone of proximal development (ZPD) for greater insights and learning. The teacher’s role in determining zones of proximal development will be different for each child within the class and requires skill and dedication beyond her ability to impart knowledge about facts, coupled with an understanding of the procedures required for efficient learning. Efficient learning is also unlikely to occur without a degree of modelling and explanation of mature thought, coupled with an opportunity for practice with interesting and relevant materials. Together then, a range of factors both intrinsic and extrinsic to the learner contribute to the hierarchy of conditions and outcomes indicative of deep or surface approaches to learning (detailed in Table 7.9).
### Table 7.9
Study 2: Hierarchy of Characteristics - Deep and Surface Learners

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Deep Learners</th>
<th>Surface Learners</th>
</tr>
</thead>
</table>
| **Learning Outcomes**            | • Perceive learning as understanding  
• A holistic or open approach  
• Self-regulating, metacognitive | • Perceive learning as memorisation  
• Assessment orientated  
• An atomistic or closed structure  
• Minimal or poor strategy use |
| **Strategy Use**                 | • Developed higher-order thinking skills - set goals, plan, organise, rehearse  
• Actively construct knowledge  
• Seek and retrieve information in task domain  
• Monitor involvement in task  
• Make / focus on strategic plans  
• Revise domain knowledge | • Disrupted organisational and planning abilities  
• Prefer low-level routines to complex strategies e.g. rehearsal  
• Taught strategies cannot be generalised |
| **Attention**                    | • Translate knowledge into performance through use of strategies  
• Select relevant aspects of tasks | • Often poor on memory tasks - attend to whole rather than relevant aspects of tasks |
| **Motivation**                   | • Intrinsically motivated  
• Learning or task oriented, valued as ends in themselves  
• Value effort and challenge  
• Motivated to use deep-processing strategies | • Extrinsically motivated  
• Performance or ego-oriented, based on other’s standards  
• Preoccupied with ability - equate high effort with low ability  
• Minimal strategy use - not worth effort |
| **Self-Concept**                 | • Positive self-concepts  
• Such students tend to use deeper, more elaborate strategies | • Often negative associated with poor academic performance  
• Anxious, fear failure, impulsive, desire self-assurance, high need for approval  
• Students tend to use shallow, repetitive strategies |
| **Learning Environment**         | • Sociocultural, collaborative  
• Cognitive strategies taught and regularly modelled  
• Scaffolded thinking  
• Encourages self-regulation  
• Students encouraged to “find out why and how”  
• Focus on ‘assisted discovery’ | • Often didactic  
• Emphasis on mastery of skills and facts  
• Students encouraged to focus on the “what” of lessons  
• Developmentally Appropriate Practice with focus on ‘self-discovery learning’ |
| **Perceptions of Learning Goals**| • Provide tools for thinking beyond classroom  
• Transfer concepts to novel situations  
• Discovery of meaning  
• Inter-relates with existing knowledge | • To meet institutional requirements  
• Rote learning of facts and skills for future reproduction  
• Learning seen as means to end |

Strategy Use as Indicators of Deep or Surface Learning Approaches
As previously noted, the students who had been classified as high achievers also displayed considerably higher frequencies of strategic behaviour per task than the lower achieving students. That is not to say that all high strategy users were high achievers as is demonstrated clearly by Susie (see Susie in Case Study 2). Initial impressions of Susie’s behaviour suggested that she employed a number of metacognitive strategies to facilitate understanding. Repeated observations of her behaviour however, revealed that she was insecure in her understanding and that rather than enhance her ability to solve problems, the questioning techniques used were designed to ensure that she met the researcher’s demands. Nor, of course were all high achievers high strategy users (see Anna in Case Study 2). Anna for example, noted as a high achiever by her teacher, accomplished the tasks she chose with ease displaying little or no observable strategic behaviour.

Generally speaking, deep learners have been found to use more higher-order strategic activity in their learning/problem-solving behaviour than surface learners. One of the characteristics of deep learners is that they are more proficient than other learners at actively making and focusing on cognitive plans to facilitate the construction of knowledge by assimilating and accommodating past knowledge with aspects of the task being undertaken. Surface learners on the other hand, are often deficient in this area and prefer low-level routines such as rote memorisation to more complex strategies which can be generalised and transferred across domains.

Linking High Strategy Use and Deep Learning
Just as there were anomalies in the strategic behaviours of some children, in some cases there were also definite links between strategy use and learning approaches. In one example (see Andrew in Case Study 1), the strategic
behaviours employed were clearly indicative of the deep learning approach which Andrew adopted. It was very apparent that Andrew viewed learning and problem-solving as a process, not merely as a means to an end. He used metacognitive strategies to fulfil his purposes, as tools through which real understanding might be gained. This involved considerable discussion with the researcher in order that he might clarify his understanding, plan moves clearly, cognitively monitor the task demands and finally reflect on the whole. Similarly, Martin (Case Study 3) was clearly a strategic learner, demonstrating his pleasure at being able to purposefully engage in the process of tasks rather than merely suffer the necessity of having to do them. He was attentive and highly motivated to invest energy into the use of metacognitive behaviour as much for the enjoyment of meeting the challenge as of reaching a successful completion.

It is clear then that several students, generally those identified as high achievers, already appear to have developed the deep level, higher-order thinking skills which enable them to set goals, plan, organise and in most cases, successfully complete tasks. They have demonstrated that they are active constructors of their own knowledge as they seek and retrieve information within the task domain.

**Linking Low Strategy Use with Surface Learning**

Just as the link between high strategy use and deep learning was in many cases quite clear, there were definite links between low strategy use and surface learning as well. Some students for example, appeared to be more concerned with the duty of completing each task to meet the requirements of the researcher than with personal engagement in order to gain understanding. Where this occurred, strategy use was generally minimal, a characteristic of surface learning. There were exceptions of course and some displays of
moderate strategy use was apparent amongst low achievers. Notably though, strategic behaviour is time consuming and requires considerable mental effort, and many children are loathe to invest time in activities perceived as being beyond their level of understanding or ability. While each student selected for Study 2 was thought to have the potential to achieve at a moderate to high level, some of the low strategy users attended poorly to instruction and were more anxious to complete tasks than to engage in challenging activity. As mentioned previously, although Susie, a low achiever, continuously discussed the goals of the tasks, repeated observations of her videotaped segments, showed that her strategic use of questioning was possibly no more than a tool for dealing with her personal insecurity. It became clear that her behaviour was aimed at ensuring that she provided the "right answer", not as a strategy designed to provide her with greater understanding (see Case Study 2). In most cases where strategy use was minimal, students tended to display disrupted organisational and planning abilities, preferring low-level routine actions (listening to explanation and engaging in task), to investing time and effort in complex strategies (clarifying issues, planning moves and monitoring own actions).

The following tables (Tables 7.10 & 7.11) show the observed strategic behaviours and problem-solving outcomes of the sixteen students in the study. These tables have identified outcomes as either successful or unsuccessful attempts at solving problems. Such superficial achievement outcomes however, suggest that the primary goal is successful completion of tasks. Of greater significance though, and critical to the phenomenographic analysis of this study, is to view outcomes in terms of approaches to learning. The actual learning outcomes of students using higher-order thinking skills and self-regulating, metacognitive strategies, are likely to be the quest for transferable knowledge and deep understanding. For students using fewer,
low-level strategies, learning outcomes are likely to be pragmatic and assessment oriented.

Table 7.10
Study 2: Strategic Behaviours and Problem-Solving Outcomes Displayed by Students from Experimental Group

<table>
<thead>
<tr>
<th>CHILD</th>
<th>OUTCOMES</th>
<th>STRATEGIC BEHAVIOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrew (H)</td>
<td>Maze, Toothpick, Numbers, Others - Successful in all areas. Perceives learning as understanding</td>
<td>Has developed higher-order thinking skills. Set goals, plans, monitored &amp; reflected on task. Entirely self-monitoring</td>
</tr>
<tr>
<td>Timothy (L)</td>
<td>Maze only, Unsuccessful</td>
<td>Used most strategies at minimal level. Low-level routines. Don’t enhance understanding</td>
</tr>
<tr>
<td>Anna (H)</td>
<td>Maze, Toothpick, Numbers, Others Successful except for numbers</td>
<td>Low observable strategies, but cognitive behaviour not always visible. Strategies effective enough for success.</td>
</tr>
<tr>
<td>Susie (L)</td>
<td>Maze, Toothpick, Unsuccessful both tasks</td>
<td>High strategy use, especially questioning for reassurance rather than to enhance performance. Nervous</td>
</tr>
<tr>
<td>Andrea (H)</td>
<td>Maze, Toothpick, Others Maze unsuccessful, Toothpick successful</td>
<td>High strategy user, verbal and non-verbal. Made and focused on strategic plans, monitored own performance</td>
</tr>
<tr>
<td>Helena (L)</td>
<td>Maze, Toothpick - Maze unsuccessful, Toothpick successful</td>
<td>Low observable strategies, almost none evident on toothpick task.</td>
</tr>
<tr>
<td>Larry (H)</td>
<td>Maze, Toothpick, Numbers Successful all areas</td>
<td>Extremely high strategy use. Higher-order thinking skills articulated clearly</td>
</tr>
<tr>
<td>Amos (L)</td>
<td>Maze, Toothpick, Numbers - Successful toothpick &amp; numbers unsuccessful.</td>
<td>Very quiet, some observable strategies. Given time tasks completed.</td>
</tr>
</tbody>
</table>
Table 7.11  
Study 2: Strategic Behaviours and Problem-Solving Outcomes Displayed by Students from Control Group

<table>
<thead>
<tr>
<th>CHILD</th>
<th>OUTCOMES</th>
<th>STRATEGIC BEHAVIOUR</th>
</tr>
</thead>
</table>
| Martin (H) | Maze, Toothpicks, Others  
Extremely successful all tasks | Very articulate, displayed considerable strategy use. Set goals, plans, monitored and reflected. Entirely self-monitoring. |
| Wendy (L) | Maze, Toothpicks, Numbers  
Maze & Numbers unsuccessful  
Toothpick successful | Only concentration observed. Teacher directed reflection. No other dialogue.         |
| Dara (H)  | Maze, Toothpicks, Numbers  
Toothpicks & numbers successful, maze unsuccessful | Tasks completed in almost silence. Concentration when explanation given. Few other strategy behaviours observable. |
| Daniel (L) | Maze, Toothpicks, Numbers  
Toothpick successful  
Maze & numbers unsuccessful | Intense concentration but few discernible strategies                                |
| Kim (H) | Maze, Toothpick, Others  
Most attempted puzzles successful | Very articulate, impetuous. When settled used range of strategies to successfully plan & execute. |
| Natalie (L) | Maze, Toothpick, Others  
Unsuccessful all tasks | Few observable strategies. Answered questions but otherwise little dialogue.       |
| Kevin (H) | Maze, Toothpicks  
Both activities successfully completed | Some strategic behaviour, especially with maze. Clear goals, plans move.          |
| Liam (L)  | Maze, Toothpick, Numbers, Others -  
Toothpick successful  
Maze & numbers unsuccessful | Few observable strategies, although adopted trial and error approach.             |

Attention and Motivation as Indicators of Deep or Surface Learners

Attention

Although each student attended to the tasks as explanations were given, attention and concentration levels varied while students attempted to translate knowledge into performance as tasks proceeded. Simple attentive behaviour, although in many respects difficult to assess, was evident when children concentrated during explanation of tasks and as tasks were undertaken. Of
greater consequence however, and more easily discernible were the attentive behaviours evident when children questioned aspects of the tasks, clarified concerns and verbally outlined their thoughts.

In general, the students who were successful in their problem-solving efforts not only used a greater range of thinking strategies but directed their attention more meticulously and concentrated carefully to select relevant aspects of tasks for their ultimate conclusion. For these children, attention focused on the translation of the knowledge they already possessed about spatial and numerical problem-solving into a successful practical outcome through the use of planning and performance strategies. Generally, students who were unsuccessful on tasks appeared to adopt quite a different approach to problem-solving, in many cases attending minimally until the demands of the tasks became known, after which time attention varied according to the individual. In most cases however, rather than clarifying concerns, establishing goals and planning moves, effort was simply directed toward task completion.

Motivation
There were also differences in motivation evident amongst children, although this was an even more difficult attribute to discern. In some cases it was obvious that children valued effort and challenge as ends in themselves. Such students engaged in activity with enthusiasm and a sense of fun, eager to take up the challenge of a novel task. One child devised a metaphor for the task noting that the Maze was,

"like a treasure map", 
thereby demonstrating his personal engagement. To some children the process of the exercise appeared to be the most important aspect of it rather than its successful completion. Ironically, but not surprising, while the process-orientation displayed by some students appeared to suggest that correct answers were subordinate to engagement in the task itself, the performance outcomes were often more successful than those of the children concerned with academic correctness.

For other participants in this study, while initially enthusiastic about their selection for “special attention”, their motivation wavered when the demands of the tasks required of them became known. In the case of some of the underachieving students, perhaps recalling their previous experiences with academic failure, the presented tasks represented just another classroom chore to be completed to meet the demands and expectations of the school. For students like this, the motivation to expend time and effort making strategic plans and monitoring performance is frequently absent. Often linked to attributions regarding ability, students are rarely motivated to achieve when they perceive themselves as unable to accomplish tasks because they are deficient in some manner. Motivation of course like attention, has serious implications for the development of learning approaches.

Deep approach learners are motivated by their own efforts to succeed, to learn or solve problems because the task is seen as enjoyable or challenging, and because they feel confident in their ability to tackle such tasks. Having been rewarded for past effort, they are more prepared to invest the extra time required by the use of deep processing strategies to ensure further success. Tasks are frequently seen in terms of “how they are to be accomplished” however, rather than “what the end result should be” which in some cases
becomes almost secondary. While a number of higher achieving students clearly displayed such motivational characteristics (Andrew in Case Study 1 and Martin in Case Study 3), others however, did not.

In some cases where students appeared initially motivated intrinsically, other factors thought to be characteristic of learning approaches such as learning outcomes and perceptions of learning goals, suggested that the goal toward which they were working was external. For example, Susie (Case Study 2) was an enthusiastic student, bubbling with energy and unconcealed interest, a fact made obvious by her constant efforts to seek clarification of the proposed task. With time and closer observation however, it became clear that Susie’s questioning strategies were not designed to enhance her own understanding, but were rather attempts to increase her security about the researcher’s expectations. Susie was stressed and anxious to give the “right” answer. What was initially perceived as a desire for personal challenge became an indication of her motivation to meet the standards expected of others (See Table 7.12).

Amongst those students whose motivation was clear and unambiguous either at an intrinsic or extrinsic level, their approach to learning was in most cases, also clear. Tables 7.12 and 7.13 indicate the attentional and motivational characteristics displayed by each child from the experimental and control groups.
<table>
<thead>
<tr>
<th>CHILD</th>
<th>ATTENTION</th>
<th>MOTIVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrew (H)</td>
<td>Attention directed toward high strategy use and reaching goal. Able to translate previous knowledge into performance.</td>
<td>Intrinsically motivated. Enthusiastic about tasks seen as valuable. Learning seen as process worth engaging in. Valued effort and challenge. Motivated to use strategies.</td>
</tr>
<tr>
<td>Timothy (L)</td>
<td>Attention directed toward speedy conclusion. Focused on whole task rather than attend to relevant aspects.</td>
<td>Extrinsically motivated. End goal was completion of task. No enjoyment. Used some strategies but no sustained mindfulness.</td>
</tr>
<tr>
<td>Anna (H)</td>
<td>Attended to relevant aspects of task. Minimal observed strategy use but successful outcome. Attendance not always visible.</td>
<td>Motivation difficult to discern. Amused by tasks, but no real, personal engagement. Seemed to value effort and took challenge in her stride.</td>
</tr>
<tr>
<td>Susie (L)</td>
<td>More concerned with completion of whole rather than focus on parts. High attention level but on extrinsic factors.</td>
<td>Enthusiastic but extrinsically motivated. Concerned with “getting it right”. Desired to meet institutional requirements. Motivated to question to confirm that she was “right”.</td>
</tr>
<tr>
<td>Andrea (H)</td>
<td>Attended thoroughly to task demands. High strategy use.</td>
<td>Intrinsically motivated, thrilled by tasks. Task valued as challenge and fun.</td>
</tr>
<tr>
<td>Helena (L)</td>
<td>Attended during explanations but no other real evidence of high concentrated effort.</td>
<td>Possibly extrinsically motivated. No real enthusiasm for task, anxious to complete promptly.</td>
</tr>
<tr>
<td>Amos (L)</td>
<td>Attention to task explanation. Focus on whole task - little concept of relevant parts.</td>
<td>Intrinsic motivation. Valued tasks. Motivated to persevere in spite of difficulties, for successful outcome.</td>
</tr>
</tbody>
</table>
Table 7.13
Study 2: Attentional and Motivational Characteristics Displayed by Students from Control Group

<table>
<thead>
<tr>
<th>CHILD</th>
<th>ATTENTION</th>
<th>MOTIVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wendy (L)</td>
<td>Attention varied. Concentrated when goals explained.</td>
<td>Possibly extrinsically to meet institutional demands. Anxious to complete.</td>
</tr>
<tr>
<td>Dara (H)</td>
<td>Attended carefully as tasks explained but otherwise very difficult to determine extent of attention and effort.</td>
<td>Difficult to ascertain as little emotion and minimal demonstrable effort displayed.</td>
</tr>
<tr>
<td>Daniel (L)</td>
<td>Attended carefully when task explained. Otherwise difficult to discern. Appeared to lose interest.</td>
<td>Again difficult to ascertain. Emotionally controlled.</td>
</tr>
<tr>
<td>Kim (H)</td>
<td>Attended carefully when settled down to tasks. Initially too anxious to begin for maximum concentration and effort.</td>
<td>Intrinsically motivated. Very enthusiastic and personally involved in task. Valued the experience. Used deep strategies.</td>
</tr>
<tr>
<td>Natalie (L)</td>
<td>Initial attention but difficult to keep “on task”</td>
<td>Extrinsically motivated. Task seen as another classroom problem. Minimal effort.</td>
</tr>
<tr>
<td>Kevin (H)</td>
<td>Engaged in task, mindful behaviour initially, later attention wavered.</td>
<td>Possibly intrinsic, but could also be extrinsic. Some concern about institutional requirements. Not enthusiastically involved.</td>
</tr>
<tr>
<td>Liam (L)</td>
<td>Attended well to task and tried to select relevant aspects, through trial and error process.</td>
<td>Intrinsically motivated. Enthusiastic about tasks even when success was elusive. Concerned with the process rather than completion of task.</td>
</tr>
</tbody>
</table>

Not all high achievers of course displayed either the attentional or motivational qualities for deep learning, nor was high attention to detail or intrinsic motivation a feature of high achieving students alone. Nevertheless, the students who displayed the attentive behaviours which enabled them to focus on relevant aspects of tasks and to select metacognitive strategies to facilitate problem-solving were overwhelmingly representative of the high
achieving groups. Similarly, those students motivated intrinsically by the fun and challenge of each task, who were happy to spend as much time on the process, thinking and experimenting as they did on the end product, were also from the higher achieving groups.

**Self-Concept and the Learning Environment as Indicators of Learning Approaches.**

**Self-Concept**

Based on the *Pictorial Scale of Perceived Competence and Social Acceptance for Young Children* (Harter, 1982; Harter & Pike, 1983) which examines students' perceptions of their own competence and acceptability in cognitive pursuits, at home with parents, socially with peers and at a physical level, most students were found to have reasonably high overall self-concepts. Of a possible 96, the mean raw score for the entire group was M=82.3, SD 9.94. Harter and Pike (1983) note that raw scores ranging between 72-96 are high, between 48-72 are medium, and between 24-48, low.

Once the scores were broken into their component parts, individual students displayed some interesting characteristics indicating that self-perceptions may vary according to circumstances and experiences. Harter and Pike (1983) in the procedural manual accompanying the pictorial scale, suggest that the distinction that children make between competence and acceptance is valid and should be considered seriously. When overall scores are broken down therefore, they give an individual profile of students' perceptions regarding acceptance and competence at home and at school. Caution should be exercised however, when assessing the scores related to maternal acceptance (H) in the following tables. Some of the questions relating to maternal acceptance must be regarded with caution for example, statements such as:
"Mum lets me stay overnight with friends", and
"Mum cooks favourite foods"

may reflect inappropriate activities for some of the children in this study. Many five and six year olds have not been allowed to stay overnight with friends and often favourite foods include heavily processed “convenience products” which many parents refrain from buying.

According to Harter and Pike (1983), subscale scores are considered high if they range between 18 and 24, medium between 12 and 18, and low between 6 and 12. Certainly, while the overall scores of the experimental and control groups (Study 1) were high (total Mean all groups M=82.3 SD 9.9), and the subscale scores for the groups were also high (Cognitive Competence, M=20.7, SD 3.2) (Physical Competence, M=20.5, SD 2.9) (Social Acceptance by Peers, M=21, SD 3.3) (Social Acceptance by Parent, M=19.9 SD 3.4), scores of the individual students varied considerably.

McCarthy and Schmeck (1988) have noted that students with healthy self-concepts are more likely to attribute success and failure appropriately and place the locus of control within themselves. They go on to note that such students often use more sophisticated learning strategies than their less confident peers and generally perform better on a range of tasks. With this in mind, the overall scores and subscores of the sixteen children in this study are set out in Tables 7.14 and 7.15.
Table 7.14  
Study 2: Self-Concept Scores of Students from Experimental Group

<table>
<thead>
<tr>
<th>CHILD</th>
<th>SELF-CONCEPTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(All children total M=82.3, SD 9.9)</td>
</tr>
<tr>
<td></td>
<td>C: M=20.7 SD 3.2, P: M=21 SD 3.3</td>
</tr>
<tr>
<td></td>
<td>H: M=19.9 SD 3.4, S: M=20.5 SD 2.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Raw score 79</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrew (H)</td>
<td>C=23, P=19, H=17, S=20</td>
</tr>
<tr>
<td></td>
<td>Positive self-concepts, sure of own abilities, extremely confident</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Raw score 82</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timothy (L)</td>
<td>C=17, P=23, H=20, S=22</td>
</tr>
<tr>
<td></td>
<td>Positive self-concepts, slightly lower cognitive score, lacked confidence.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Raw score 90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anna (H)</td>
<td>C=24, P=24, H=21, S=21</td>
</tr>
<tr>
<td></td>
<td>Positive self-concepts overall, confidence increased during tasks.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Raw score 75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Susie (L)</td>
<td>C=17, P=20, H=15, S=23</td>
</tr>
<tr>
<td></td>
<td>Anxious, desired assurance, high need for approval, feared failure.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Raw score 87</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrea (H)</td>
<td>C=21, P=24, H=22, S=20</td>
</tr>
<tr>
<td></td>
<td>Positive self-concepts, quietly confident in own abilities.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Raw score 81</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helena (L)</td>
<td>C=14, P=22, H=22, S=23</td>
</tr>
<tr>
<td></td>
<td>Less assured of cognitive ability, overall high self-perceptions.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Raw score 84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Larry (H)</td>
<td>C=24, P=21, H=19, S=20</td>
</tr>
<tr>
<td></td>
<td>Very positive self-concepts. Extremely confident, self-assured.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Raw score 79</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amos (L)</td>
<td>C=23, P=19, H=17, S=20</td>
</tr>
<tr>
<td></td>
<td>Positive score, less assured when undertaking tasks.</td>
</tr>
</tbody>
</table>

**Key:**  
C=Cognitive Competence, P=Social Acceptance by Peers, H=Social Acceptance by Parent, S=Physical Competence
Table 7.15
Study 2: Self-Concept Scores of Students from Control Group

<table>
<thead>
<tr>
<th>CHILD</th>
<th>SELF-CONCEPTS</th>
<th>RAW SCORES</th>
<th>SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Martin (H)</td>
<td>Raw score 81</td>
<td>C=24, P=23, H=16, S=18</td>
<td>Displayed high self-confidence, very sure of own abilities.</td>
</tr>
<tr>
<td>Wendy (L)</td>
<td>Raw score 78</td>
<td>C=16, P=21, H=22, S=19</td>
<td>Less confident than some other children. Lower than mean on academic score.</td>
</tr>
<tr>
<td>Dara (H)</td>
<td>Raw score 88</td>
<td>C=23, P=23, H=21, S=21</td>
<td>No overt display of confidence. High self-concept score.</td>
</tr>
<tr>
<td>Daniel (L)</td>
<td>Raw score 83</td>
<td>C=24, P=22, H=21, S=16</td>
<td>High score, appears less confident about academic tasks than score suggests.</td>
</tr>
<tr>
<td>Kim (H)</td>
<td>Raw score 72</td>
<td>C=21, P=21, H=12, S=18</td>
<td>Medium self-concept. Low score on perceptions of home. Less confident than some on tasks.</td>
</tr>
<tr>
<td>Natalie (L)</td>
<td>Raw score 80</td>
<td>C=14, P=23, H=23, S=20</td>
<td>High measured score. Not as confident about doing tasks. Fairly anxious about academic work.</td>
</tr>
<tr>
<td>Kevin (H)</td>
<td>Raw score 77</td>
<td>C=22, P=19, H=17, S=19</td>
<td>Medium measured score. Anxious about tasks. Needed reassurance.</td>
</tr>
<tr>
<td>Liam (L)</td>
<td>Raw score 68</td>
<td>C=17, P=18, H=19, S=14</td>
<td>Medium/low score on all components. Unsure about expectations.</td>
</tr>
</tbody>
</table>

Key:
C=Cognitive Competence, P=Social Acceptance by Peers, H=Social Acceptance by Parent, S=Physical Competence

Although students’ perceptions of competence and acceptance varied, and in some cases bore little resemblance to the way they used strategies while undertaking problem-solving tasks, the subscores relating to cognitive
competence were in most cases fairly consistent with their actual achievement status. Students classified as high achievers generally had higher cognitive subscores than those students who had been classified as underachievers (see Tables 7.16). Of the high achieving students in the experimental group, all four had high cognitive competence scores (scores ranged between 21 and 24), while amongst the underachieving students only one had a high score (23) with the others scoring in the medium range, between 14 and 17. The ratio on the cognitive competence subscale was identical for the control group.

Table 7.16
Study 2: High and Underachievers Subscale Scores - Pictorial Scale of Perceived Competence and Acceptance

<table>
<thead>
<tr>
<th></th>
<th>Cognitive</th>
<th>Peers</th>
<th>Parents</th>
<th>Physical</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental</strong> (means)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Ach. ((n=4))</td>
<td>23</td>
<td>22</td>
<td>19.7</td>
<td>20.2</td>
</tr>
<tr>
<td>Underach. ((n=4))</td>
<td>17.7</td>
<td>21</td>
<td>18.5</td>
<td>22</td>
</tr>
<tr>
<td><strong>Control</strong> (means)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Ach. ((n=4))</td>
<td>22.5</td>
<td>21.5</td>
<td>16.5</td>
<td>19</td>
</tr>
<tr>
<td>Underach. ((n=4))</td>
<td>17.7</td>
<td>21</td>
<td>21.2</td>
<td>17.2</td>
</tr>
</tbody>
</table>

As can been seen in Table 7.16, there are observable differences in the mean subscale scores of the sixteen selected children, with the high achieving students scoring higher on the cognitive competence scale than their underachieving counterparts. This is the clearest trend observable; other subscale differences are less reflective of students’ self-perceptions regarding their learning and problem-solving abilities. Although possibly not statistically significant, differences in perceptions held by high and underachieving students regarding cognitive competence may suggest that even very young children are concerned about their classroom performance,
equating it with ability. Unless instructional methods designed to increase both academic performance and more realistic attributions are instituted, then students regarding themselves as less competent in their cognitive abilities will be unlikely to modify these perceptions.

The results thus far have explored the strategic behaviours of students as they approach learning and problem-solving tasks. They have addressed issues such as the attentional focus directed toward such tasks in terms of being in control of the process, and motivational factors such as the meeting of institutional requirements on the one hand or the enjoyment of the challenge of the task on the other. The results have also looked at students' self-concepts, especially for the purpose of this study, as they relate to their perceptions regarding cognitive competence. While such intrinsic factors are vital in determining whether students are already indicating they are perceiving learning as a deep or surface endeavour, external factors such as the classroom environment and teaching approaches are also of paramount concern.

**Learning Environment and Teaching Approaches**

**Experimental Classes**

Observations of the videotaped data collected in Study 1 indicate clearly that the learning environment and especially the teaching approaches adopted for the experimental programme were qualitatively different to those maintained by teachers in the control groups. Although each of the teachers participating in the "metacognitive" teaching programme brought their own particular teaching style to the classroom (see Table 7.17), they all embraced the idea of "scaffolded" learning well. Having been made aware of the theory underpinning the importance of the sociocultural environment for learning, as well as instruction in how to extend children's metacognitive understanding,
each teacher became enthusiastic about the implications of such training for
her students.

Table 7.17
Study 2: Learning Environment and Teaching Approach used with Students
from Experimental Classes

<table>
<thead>
<tr>
<th>CHILD</th>
<th>LEARNING ENVIRONMENT and TEACHING APPROACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrew</td>
<td>Experimental programme (Study 1). The teacher in this class regularly discussed the use of strategies, demonstrated their use and modelled metacognitive behaviours. Cognitive thinking expanded and encouraged. Reinforcement academic, affirming cognitive actions not classroom behaviour.</td>
</tr>
<tr>
<td>(H)</td>
<td></td>
</tr>
<tr>
<td>Timothy</td>
<td>Anna and Susie part of experimental programme (Study 1). Their teacher had embraced the programme with vigour and videotaped interactions demonstrate “metacognitive” teaching. Externalisation of thinking behaviours was a feature of this classroom. Students enthusiastic. Feedback useful. Focus on “assisted discovery”.</td>
</tr>
<tr>
<td>(L)</td>
<td></td>
</tr>
<tr>
<td>Anna</td>
<td></td>
</tr>
<tr>
<td>(H)</td>
<td></td>
</tr>
<tr>
<td>Susie</td>
<td></td>
</tr>
<tr>
<td>(L)</td>
<td></td>
</tr>
<tr>
<td>Andrea</td>
<td>Experimental classroom (Study 1). Teacher approached tasks with quieter but nonetheless metacognitively effective approach. Much cognitive discussion, lots of hands-on activity. Thinking scaffolded by teacher externalising own cognitive behaviours. Students encouraged to find “how” and “why” not on “right answer”</td>
</tr>
<tr>
<td>(H)</td>
<td></td>
</tr>
<tr>
<td>Helena</td>
<td></td>
</tr>
<tr>
<td>(L)</td>
<td></td>
</tr>
<tr>
<td>Larry</td>
<td>Teachers encouraged self-regulation of learning and problem-solving. Externalised cognitive thinking. Students enthusiastic although always constrained by time. Classroom not as efficient at time management as others. Lots of hands-on activity seemed often cut short.</td>
</tr>
<tr>
<td>(H)</td>
<td></td>
</tr>
<tr>
<td>Amos</td>
<td></td>
</tr>
<tr>
<td>(L)</td>
<td></td>
</tr>
</tbody>
</table>

The most notable differences observed in the teaching in the experimental programme were the way students’ cognitive thinking was extended and how rewards and encouragement were distributed. For example, the teacher in experimental classroom 2 was amazed at the extent to which her questioning and modelling could challenge a student’s thinking. On one memorable occasion when the lesson focused on measurement, two small girls of similar but not equal height were selected as “visual aids” for the discussion. The goal of the lesson was to accurately measure and compare the heights of people or objects by eliminating as many variables as possible which might hinder this task. One of the little girls stood on a chair and the other on the
floor beside her and the students were asked to decide which was the taller. Of course the children already knew that this was not the way to go about such a task and quickly told the teacher that both girls must at least be on a level plane. When questioned by the teacher as to why this was important, the students explained that it was difficult to compare heights accurately,

"when Melanie's feet and Tamar's feet are in different places".

The discussion ensued with the teacher continually drawing more from each student until completely of their own volition, the classroom group had insisted that the girls not only stand on the floor, but also remove their shoes (one had not yet changed her shoes from the previous gym class and was wearing thick soled joggers while the other was back in schoolshoes) and their socks (it was perceived that one pair of socks was thicker than the other). This, it was believed would enable measurement with greater accuracy, until they also noticed that one of the girls had a hair ribbon on the top of her head which was also promptly removed.

Following each response from the children the teacher reinforced their thinking by articulating her own cognitive explanation. For example when the shoes were removed, she said:

"Of course you are right. If Melanie's shoes are thicker than Tamar's, then Melanie will have several extra millimetres added on to her height" "Of course, we know that it is just her shoes and not really Melanie" "If she is wearing them, we cannot find out how tall only Melanie really is!"
Following completion of this lesson, the children in pairs were encouraged to compare the height of various items on both the vertical and horizontal plane. Much interaction between pairs occurred while the teacher moved about offering advice regarding strategies and giving cognitive support and practical assistance when the items to be measured proved unmanageable or a project too ambitious. The children themselves quickly picked up the questioning techniques the teacher had previously used to extend their own thinking. All this occurred in the busiest classroom imaginable where all students engaged in these activities with considerable enjoyment. So great was the enjoyment of this learning enterprise in fact, that it continued long past the time allocated for the mathematics session.

Another class had recently had several lessons and practice in a variety of contexts looking at addition. On the day the class was videotaped however, the lesson was to be devoted to subtraction. After questioning the class about the previous “addition” lesson, the teacher reinforced the students’ understanding with some more concrete examples, saying:

"I have brought some boxes of skittles with me today and I have two boxes in this hand and three in the other...now...how many is that altogether?"

Such computations continued briefly. Once certain that the previous lesson had been recalled and confident that most children had developed an understanding about addition, discussion then ensued about subtraction. Placing six of the “Skittles” (small sweets) that she had brought on a sheet of paper, the teacher invited one of the children to count them for her and another to check this calculation. Children were then asked to remove sweets at various times to either eat themselves or distribute to friends and after each
subtraction, the remainder was checked and rechecked. When asked what they were doing with all these skittles one of the children replied...

"Well, um, it's maths and it's helping us to count more".

Another child spoke, before the teacher had time to reply, and said:

"We are counting skittles and we are taking them away to eat them".

"Good thinking", replied the teacher, "when we add things together we are making more and the number gets bigger, but when we subtract, we are taking things away and the number gets smaller".

Discussion then focused on the necessity of being able to subtract items as the teacher drew from the children some of the practical aspects of this mathematical concept.

In each of the four experimental classrooms, the focus of teaching was always on "how" and "why", or the process of learning rather than the end result. At no stage during the videotaped observations was the emphasis seen to be directed toward giving the "correct" answer. If students miscalculated, they were always invited to give an explanation of their thoughts or actions, and then taken back to the point of error where misunderstandings were discussed and the problem completed with help from the teacher. While "hands on" activity was always a feature of both experimental as well as control groups, the activity in the experimental classrooms was used to reinforce and practice material discussed in teaching sessions. Teacher and student together solved problems, discussed concepts and experimented with
materials. Interestingly in one class as previously mentioned, the students themselves quickly adopted the questioning, "teasing out" approach used by the teacher. This they used to great advantage in support and encouragement of their peers on more than one occasion.

Reinforcement while a common feature of all classrooms, tended to focus on cognitive actions rather than behavioural matters in the experimental groups. For example, teachers in the experimental groups were encouraged to say:

"I really liked the way you stopped and asked questions about that, that's a good strategy to help you learn about measuring", or "that was a really good try, but I think you forgot to include ..., so why don't we move that over there and try again?"

In this manner, feedback, which is necessary for the evaluation of effort and performance and which frequently enhances the motivation to continue with tasks, is of real and lasting value, addressing academic rather than the personal behaviours of the student.

While all participating teachers in the experimental programme responded well to their training sessions, two were outstanding in their demonstrations of metacognitive teaching, and a third was very competent. Despite initial doubts, these teachers found that externalisation of their own thinking processes was not as difficult as first supposed. Therefore, by following the modelled behaviour of their teachers, students in these classrooms were encouraged to extend their own thinking and to take responsibility for their cognitive process.
"Discussions with yourself" and "discussions with your friend", were constantly encouraged by teachers in the classroom.

Control Classes
As with the teachers in the experimental groups, those from the control group were also highly qualified, competent teachers whose classrooms reflected the happy, secure nature of their students. While thoroughly professional, each teacher was distinctly different, thereby bringing a novel teaching approach to their classrooms. Nonetheless, their teacher training ensured that they displayed "best practice" which encourages a recognition of each student as unique and the provision of activities which enable "discovery learning" in a developmentally appropriate environment. Obviously some of the teachers intuitively displayed some "metacognitive" tendencies however, observations of the videotaped interactions between the teacher and students in these classrooms suggest that none displayed the stretching and expanding of thinking that was so evident amongst the experimental groups.

In most classes teaching was found to consist of large group work where the whole class was encouraged to sit and listen with minimal interaction to the explanation of a task or topic, prior to participation in smaller groups with related activities. These frequently occurred on a rotation basis with each small group encouraged to complete a task before moving on to another. Obviously, this theme varied between classes with more interaction and less structure evident in one class and a great deal of structure and control in another. One extremely stressed classroom teacher had great difficulty in meeting the demands of her very exhausting programme where insufficient time allocated to activities resulted in considerable frustration for both herself and the students.
A significant difference between the control and experimental classrooms was evident in the way rewards were distributed. Within the control groups for example, reinforcement for personal behaviour was a common feature. Students were frequently rewarded in these classes for having,

“nice manners”, “sitting so beautifully”, “packing away carefully” or “being brave”.

Rewards were also distributed for completion of tasks, such as,

“Good boy, you have finished everything today”.

While behavioural reinforcement encourages the continuance of these actions, some of which may be worthwhile and highly desirable, it does not address cognitive errors or misconceptions, nor reinforces the positive, beneficial cognitive behaviours thought to enhance learning (see Table 7.18).

Control classroom 2 was so highly organised that while students seemed very content and secure in the very calm environment, observations revealed that little interaction between students was encouraged in the classroom and interaction occurred between students and teacher essentially only when problems arose, for which help was required. Students were encouraged to work quietly and independently however, while the emphasis on self-control of behaviours appeared to result in a high degree of composure, it appeared to be at the expense of self-regulation of cognition. The calm nature of this classroom was reflected in the behaviour of many students including the high and underachieving children selected to undertake the problem-solving tasks required by this study (see Table 7.18). The overt behaviours of Dara and
Daniel (Control Group - Case Study 2) are reflective of their controlled environment and are detailed later in illustrative case studies (Chapter 8).

Table 7.18
Study 2: Learning Environment and Teaching Approach used with Students from Control Classes

<table>
<thead>
<tr>
<th>CHILD</th>
<th>LEARNING ENVIRONMENT and TEACHING APPROACH Control Classrooms 5,6,7,8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Martin (H)</td>
<td>Teachers displayed “best practice” in classroom activities. Developmentally appropriate classroom with exemplary teaching. Much “discovery learning” opportunities.</td>
</tr>
<tr>
<td>Wendy (L)</td>
<td>Teacher/pupil interaction focused on management more than experimental groups. More reinforcement on behaviours than on academic responses. “Good girl”, “nice try” feedback.</td>
</tr>
<tr>
<td>Dara (H)</td>
<td>“Best Practice” employed in classroom. Although class was busy, active and harmonious, also very controlled. Emphasis on self-control rather than self-regulation of cognition. Much teacher direction with emphasis on mastery of tasks and facts. Children secure and extremely quiet and happy. Rewards for behaviour, manners etc.</td>
</tr>
<tr>
<td>Kim (H)</td>
<td>Didactic teaching approaches with emphasis on development of facts and skills. Attempts at expanding cognition often ended in classroom management sessions, when interactive activities ended in chaos. Poorly managed classroom.</td>
</tr>
</tbody>
</table>

In summary, approaches to learning, whether at a deep or surface level are already evident in the performance outcomes, metacognitive behaviours, problem-solving strategies, attention, motivation and self-concepts of the students participating in this study. Most of those students previously identified as high achievers demonstrated qualitatively different learning and problem-solving characteristics to those currently underachieving on school tasks (Tables 7.10 and 7.11). The attentional and motivational characteristics
they displayed in most cases indicates the value placed on effort through the use of higher-order thinking strategies for deep level understanding (Tables 7.12 and 7.13). Such students appear to value tasks for their challenge and enjoyment value as much as for the successful outcome the use of strategies might bring. In addition, the high achieving students are already confident of their cognitive abilities, perceiving themselves as competent in this area (Tables 7.14 and 7.15). In contrast, most of the students in this sample currently experiencing academic difficulty were already, even in the first year of school, perceiving themselves as less cognitively competent and less motivated to use metacognitive strategies than many of their peers (Tables 7.14 and 7.15).

If it is assumed that deep and surface approaches to learning result from the way classroom phenomena are perceived and understood by individuals, then certainly the children observed in this study appear to have developed a range of qualitatively different understandings about why material is taught as well as fundamentally different understandings of the importance of that teaching for their own use.

**Differences in Strategy Use and Performance Between Students from Experimental and Control Groups.**

Observations during problem-solving episodes have already highlighted differences amongst high and underachieving students in terms of their cognitive understanding and strategic behaviour. This information along with an appreciation of numerous affective characteristics such as attention, motivation and self-concepts, have indicated that students even in the early stages of their educational history, have qualitatively different understandings about their own abilities, performance and learning goals.
Given that the sociocultural context has been thought to be crucial in the development of such understandings, and that perceptions may be modified through the use of certain teaching strategies, this study has sought to ascertain whether participation in an experimental teaching programme can influence learning and problem-solving behaviours. In classrooms where higher-order cognitive strategies are regularly talked about and modelled and where their use is promoted and demonstrated as being beneficial to academic success, then it is likely that students will be more inclined to adopt such strategies than students in classrooms stressing different goals.

Observations indicate that the teachers participating in the experimental programme (Study 1) from which eight of the students in this study were drawn, did in most cases display the characteristics necessary to encourage strategic learning (see Table 7.17). On the other hand, the teachers from the control group while being exemplary practitioners, did not always encourage strategy use and self-regulation to the same degree (see Table 7.18).

Although the pre and posttest mathematics results (measured by the TEMA 2 instrument) (Ginsburg & Baroody, 1990) of students who had benefited from the experimental programme and those from the control group showed only small overall gains (Study 1), a closer look at the frequency of the strategic actions of the sixteen participants in Study 2 suggests otherwise. As Tables 7.6, 7.7, and 7.8 indicate, the students who had participated in the experimental programme demonstrated greater use of strategic behaviours on most tasks, irrespective of their high or underachieving status, than did the students from the control groups. Table 7.19 gives the frequencies of strategy use on the three tasks undertaken by the majority of students. While a range of eight tasks (see appendices) were presented to students, only the Maze (Appendix F) was undertaken by all sixteen students, the Toothpick Puzzle
(Appendix G), by fourteen students, and the Number Triangle (Appendix H), by just eight. Although most tasks were attempted by at least one student, some were selected only by two or three. Table 7.19 therefore, shows the frequency scores on the three most popular problem-solving tasks attempted by students.

Table 7.19
Study 2: Observed Frequencies of Strategy Use on “Maze”, “Toothpick” and “Number Triangle” Puzzles Showing Differences Between High and Low Achievers

<table>
<thead>
<tr>
<th></th>
<th>Experimental</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>Maze Puzzle (n=16)</td>
<td>43</td>
<td>22</td>
</tr>
<tr>
<td>Toothpick Puzzle (n=15)</td>
<td>33</td>
<td>20</td>
</tr>
<tr>
<td>Number Triangle (n=8)</td>
<td>27</td>
<td>6</td>
</tr>
<tr>
<td>Total (all strategies, both puzzles)</td>
<td>103</td>
<td>48</td>
</tr>
</tbody>
</table>

As previously noted, the higher achieving students from both the experimental and the control groups displayed a greater use of strategies than the underachieving students from each group. With the exception of the Number Triangle puzzle however, where an uneven distribution of students attempting this activity has given a skewed result (see Table 7.8), even the underachieving students from the experimental group have used a greater range of strategies and used them more frequently than the students from the control. Relatively speaking, the strategic behaviours of the underachievers from the experimental group is similar to those displayed by the high achievers from the control group.

Of course, it is important to be cognisant of other factors which may have influenced strategic awareness amongst the students in the experimental group. Such factors might include strategic encouragement on both academic
and non academic tasks by parents and other caregivers, the intuitive responses of some teachers as well as a certain innate metacognitive awareness held by individual students. Nonetheless, of vital interest to this study is the fact that the observed differences between two groups of students from very similar cultural and socioeconomic backgrounds is so marked.

Participation in this project compelled the teachers of the experimental classes to challenge and question their own teaching style. These teachers indicated that while provoking students to expand their cognitive understanding was always a desired goal of teaching, they had not previously focused on the development of strategic behaviours nor externalised their own cognitive actions to any extent. Scaffolding learning through Vygotsky’s zone of proximal development (ZPD), encouraging the use of and demonstrating strategic thinking and urging students to begin to take responsibility for their own learning and problem-solving in the manner discussed in their training sessions, forced the teachers to examine their own teaching goals.

**Phenomenographic Understandings**

If “what” is taught in the classroom cannot be separated from “how” students perceive the purpose of learning, then it must be concluded that learning behaviours consistently displayed across a range of tasks are likely to be indicative of this perceived purpose. Recalling the research of the phenomenographers (Crawford et al., 1994; Marton, 1988; Marton et al., 1984; Marton & Saljo, 1976; Prosser, 1993) who note that many differences in academic outcomes are based on students’ personal perceptions of learning foci, observations of students engaged in problem-solving activities, including their actions and dialogue, have been used to determine this understanding. Recognising that approaches to learning are reflected in
categories of outcome, in conjunction with a range of affective characteristics, it has been possible to draw certain assumptions from these results. By drawing upon research relating to both the intrinsic and extrinsic factors thought to influence understanding in the learning context, the behaviours listed in the hierarchical table (Table 7.9) which relate to deep and surface learning criteria have been applied to the behaviours of the sixteen student participants in this study.

Prosser (1993) and Walsh, Dall’Alba, Bowden and Martin (1993) believe that even students within the same classroom, exposed to similar teaching methods will acquire different understandings about the concepts under discussion. While this may account for some of the differential academic outcomes in any classroom, this study has sought to determine whether attempts to circumvent the misappropriation of certain perceptions about learning have been successful.

By logically relating the various ‘categories of description’ (Entwistle & Entwistle, 1991), or students’ affective dimensions with their experiences and outcomes, it is very clear that individual students come to any learning and problem-solving situation with a range of understanding, beliefs and perceptions about the purpose and value of such tasks. In many cases, the children who have already demonstrated academic adeptness have also been found to display many of the characteristics of deep approach learners. In contrast, in relation to the surface learning hierarchy, it is also evident that some children already display the characteristics found to be consistent amongst surface learners.

Given that sociocultural learning theorists (Covington, 1992; Palinscar & Klenk, 1992; Rogoff, 1990; Vygotsky, 1976; 1978; 1996) note that the
learning environment and the quality of teacher/pupil interactions is crucial in the development of appropriate perceptions about learning, then specific teaching programmes designed to modify students’ perceptions should result in some change. It is therefore, noteworthy that irrespective of their perceived academic potential, the students who had been previous participants in an experimental teaching programme (Study 1), have demonstrated greater awareness about learning strategies than their contemporaries in other classes. Learning strategies, especially the use of metacognitive, self-regulatory behaviours have been thought to reflect the attitudes, largely acquired through the environment, of deep approach learners. Both implicit and explicit teaching about strategic learning methods within a sociocultural classroom has been found to greatly influence students’ perceptions about learning (Entwistle & Entwistle, 1991; Marton, 1994; Prosser, 1993).

Although not all the students who participated in the experimental teaching programme have become deep approach learners, there is some indication that explicit instruction about metacognitive strategy use has already begun to influence a change in thinking about learning. Tables 7.6, 7.7, and 7.8 for example, indicate that the frequency of strategy use is greater amongst students from the experimental groups, irrespective of their current performance outcomes. These figures have been summed up in Table 7.19, and show that even the low and underachieving students have begun to develop strategic understanding, in some cases similar to the high achieving students from the control classes.

It may be assumed therefore, that the students in the experimental group are beginning to develop the understanding that learning is a process, facilitated through the use of strategic behaviours. When such behaviours are taught and
modelled, their importance to the learning process, to self-regulation and over
time, to outcomes, cannot fail to be recognised by students. The development
of strategic behaviours contribute to perceptions of learning as a search for
meaning and understanding with consequences reaching far beyond the
classroom.

**Summary and Conclusion**

This chapter (Chapter 7) has sought to address the three research questions
fundamental to the study through an analysis of the observed behaviours of
sixteen kindergarten grade students. Firstly, it notes that children in the first
year of school have already begun to use a small range of metacognitive
strategies to assist with learning and problem-solving. Four strategies, (a)
identifying the problem, (b) planning the task, (c) self-monitoring when
engaged in tasks, and (d) reflection were found to be fairly consistently used
by children. Additionally, strategic behaviours were found to be at least one
of the contributing factors to high academic achievement. High achieving
students consistently used strategies more successfully and more frequently
than lower achieving students.

Secondly, the results suggest that strategic behaviours, along with a range of
other factors including attention, motivation, self-concepts and the learning
environment, indicate that qualitatively different approaches to learning may
already be present amongst individual students. It is clear from a range of
characteristics that some students even in their kindergarten years, seek
meaning and understanding at a deep level from their academic endeavours.
Other students however, have already adopted many of the characteristics
which suggest that they are pragmatic in their use of effort, time and interest,
perceiving learning as a surface endeavour, in terms of the acquisition of facts and skills often just to meet institutional requirements.

Thirdly, the results have shown that not only are there many qualitative differences in the range of behaviours displayed by students who are high achievers and those currently underachieving, but that a dynamic sociocultural teaching environment seems to enhance students' strategic behaviours. Students from the experimental classrooms were found to use more strategies and to use them more frequently, irrespective of their current achievement status than students from the control groups.

Obviously, the behaviours of individual children revealed personal characteristics not evident in the quantitative posttest analyses of Study 1. Study 2 has demonstrated that students' actions and discussion demonstrate in an intimate manner how these characteristics highlight strategic behaviours, motivation, self-concepts and perceptions of learning.

Phenomenographic analysis was applied to the data to ascertain students' perceptions of learning. Although five and six year olds lack the skill, the understanding and the complex language required to personally account for their own learning approaches, these approaches have been discerned through repeated observations of videotaped data gathered while students completed a range of mathematical problems. Through their actions and discourse, the 'voices' of the children have given insight into their beliefs about learning which when applied to an established hierarchy and measured against a range of criteria, indicate understanding at a deep or surface level.

In the following chapter (Chapter 8), the behaviours and characteristics of children from four classrooms (two experimental and two control) will be
examined in more detail. In these illustrative case studies, the actions and thoughts observed during the period of research are outlined.
Chapter 8

ILLUSTRATIVE CASE STUDIES

In the previous chapter (Chapter 7) the results of the experimental study (Study 1), designed to test for changes in mathematics scores following an experimental teaching programme, as well as the more detailed findings pertaining to the three focus questions of this thesis (Study 2), were outlined.

Firstly, the results of Study 2 which are qualitative in nature, show the frequency of strategic behaviour demonstrated by sixteen kindergarten-aged children. They also highlight the way that strategy use, along with other factors such as attention, motivation and self-concepts, may reflect approaches to learning at a deep or surface level. Lastly, they suggest that students participating in programmes designed to enhance metacognitive understanding are more likely to develop strategic behaviours and thus over time, deep learning approaches than those students who do not have that kind of training.

Schratz (1993) has noted that educational research based on quantitative measurement, variables and experimentation often converts the “voices” of research participants into statistical data and other abstract concepts. He goes on to say that the social context within which research is conducted and which may be integral to the behaviours displayed, often becomes “disembodied” from the “voices” of the participants (Schratz, 1993, p.1). Given that the social context within which this study was conducted (experimental or control groups) is vital to understanding the behaviours and the voices of the students involved, explanations to the questions posed
outside the purely quantitative paradigm have been explored with that in mind.

Schratz (1993) is also concerned about "silent" voices. He notes that audiovisual media such as videotape, used in this study to determine the qualitative complexity of behaviours displayed by children engaged in problem-solving and other learning endeavours, can act as a silent voice for unravelling complex social settings. Using a window metaphor, Schratz (1993) suggests that videotape can open up a panorama of meanings, giving new perspectives which when related to other qualitative data in the research portfolio, more adequately uncover the powerful impact of "situated cognition" (Mehan, 1993).

This chapter (Chapter 8) allows the "voices" both spoken and "silent" to be heard in four illustrative case studies. They are the "window of socialisation" into the culture of the classrooms of the children in this study and at a more generalisable level, in learning contexts around the world (Mehan, 1993).

**Factors Influencing Approaches to Learning**

Although it is agreed that a student’s ability to understand and master critical thinking improves with age and that the individual needs of students must be taken into account when instruction is planned, there is still reason to believe that not all students will develop the thinking skills necessary for successful learning (Kennedy, Fisher & Ennis, 1991). Development as we know does not always equate with age however, while recognising the individuality of each student, all students in this study like their classroom peers, appeared similar in aspects of their developmental readiness to tackle the mathematical concepts under discussion. Certainly each of the sixteen participants was
physically, socially and emotionally adept with language skills consistent with those of the remainder of their cohort. Neither the high achieving nor the underachieving students showed any apparent physiological or psychological dysfunction. The most significant disparity between these groups of students was their performance at school.

Differences in their knowledge and understanding of the use of thinking strategies may therefore, be assumed to be linked to factors present in the sociocultural learning contexts of each child both at school and at home rather than from a physiological or developmental readiness point of view. From a sociocultural perspective, any support received which encourages and facilitates learning through the zone of proximal development should allow children to respond cognitively to tasks which in a purely developmental sense, might be perceived as being beyond their level of current understanding (Ebbeck, 1995; Elliott, 1995; Fleer, 1992; 1995; Rogoff, 1990). In other words, an understanding of concepts thought to be characteristic of say the late preoperational stage (5-7 years), may occur at an earlier age if the learning environment and teaching approach is conducive to the support of complex cognitive concepts. As developmental stage theories, therefore, have been questioned by sociocultural theorists, the developmental characteristics of the children highlighted in these cases studies, at least in the Piagetian sense, have been viewed as less important than some of the other factors inherent in learning such as attentional factors, motivation, self-concepts and the teaching environment.
CASE STUDY 1
Experimental Classroom 1
Timothy and Andrew

Introduction

Timothy, aged five years and nine months, and Andrew, aged six years were students in their kindergarten year at a school in Sydney. Both boys had been perceived by their classroom teacher as having reasonable cognitive potential nevertheless, Timothy was underachieving, while Andrew was a high achiever on all classroom tasks. Their current academic achievements were supported by the pre and posttest scores (Study 1) measured by the TEMA 2 instrument (Ginsburg & Baroody, 1990), as indicated in Figure 8.1.

Both boys appeared popular with their peers as they worked in a small interactive classroom. Timothy seemed happy at school in spite of the difficulties he was encountering with his academic work, although his attention wavered at times when the demands of tasks became too great or fell outside his realm of interest. Andrew was a serious, highly articulate young man who tackled tasks with intense concentration.

Testing prior to and following the intervention program with the TEMA 2 instrument (Ginsburg & Baroody, 1990) (Appendices A & B) gave Timothy and Andrew pretest raw scores of 18 and 44 respectively (experimental group M=27.8, SD.6.5) and posttest raw scores of 24 and 44 (experimental group M=31.5, SD.6.0). While Timothy's score increased considerably over the six week intervention period, Andrew's score remained constant throughout that time.
Performance and Behaviour on Problem-Solving Tasks

Each boy was presented with a range of problem-solving tasks but while Timothy chose only to attempt the most popular, a Maze puzzle (Appendix F), Andrew was interested and challenged by several. Timothy was slow to engage in the Maze activity, was easily distracted and anxious to complete the problem-solving task before him in the briefest time possible and throughout the session it was necessary to continually encourage “on-task” behaviour. Surprisingly however, when given the opportunity, Timothy decided to attempt the task a second time after the first unsuccessful attempt.

Andrew’s concentration level was high, especially on the first two of the several tasks he attempted. Andrew frequently discussed aspects of each puzzle, requesting either clarification of task elements or explanation of points not fully understood. While completing all tasks, especially those selected for discussion in this thesis (the Maze and Toothpick puzzle) (Appendices F and G), Andrew used the full range of strategies identified in
Chapter 7 - see Table 7.5. These were evident in both his verbal and non-verbal behaviours as he sought to clarify, plan, monitor and evaluate his own performance.

Although ultimately unsuccessful in completing his puzzle, Timothy also used many of the metacognitive, self-regulatory strategies identified in Table 7.5, as he completed the Maze task. His use of strategies however, was frequently evident only with non-verbal behaviours. While concentrated attention to explanations and task demands are considered valid strategic characteristics, determining the cognitive understanding behind such behaviours is problematic.

**Strategy 1 - Identifying the Problem**

When presented with the Maze task, observations suggested that behaviours indicative of identifying and clarifying the problem such as *attending with concentration when the task was explained* (see Table 7.5), were displayed by both boys. Timothy however, did not question any aspect of the task, nor did he request clarification, nor in fact indicate that he understood the task requirements during the initial explanatory phase.

Andrew on the other hand appeared to have no intention nor any expectation of commencing each of the tasks he attempted until he was satisfied that he understood the objectives clearly. While the objective of each task was being discussed and demonstrated by the researcher, Andrew’s attention appeared to be clearly directed toward the problems to be undertaken, and during each explanation he nodded several times suggesting understanding. For example, to clarify at one point in the Maze explanation, Andrew said:
“Where do you have to go...?” and at another time, “You mean here...?”

When Andrew was finally satisfied that his understanding was reasonably clear, he began to trace through the Maze, but only using his finger at this stage, not the pencil.

To complete the Toothpick puzzle, Andrew was asked to remove just two of the ten Toothpicks laid out to form three connecting squares so that two complete squares remained. Andrew indicated a further need for clarification of the problem however, when he asked:

“...joined together?” and “can you take less than two off?”

It was only after intense concentration and some tentative trial and error Toothpick shuffling that Andrew felt confident enough to make a determined move.

**Strategy 2 - Planning the Task**

While engaged in his first attempt at the Maze puzzle, observations of Timothy’s behaviour suggested that he had no overtly formulated goal or plan for how to proceed. Indeed, he appeared anxious to complete the task, suggesting that its completion was merely a means to an end. Surprisingly therefore, when presented with the opportunity of tackling the same task a second time, Timothy acquiesced and it was only then, following a question by the researcher, that Timothy displayed any visible strategic behaviour. When asked how a path could be planned through the Maze, Timothy replied:
"well, I could start..." (and he placed his pencil at a different point to that used on his first attempt).

Andrew, when presented with the Maze puzzle was told that he could start at whichever point he considered most appropriate, providing each opening was only passed through only once. When certain of the task goal, Andrew began to trace through the Maze with his finger using a variety of self-verbal and non-verbal behaviours to plan his eventual action, such as:

"if I go down like this...down there..." (at this point he stopped and monitored his action), continuing a moment or two later with, "... I mean...I'll come through that..." (again Andrew stopped and reconsidered), and continued: "...I'll go down there!"

Andrew again sought clarification at this point, questioning the researcher saying:

"can I go through there and come through there and around like that?"

Once satisfied that he understood precisely the objective of the task and had planned an appropriate path through the Maze, Andrew proceeded to take up the pencil and commence work. Andrew indicated both verbally that he was establishing the end goal as well as non-verbally. Non-verbal indicators of strategy use included frequent markings with his finger through the Maze, pausing to reconsider, further tracings and reconsiderations, all long before eventually proceeding with the task.
Planning strategies for the Toothpick puzzle involved exploration of the space within which the Toothpicks were placed. Even after clarification of the task, Andrew had no clear notion of which Toothpicks he should move, and so they were moved tentatively as a trial to determine effect. Andrew made comments like:

"...so, if I took those two would that be OK"? ..."Oops ...that bit's missing!"

Strategies for planning in this case merged with the cognitive demands of the task and self-monitoring.

Strategy 3 - Self-Monitoring

Further observations of Timothy while he was engaged in the Maze task showed some verbal and non-verbal self-monitoring behaviour. At one point for example, Timothy paused in his drawing, appearing to concentrate on and focus some attention to the task. During his second attempt, Timothy stopped his progress long enough to discuss his action briefly saying:

"and go around there...?"

Only very briefly on one occasion, did Timothy engage in momentary discussion with the researcher. Generally he did not pause, look back to where he had drawn, nor forward, during either attempt at the Maze.

Andrew, while engaged in the Maze task, worked silently with his pencil, concentrating intently. Again however, he frequently paused to think about the task, to evaluate his performance and to monitor his progress. Evidence of attending to cognitive demands emerged as Andrew discussed his
behaviour after the successful completion of the Maze puzzle. When questioned regarding the strategies used to achieve the desired result, Andrew replied:

"I just did it in my mind!" He went on to say that "I imagined I was in my mind and then I did the way my mind...so I knew it!"

When asked to explain why he had started at the point in the Maze that he had, Andrew replied:

"because I did exactly the same sheet, and I tried every way and that was the way that it worked..."

Curious to know more about his ‘trial run’ with ‘exactly the same sheet’, especially as this particular Maze had not been displayed previously, Andrew was asked where exactly he had tried it.

"In my mind", he replied, "I started in every top one (chamber)...and none of them worked, I couldn’t get through every door...I had to go through that door there...twice I think..."

The Toothpick puzzle kept Andrew spellbound for several minutes and although he did not discuss the problem much, he spent some time exploring alternative possibilities, both at a concrete level as he moved pieces and cognitively as he worked it out “in his mind”. At one point he exclaimed:

"Oh...yes!"
and proceeded to move the correct pieces without any further hesitation. It was upon reflection that he discussed his strategies.

**Strategy 4 - Reflection**

When asked by the researcher to reflect on his problem-solving behaviour while engaged in the Maze task, Timothy replied in monosyllables, although it must be acknowledged that some of the questioning could have been more open-ended. For example, to the question:

"remember Timothy, you could only go through the doorway...how many times?,"

Timothy replied:

"once!"

and on another occasion, when asked:

"What did you do here?,"

Timothy just said: "That!"

Some non-verbal indicators of reflective behaviour may have been displayed in a protracted look at the completed (albeit unsuccessful) task and pointing to the line through the Maze. When asked if the task had been hard and where the difficulty lay, Timothy replied:

"just going out and in all the times"
Andrew on the other hand was keen to talk about his performance, and when asked what might have been the outcome had he started the path through the Maze at a different position, he replied:

"If I’d started there...I’d probably have to go around there and right through here and come around here and how could I get out of that room...there’d be no way!...I’d have to go down through there and couldn’t go through there...could I?"

When asked why he had finally chosen the two Toothpicks required to be removed in order to solve the puzzle, Andrew replied:

"because I worked out that if those two weren’t there...there’d be...like...you know...I took that one away and I took the top off that (this was referring to his first attempt) and so I decided I might try the other one!"

Timothy displayed some strategic behaviour as he worked on the Maze task however, the attention he directed towards its completion was minimal and the strategies used were insufficient to ensure complete understanding and to enhance performance. Of considerable interest is that Timothy used a range of strategies, albeit at a low functional level, as it was apparent that he was anxious to complete the task as quickly as possible. Andrew on the other hand, was keen to spend considerable time on strategies which would enable him to gain a clearer understanding of the task goals. He appeared to be a logical, clear thinker who enjoyed the cognitive challenge of problem-solving.
To summarise, Timothy’s strategy use was minimal especially when compared to that of his classmate Andrew. Although Timothy displayed some of the characteristics of all four of the identified strategies, using both verbal and non-verbal behaviours, the use of these strategies did not appear to enhance understanding greatly nor contribute to a successful completion of the task.

Consistent with his high strategy use, Andrew’s performance on all tasks was ultimately successful, although certainly he lingered a little longer over tasks than did some other students. Andrew obviously considered the extra effort and time required by the use of each strategy essential for both the personal satisfaction he derived from the tasks and for their successful completion. Andrew was always confident in his approach to tasks and competent as his high performance demonstrates. He was not surprised at his success, indeed he expected nothing less. When mistakes did occur, Andrew appeared undeterred and merely pondered his actions or retraced his steps thereby extending his thinking and understanding.

Following completion of one task, when asked what he did when faced with a problem he could not solve, Andrew was recorded as saying that if he ever encountered difficulty, he would possibly ask another child or the teacher *how it was done*. Without embarrassment or false modesty however, he noted that it was he who was most often asked because he could usually *work it out!*

Timothy’s overall goal, although never articulated, appeared to be simply to complete the task at hand as quickly as time would allow. He was not especially curious about the Maze puzzle, although it appeared to interest him more than the other activities offered. According to Biggs (1989) and Biggs
and Moore (1993), depending on their perceptions of what learning is about, some students adopt a pragmatic, corner-cutting approach to problem-solving, choosing to invest little time and effort in tasks seen as irrelevant or as having little interest. Timothy’s minimal use of strategies, his lack of interest and motivation for a novel task and eventually his apparent indifference at being unable to successfully complete the Maze, are all indicative of Biggs’ notion of surface learning.

Andrew’s language and behaviour however, suggests that he viewed the process of learning and problem-solving as important as task completion. Indeed the two appear so inextricably linked as to be not two aspects of a whole, but as the whole itself. For Andrew, thinking about and ultimately solving a problem is a process; a process which involves the use of a range of strategies to initially identify and clarify the objectives of the task, to plan appropriate moves, which help cope with cognitive demands, which enable self-monitoring of actions and which finally assist in reflection of the task and its eventual outcome.

Andrew’s metacognitive, self-regulatory behaviours are consistent with Biggs’ concept of deep achieving approaches to learning (Biggs, 1989). By choosing strategies and by the use of questioning, inquiring language, Andrew has shown that the intent of his activity has been to gain meaning from the experience. In addition to this, it was apparent that Andrew was enjoying himself, engaging in tasks for the fun and challenge they presented!

Certainly, in respect of strategy use and self-regulatory behaviour, Timothy appears to be a surface approach learner. Timothy was anxious to complete the task and held an atomistic or closed view of the task requirements. However as Biggs (1989) suggests, learning approach pathologies are
manifest in numerous aspects of a student’s behaviour, not merely in their strategic behaviours and factors such as attention, motivation, the process of learning or task work which may be passive or active may all contribute to a surface approach outcome.

*Factors Influencing Approaches to Learning*

*Attention*

Although both Timothy and Andrew attended when tasks were presented, very quickly significant differences became apparent. While Timothy attended to the explanation of the task when it was first presented as previously mentioned, he was easily distracted. Timothy was anxious to take the pen and begin the task toward which very little further attention appeared to be directed.

When engaged in the Maze and Toothpick puzzles, Andrew’s attention to the demands of the tasks did not waver even when competing stimuli, specifically a number of noisy boys in transition from one room to another, moved across his line of vision. He was able to translate the knowledge he possessed about problem-solving into a successful completion of the tasks through the use of strategies. Rather than concentrating on the whole, Andrew’s careful attention to and selection of aspects such as choosing the right chamber to commence the Maze from facilitated a successful outcome.

Mindful of the fact that sustained attention and a clear focus on relevant aspects of a task are factors which influence students to adopt deep learning approaches and are vital for metacognitive strategy use (Biggs & Collis, 1982), it is hardly surprising that Timothy’s strategic behaviours were minimal. Low attenders are also more likely to respond to the whole situation presented rather than selecting the relevant aspects for specific
attention. Certainly Timothy’s minimal use of strategies to clarify objectives, plan moves, monitor actions and reflect on his own behaviour, suggests that he was unable or unwilling to attend to the important aspects of the tasks thereby, rendering completion of the whole less effective.

Factors Influencing Approaches to Learning

Motivation

Although the environment within which the boys worked on each problem-solving task was cheerful and non-threatening and the boys’ efforts were constantly affirmed, their previous academic histories are likely to have already considerably influenced motivation. Motivation is closely related to attributional processes and may be linked to feelings of success or failure, perhaps acquired in the classroom through placement in ability groupings or as a result of assessment. Based on their previous academic histories therefore, Timothy may have perceived himself as academically deficient, while Andrew is likely to have perceived himself as highly academically competent.

Poor perceptions of personal ability, especially measured against another’s standard tend to make students less inclined than their peers to invest energy in and to persevere with complex tasks. As positive attributions are only acquired through consistent academic encouragement and elements of success over time, even scaffolded instruction in the classroom over a six week period may be unlikely to significantly influence motivation so readily.

Timothy was motivated by external factors to complete the Maze task. There appeared to be no sense of enjoyment in his activity, just a desire to finish the task and to satisfy the demands of the researcher. If as is so frequently the case with low achieving students, previous effort on classroom tasks has
resulted in failure, then the time spent on self-monitoring performance, even after a concerted period of strategic instruction may have been viewed as simply not worth the effort.

Andrew however, was challenged by the cognitive demands of the tasks presented and engaged in them with enthusiasm and a sense of fun. He was motivated primarily by the desire to meet the challenges presented by each task rather than as a chore to be completed. Andrew gave every indication that learning and problem-solving were valuable in their own right as worthwhile accomplishments, not simply as means to an end. As part of the problem-solving process, Andrew appeared to be motivated to employ a range of deep processing strategies such as questioning, planning and monitoring. Andrew was undeterred by any extra time and effort such strategy use entailed. Indeed, having firmly developed this type of approach to tasks across a range of academic domains, it may be supposed that such efforts on Andrew’s part have been internalised to form part of his repertoire of learning behaviours.

Meece (1994) suggests that learning or task-oriented goals which are valued as end in themselves tend to engender a sense of pride, success and achievement. Low-achieving students however, frequently adopt performance-oriented goals which are self-assessed in relation to a set of standards based on the performance of others. Students with a history of failure, who see themselves as less able than their peers, adopt negative approaches to their learning, seeing little point in sustained effort for little or no reward.
Factors Influencing Approaches to Learning

Self-Concept

It had been suggested that students with positive self-concepts are more likely to use more sophisticated learning strategies and perform better on a range of tasks than students with poor self-concepts (McCarthy & Schmeck, 1988). Sinclair (1991) also notes the interrelationship between positive self-concepts and learning, linking low achievement motivation, high anxiety and poor self-concepts.

Timothy’s and Andrew’s overall self-perceptions were measured by the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children (Harter, 1982; Harter & Pike, 1983) (see samples Appendices C & D). Scores for each boy were high, showing raw measures of 82 and 79 (max 96) (mean for group 82.3 SD. 9.9) respectively. A breakdown of the total measures into four component parts suggests that Timothy perceived himself to be slightly less cognitively competent (score of 17) (group M=20.7, SD.3.2), than accepted by his peers (score of 23) (M=21, SD.3.3), maternally accepted (score of 20) (M=19.9, SD. 3.4), or physically competent (score of 22) (M=20.5, SD, 2.9). Andrew perceived himself as highly competent in cognitive pursuits (score of 23) (M=20.7, SD.3.2), competent socially with peers (score of 19) (M=21, SD.3.3), and physically competent (score of 20) (M=20.5, SD, 2.9), but just a little less maternally accepted (score of 17) (M=19.9, SD. 3.4) (See figure 8.2).
Interestingly, Timothy's overall self-concepts are slightly higher than Andrew's in all but the cognitive measure. Moreover, while Andrew appears to perceive himself as very cognitively able, his scores are lower than the group means on all other components.

Factors Influencing Approaches to Learning

Learning Environment

Teachers participating in the intervention programme (Study 1) had been encouraged to explicitly teach about and actively model the use of metacognitive, self-regulatory strategies and to encourage deep approaches to learning as they taught mathematics. Timothy and Andrew therefore, had been exposed to an intensive period of strategy development where the teacher had scaffolded students' thinking through the use of prompts, cues, questions and statements and rewarded cognitive effort with academic feedback. Initially, cognitive demands were modelled and articulated by the teacher who encouraged students to engage with her in tasks beyond their current level of development through the zone of proximal development.
Observation of videotaped teaching sessions (Study 1) suggest that the teaching focus during that intervention period was aimed at encouraging students to regard task engagement as a process, rather than a mere acquisition of facts and skills, and general student participation in the classroom process was high. Within the classroom, students were encouraged to find out “why” and “how” mathematics concepts developed and their contribution to real life experiences. There was an emphasis on a shared discovery of meaning, usually with the teacher but also amongst peers, with the strategic tools for thinking designed to take students beyond the classroom.

Summary

Phenomenographic application suggests that even within their first year of school, Timothy and Andrew have begun to adopt qualitatively different approaches to learning and problem-solving, possibly as a response to the teaching within the classroom and perceptions of learning articulated at home. Although Timothy and Andrew were both participators in the experimental teaching programme (Study 1), at this stage it is unlikely that just six weeks tuition will have changed any previously adopted perceptions of learning as these take considerable time to develop and consequently to modify. Nonetheless, what is likely to have developed, is a greater understanding of the types of strategies available to assist with more efficient learning. So while Timothy’s approach to tasks was found to be pragmatic, aimed at prompt task completion to meet another’s expectations, and Andrew’s approach suggests a valuing of learning as an end in itself, and a desire to confront the challenges presented irrespective of the effort involved, each boy has used a range of strategic behaviours to achieve their goals.
Based on the premise that acting, thinking and feeling are inextricably linked (Prosser, 1993), the problem-solving behaviours displayed by these students would appear to suggest that they view learning either as "what" the finished result should be or as "how" and "why" the task is completed. Taking this a step further, while recognising that at this point Timothy is only interested in completing his chosen task, with time and a great deal more explicit as well as implicit strategic training, it is likely that he may come to value the use of such strategies and alter his current perception of learning. Andrew on the other hand has already developed a conception of learning and problem-solving as a quest for meaning, a quest which necessitates the use of a range of processes and strategies in order to achieve this goal. Based perhaps on the rewards already received in the classroom and the differential but more positive relationship with the teacher that many high achieving students enjoy (Covington, 1992), it is likely that Andrew will continue to strive toward the attainment of deep learning goals.

CASE STUDY 2
Experimental Classroom 2
Susie and Anna

*Introduction*

Susie and Anna at the time of the study had both just turned six years of age, and were in the last term of their kindergarten year at a school in Sydney. Susie was very alert and was thrilled about having been drawn aside to complete some "special" activities with me. Anna however was more reserved, albeit very intuitive, appearing slightly amused about having been invited to participate in the study.
Although both Susie and Anna were bright, popular little girls, articulate, always ready to participate in classroom activities and seen as having similar potential, Susie had been identified by her teacher as a student who was currently encountering difficulties across all subject domains. Anna, on the other hand was achieving consistently in all domains although she initially tended to approach new things warily.

Certainly the differences in their mathematics performance were evident when the pre and post TEMA 2 (Ginsburg & Baroody, 1990) (Appendices A & B) test scores (see Figure 8.3) were calculated (Study 1). Susie scored just 18 on both her pre and posttests (experimental group pretest M=27.8, SD.6.5) (experimental posttest group M=31.5, SD.6.0), while Anna scored 33 in the pretest and 39 in the posttest.

![Figure 8.3](image)

**Figure 8.3**
TEMA 2 Pre and Posttest scores
Experimental Group 2 - Susie and Anna
Performance and Behaviour on Problem-Solving Tasks

Susie appeared to be excited about participating in the selected problem-solving tasks and overwhelmingly enthusiastic, although it soon became evident that she lacked confidence in her abilities. Although she frequently questioned the researcher, her questions were intended to seek assurance rather than clarification, especially with the Maze task. Although questioning is a desired strategy for identifying and clarifying problems and ensuring that student and teacher objectives are congruent, Susie’s questions continued for the length of each task and answers rarely gave her the confidence to continue alone. Questions were answered readily and in sufficient detail and were accompanied by demonstrations and modelling of the required movements through the actual task. End goals were discussed numerous times and strategies for planning the process and meeting those goals were explicitly detailed.

Although Susie displayed no motor difficulties, her fine movements were tight and restricted, indicators of insecurity, and she appeared tense as she attempted the Maze task (Appendix F). She moved the pencil slowly and tentatively over the puzzle as if continually uncertain about where to proceed next. When asked why she had chosen to follow the straight lines of the Maze, rather than make it “curly” (Susie’s words) using more flowing movements, she laughed rather nervously and said:

“oops”,

possibly interpreting the question as a criticism of her efforts.

Anna however, tackled the tasks casually and with the same air of amusement that was evident when she was first approached to participate in these
activities. Initially Anna too appeared to underestimate her own ability to do each task before attempting it, although she did not appear to have difficulties understanding the requirements of the tasks, and once encouraged, proceeded with ease. Although Anna successfully completed both the Maze and the Toothpick puzzles effortlessly, only rarely did she display any overt strategic behaviour.

When engaged in the tasks Anna displayed high concentration, attending carefully while the objectives of each puzzle were outlined. However, no questions were asked nor were any clarifying remarks made during this time. During the undertaking of each task, it was obvious that Anna was deep in concentration, displaying considerable non-verbal strategic use, and self-monitoring activity.

*Strategy 1 - Identifying the Problem*

Initially as Susie focused on the Maze puzzle, she was either unable to grasp the concept of drawing a line continuously through the Maze as required, or as previously mentioned, lacked the confidence to “take a risk”, and “have a go”. Nonetheless, she displayed high concentration, attending both physically and cognitively to the task. Susie frequently questioned the researcher asking:

> "do I have to go there?"..."is this the door?"..."where do you have to go?"..."can I start there?"..."should I do it that way?"

Anna’s concentration was extremely high, however, following explanation of the Maze puzzle, her only comment accompanied by a grin, was
"This is going to be hard!"

When asked if she was ready to proceed and understood the task objectives, Anna merely grimaced.

When confronted with the Toothpick squares, Susie displayed a similar attentive eagerness to that evident on the Maze however, when she was asked to try to solve the puzzle, she was again tentative in her approach, although there were fewer questions than on the previous task. When she started to remove toothpicks in an attempt to find the two remaining squares, Susie looked for reassurance asking several times:

"have we done this one?" (tried this configuration).

Overall, Susie verbally questioned the researcher, sought to clarify problems and looked for confirmation of her understanding at least nine times, and non-verbally displayed a high level of attention while engaged in the Maze task. During the Toothpick puzzle she verbally questioned, clarified and sought confirmation four times and again her attention level was high. Contrastingly, during discussion of the objectives of the Toothpick puzzle, Anna attended carefully but made no verbal comment.

**Strategy 2 - Planning the Task**

Although Susie asked a great many questions and sought clarification constantly, determining whether an objective was finally understood and whether any planning occurred for either the Maze or the Toothpick puzzle was difficult. As far as Anna was concerned, again there was little discernible strategic activity to suggest that a goal had been established and a
plan envisaged for the Toothpick task, but some indication that a plan had been formulated for use on the Maze.

When completing the Maze, some minor indicators of planning may have been evident as Susie said:

“I think I’ll go down there and here...”, and when asked “what made you start there...”, she replied, “...’cause it’s a corner...”

While there is uncertainty about the significance of the corner, it seems that to Susie at least, commencing at the corner was a planned move! Susie also appeared to consider an alternative move at one stage when she asked: “should I do it that way?”

(pointing to another point on the Maze and moving her finger to indicate an alternate route).

Anna, when told that she could start the Maze wherever and whenever she liked, initially said:

“I don’t know...”

She then proceeded however, to move her finger through the Maze saying:

“I could go around there and there...”

When Susie engaged in the Toothpick task, any planning moves made before commencing it were minimal and there were no verbal indications that
objectives were understood, regardless of previous questioning (Strategy 1). Planning behaviours were evident on only one occasion, when Susie pushed a toothpick with her finger to test the efficacy of an envisaged move.

Anna’s strategic planning behaviours while engaged in the Toothpick task again were difficult to ascertain given her reluctance to discuss and openly display her thoughts. It was obvious nevertheless that she was engaged in concentrated effort, and at one point tentatively moved two of the toothpicks in order to test her plan.

**Strategy 3 - Self-Monitoring**

**During the Maze**, Susie discussed the problem again saying:

“should I go across there?” [points], and “is this the right way?”

She also appeared to attend with considerable concentration to the task, however no attempt was made to retrace her steps, check where she had been or was going. When it was suggested again that she might move through the Maze in a more relaxed flowing manner, Susie replied:

“Should I start here again?”

Observations of Anna’s behaviours again indicate some non-verbal strategy use on each task such as concentration, attention and thinking about task demands. With the Maze, there was no self-questioning or discussion with the researcher, nor any monitoring of actions such as reviewing the previous move or looking forward to the next. Nonetheless, Anna quickly moved
through the Maze with purpose, travelling through each opening once only until she had successfully achieved the stated objective.

While working with the Toothpicks, Susie frequently discussed the task with the researcher, however this again was more for security than as a self-monitoring activity. Unlike her manner when working on the Maze, Susie was a little more experimental during this activity, removing toothpicks in quick succession. Following each move however, Susie looked up questioningly at the researcher, seeking reassurance.

The nature of the Toothpick puzzle meant that some experimentation was necessary unless the correct configuration could be envisaged without manoeuvring pieces concretely. Anna shuffled the toothpicks slightly and said:

"I don't know!"

She sighed and resumed concentration, finally taking the two toothpicks necessary for a satisfactory resolution of the puzzle.

**Strategy 4 - Reflection**

When questioned about the Maze task, Susie replied that it had been hard and that she did not know how to do it. When shown the sample sheet again with its "curly" lines weaving through the Maze, Susie commented that she should have:

"done that!" (taken sweeping moves through the maze, although this was not really necessary for a successful completion).
There were no reflective behaviours evident when engaged in the Toothpick puzzle.

When asked what had made her follow the path she had through the Maze, Anna replied as she had several times previously:

"I don't know!", she said.

When asked why she had chosen the two toothpicks enabling completion of the Toothpick task, Anna merely commented:

"Because I thought it might work."

Observations of the videotaped data suggest that Susie’s overall strategy use was fairly high while Anna’s overall strategy use appeared to be minimal. Interestingly however, the strategies Susie used were insufficient to enable successful completion of the tasks. Although Susie consistently questioned aspects of each task, it was apparent that most of her questioning was due to insecurity rather than as a clarifying measure. Questioning was certainly the most obvious strategy used, although some planning and self-monitoring behaviours were evident.

Susie did not appear to be in any hurry to complete tasks, although her manner displayed insecurity, and it was clear that she was anxious to “do the right thing” and “get the right answer!” Conformity to the disciplines sometimes required of educational institutions was evident when Susie was asked at one point:

"what do you think we should do next?"
In a questioning manner, Susie replied:

"write your name?"

This suggested that structural protocols seen as incidentals and not worth the inquiry by other children, were perceived as important task components by Susie. Every effort of course was made to put her at ease and her questioning and task attempts were always positively acknowledged.

Consistent with minimal strategy use, an emphasis on the “correct” answer, and the meeting of institutional requirements, Susie displayed all the characteristics of Biggs’ surface approach learner. Although eager to do the tasks, Susie was “assessment orientated”, extrinsically motivated to perform in the right manner. Susie’s language and behaviours suggested that the process of learning and problem-solving was not as important as correct task completion.

In contrast, in spite of the lack of observable strategic behaviour, those strategies Anna did employ led quickly to a successful completion of the specified tasks, suggesting that the strategies used were both efficient and effective. Obviously most cognitive activity is not observable unless it is verbally expressed through questioning, clarifying and confirming discussion. Of course it may also be discernible in physical actions including pointing, tracing and visual marking. Albeit less easy to observe, thinking, attentiveness and concentration are nonetheless essential for understanding and self-regulation of learning and problem-solving experiences.

As previously noted, approaches to learning are dependent on a range of factors (Biggs & Moore, 1993), not merely the use of metacognitive
strategies. Attention, motivation and self-esteem, as well as the learning environment and the quality of teaching are also major variables in determining learning approaches.

Factors Influencing Approaches to Learning

Attention

Surface approach learners are frequently deficient on memory related activities and poor attenders to the relevant aspects of learning and problem-solving tasks. They are more likely to regard the whole task as a unit, and therefore miss key aspects which constitute the whole. Children approaching learning and problem-solving however, as a quest for understanding, often maximise their efforts by attending to selective, relevant elements of tasks rather than the whole. In this manner they are able to assimilate previous knowledge with the unknown, facilitating meaning and enabling transfer across domains.

Although Susie appeared to attend when explanations were given about the objectives of the Maze and Toothpick puzzles, her subsequent questioning seemed to indicate that she either did not fully attend, was not able to comprehend the requirements of the tasks, was not able to remember the steps involved or lacked the confidence to proceed irrespective of any understanding she possessed. Certainly observations of the videotaped data suggest that Susie was intent on the activity presented, and her concentration appeared to be high, however, her manner while questioning suggested insecurity and a fear of making mistakes.

Anna's attention level was high throughout completion of the tasks, displaying considerable concentration although very little verbal communication. Attention to the tasks obviously enabled Anna to translate
the knowledge she already possessed about problem-solving into a successful outcome.

Factors Influencing Approaches to Learning

Motivation

As noted, Susie was desirous of "doing the right thing", although it appeared that she was unable to grasp clearly what the "right thing" was, possibly because there were no prescribed methods or strategies to be used. Susie certainly appeared to be motivated to carry out the tasks and questioned continually to reassure herself that all was proceeding as it should. From observations of the videotapes, there is no doubt that Susie made a supreme effort, however, if she perceived the goal of each task as "right answers" at the conclusion of a prescribed methodology, then her motivation is likely to have been extrinsically imposed. Any processing of ideas and the use of strategies were means whereby the end could be reached, not seen as having value in their own right.

Again, it was difficult to determine aspects of Anna’s thinking, including motivation. Certainly there was no anxiety evident regarding the tasks, no indication that she was preoccupied with extrinsic demands and no suggestion that she perceived these tasks as something that she had to "get right". Tasks were accomplished with a degree of detached amusement; it was almost as if Anna chose to complete the tasks to humour the researcher!

Factors Influencing Approaches to Learning

Self-Concept

Susie’s and Anna’s perceptions of themselves were tested using the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children (Harter, 1982; Harter & Pike, 1983) (Appendices C and D), however, while
Susie’s score was moderately high, showing an overall raw score of 75 (total mean experimental and control groups, 82.3, SD. 9.9), Anna’s was extremely high (overall raw score of 90). When broken into its four component parts, Susie’s score revealed that she perceived herself as physically competent and socially accepted by her peers with raw scores of 23 (M=20.5, SD. 2.9), and 20 (M=21, SD. 3.4) respectively. However, Susie saw herself as less competent cognitively and maternally accepted, with raw scores of 17 (M=20.7, SD. 3.2), and 15 (M=19.9, SD. 3.4) respectively.

Anna on the other hand perceived herself as cognitively competent and socially accepted by her peers, with raw scores on both categories of 24 (cognitive M=20.7, SD. 3.2) (social M=21, SD. 3.4). Anna also saw herself as very competent physically and maternally accepted, showing raw scores of 21 for each (physical M=20.5, SD. 2.9) (home M=19.9, SD. 3.4) (See Figure 8.4).

Figure 8.4
Pictorial Scale of Perceived Competence and Social Acceptance for Young Children - Susie and Anna
Susie’s perceptions of home and maternal acceptance are not discussed as this issue falls outside the parameters of this thesis. However, it should be noted that Harter (1982) suggests that children having mean scores of 17 (cognitive) and 15 (home) fall within the medium range on her scale, and their perceptions of themselves should be considered valid. It would appear therefore, that Susie’s continual questioning and constant need for encouragement and approval are manifestations of her lower than average perception of her cognitive capabilities.

Consistent with her high abilities, Anna obviously felt very comfortable with herself and her ability not only to manage cognitive tasks but also as she relates with others at home and in the wider social milieu.

**Factors Influencing Approaches to Learning**

**Learning Environment**

Susie and Anna had both previously been participants in the experimental study (Study 1), where for six weeks specific instruction in mathematics had been delivered by the classroom teacher who discussed and modelled a range of metacognitive, self-regulating strategies. Observations of videotaped teaching sessions revealed a high level of teacher/pupil interaction, scaffolded cognitive support and modelled cognitive and metacognitive behaviour. Learning was encouraged as being relevant, concrete materials were used, both teacher/child and peer discussion was dynamic and participation in guided problem-solving activities was high.

The teacher in this classroom embraced the “metacognitive” teaching style with enthusiasm. Not only did she view the new approach as “making a great deal of sense”, but saw the training sessions as enhancing her own professional status and development. Very possibly this teacher already used
many of the “scaffolding” techniques inherent in sociocultural teaching practices prior to the “metacognitive” training session.

Anderson (1989), Biggs (1988b), Ramsden (1988), Rogoff (1990) and others argue that the learning environment is crucial for the development of positive approaches to learning. However, despite having been a participator in an environment where the importance of the sociocultural context for effective learning was recognised and valued, where cognitive strategies were discussed and modelled, and where children’s thinking was expanded and challenged, Susie’s approach to learning was still very much at a surface level. It is hardly surprising of course, that Susie’s perceptions of learning did not change significantly over the period of experimentation. Susie obviously has significant misconceptions regarding learning goals, ideas not easily modified over a six week period. Regular strategic training within each subject domain, in addition to direct instruction about the efficacy of strategy use, needs to be part of the regular teaching regime if Susie is to develop perceptions of learning as a cognitive activity directed toward instilling meaning and understanding.

Strategic activity, although sometimes evident in Susie’s problem-solving behaviour, was repetitive and superficial in nature, seeking reassurance rather than understanding. Susie’s intent was always to “do the right thing”, to win the approval of those for whom she believed she was completing tasks. Tasks, although approached with enthusiasm, were undertaken to meet the requirements and expectations of others. There was no observable sense of personal gain, understanding or enjoyment of the task, and it is unlikely that concepts discussed could be transferred to novel situations. Susie’s perception of learning and problem-solving suggests that knowing “what” has become significantly more important to her than knowing “how” and “why”.
Although Anna’s observable strategy use was minimal, other factors were evident which suggested that she approached learning as a process of discovery rather than reproduction of facts or skills. Without doubt she had internalised a range of strategies for complex problem-solving evident in her high levels of attention while tasks were explained and concentration while they were undertaken. Certainly, she was able to transfer understood concepts in a novel situation and translate existing knowledge into a successful outcome.

**Summary**

Although Susie and Anna experienced the same innovative classroom instruction, the phenomenon of teaching is likely to have been substantially different for each child, resulting in the development of qualitatively different approaches to learning. For Susie learning was perceived as something to be memorised in order to provide the “right answer” when required, whereas Anna seemed to perceive learning in terms of understanding and appeared to be more self-regulating in problem-solving endeavours.

The classroom environment within which both girls worked was conducive to the development of higher-order thinking skills, as cognitive strategies were discussed and modelled, and where children’s thinking was expanded and challenged. For at least six weeks the classroom teacher had both explicitly as well as implicitly drawn her classroom into collaborative dialogues where students’ perceptions of the world were questioned and concepts teased out. Within this environment the use of strategies for deep learning was desired and encouraged. Although the classroom environment was not examined prior to the period of intervention before the use of the experimental programme (Study 1), observation of the control classrooms suggest that
while “best practice” teaching has been exemplary, it is often didactic in its approach with an emphasis on mastery of skills and facts.

Strategy use was difficult to ascertain in Anna’s case, although it was apparent that she was a capable learner with the skills enabling her to actively seek and retrieve previously learned information for use in novel situations. Susie, on the other hand displayed disrupted organisational and planning abilities, utilising low-level strategies for reassurance, rather than as a means of enhancing performance.

Both Susie and Anna displayed considerable attention to the tasks set before them, however, while Anna was able to attend to task details, translating knowledge into performance, Susie at this point in her education was more concerned with completion of the whole task rather than attending to the relevant aspects which enable more efficient information processing. Although Susie displayed considerable strategy use especially questioning techniques, she was still preoccupied with the expected demands of the task. Anna, on the other hand was motivated intrinsically, completing the tasks for her own amusement, rather than because she valued the challenge on this occasion.

While Anna’s overall self-concept was very high and perceptions of herself cognitively were high, reflecting confidence in her ability to perform academically at a high level, Susie’s overall self-concept was only moderate and perceptions of herself cognitively were also at a medium level. This appears to be consistent with a child who has experienced poor academic performance, and is anxious about her learning, displaying a high need for approval.
In summary, although both girls used some strategic behaviours, it seems that other factors such as attention, motivation and self-concept have been greater indicators of perceptions about learning in this case. Without further training to develop her repertoire of strategies and more importantly the understanding that strategic behaviours enhance learning, and the confidence to use and manipulate such strategies, Susie’s learning is likely to remain at a superficial level. While Anna is confident in her current abilities, she too requires continued instruction to ensure that her learning proceeds at a deep level for clear understanding.

CASE STUDY 3
Control Classroom 1
Martin and Wendy

Introduction
Martin aged six years and Wendy aged five were in the same kindergarten class at a school in Sydney. Both Martin and Wendy were perceived as bright, intelligent children with considerable academic potential, however, whereas Martin was achieving at a high level, Wendy was underachieving in all subject domains. Each child’s achievement level was supported by pre and posttest measures calculated as part of a previous experimental study (Study 1), during which time their class had participated as part of a control group.

Martin’s pre and posttest raw scores determined by the TEMA 2 instrument (Ginsburg & Baroody, 1990) (Appendices A & B) were 36, and 39, while Wendy’s pre and posttest scores were 16 and 23 respectively (control group pretest M=26.8, SD. 5.1) (control group posttest M=29.6, SD. 5.5). Although
both children increased their scores over the period the study was conducted (see Figure 8.5), the increase in Wendy's score was considerable.

![Bar chart showing TEMA 2 Pre and Posttest scores for Martin, Wendy, and Control group](image)

**Figure 8.5**
TEMA 2 Pre and Posttest scores
Control Group 2 - Martin and Wendy

**Performance and Behaviour on Problem-Solving Tasks**

When presented with a range of problem-solving tasks, Martin and Wendy each selected several to complete. Wendy was generally slow to engage in each activity, although happy to have been chosen to do some extra puzzles over her peers. She was however, easily distracted, lacked the confidence to question the researcher and engaged in almost no dialogue at all. Although Wendy voluntarily attempted three of the variety of tasks available (Maze, Toothpicks, and Number triangle - Appendices F, G and H), it was necessary to continually encourage “on-task” behaviour, and each task was almost entirely teacher-directed. Martin attempted four of the tasks (including the Maze and Toothpick puzzles - Appendices F and G), successfully finding a satisfactory solution to each.
Following observation of the videotapes and a review of the strategic behaviours indicated on the rating matrix (Appendix R), qualitative differences in the behaviours of the two children were discernible. Whereas Martin displayed significant use of metacognitive, self-regulatory strategies in all four strategy categories, Wendy gave almost no verbal indication of her cognitive reasoning, and although she displayed concentration while task goals were being outlined, there was almost no non-verbal indication that she was actively engaged in cognitive problem-solving as the tasks proceeded.

**Strategy 1 - Identifying the Problem**

Martin was an eager participant, ready to discuss the problem and clarify issues before commencement of the Maze task. He displayed extraordinary concentration adopting a personal metaphor for the task thereby clearly demonstrating his engagement. When told that a route was to be found that moved through the Maze continuously via every opening just once, Martin replied:

"you mean like a pirate looking for buried treasure?"

He further commented:

"when there's a map, we can go the same way every time!"

When faced with the Toothpick puzzle, not only did Martin attend with intense concentration, but again demonstrated his personal engagement with the activity when he started to discuss other hypothetical toothpick configurations. In each case however, Martin established a clear understanding of the problem and task goal through questioning and confirming dialogue.
Wendy on the other hand, tackled the number triangle but sought no verbal clarification when the goals were discussed. Seeing the number 2, and two number 3s already placed within the triangle (Appendix H), Wendy’s first impulse was to add a number 4, irrespective of the stated goals. Like Martin, Wendy also undertook the Maze puzzle, however, she appeared less clear about the problem goals although she seemed to attend carefully as the task was being explained.

**Strategy 2 - Planning the Task**

An articulate and expressive Martin obviously set about planning his actions on the Maze puzzle the moment he saw it. For example, after discussing its similarity to a pirate map, Martin again looked carefully at the Maze and said:

“I think I've found a way already!”

After further careful consideration, he pointed and remarked:

“I’ll start here and go there!”

With the same confident approach Martin demonstrated planning strategies when engaged in the Toothpick task. This time however, there were no verbal comments, so planning was only evident in eye movements and the intense level of concentration he displayed.

Wendy, on the other hand displayed no observable planning strategies with either task, launching immediately into each with apparently no clear direction in mind.
**Strategy 3 - Self-Monitoring**

Martin displayed all the characteristics of a self-monitoring student as he engaged in the Maze task. Not only did he stop and pause while drawing the path through each door, but he also looked back from where he had come, and then forward to determine the effectiveness of each move. At one point he stopped and said:

"Oh, I can't go there...!"

and following this self-imposed check, the direction of his move was changed and he proceeded to successfully complete the task. The Toothpick task came to a swift conclusion when Martin said:

"Oh Yeah......!"

and removed the only two toothpicks which would bring the puzzle to a successful end.

Wendy consistently required teacher rather than self-direction with both the Number Triangle and the Maze. Although every effort was made to ensure that Wendy understood the requirements of each task, for example, the need to add numbers on one line to give a sum total on another, or the spatial concepts involved in discerning a path through the Maze, were difficult for her to grasp at that point in time. Again there were no articulated indications of cognitive effort, however, there were indications that her attention was wavering and calls back to task were frequent.
Strategy 4 - Reflection

Qualitatively different approaches to learning were evident in numerous aspects of Martin’s and Wendy’s problem-solving behaviour, but none more so than their reflective responses to researcher questioning. Whereas Martin was eager to discuss his performance, likening aspects of each task to previous experiences, Wendy merely shrugged when questioned and was not prepared or alternatively was unable to articulate thoughts she may have had regarding her problem-solving efforts.

As mentioned previously, Martin engaged wholeheartedly in the Maze task, however, he said that in fact he had not had a plan in his mind, but rather:

"...just worked it out as I went along..."

He then suggested that he thought that:

"if I started there, I would look around to see if I could...", and "if I was going wrong there...I saw, and stopped and went back there...!"

Martin’s comment on his management strategies in general suggested that he had already internalised many thinking skills, as he said:

"I just think... bang, bang, bang, as I go along!"

When asked if he would do anything differently next time he encountered a problem like the Maze, Martin replied:

"I’m not sure that I would do anything differently at all!"
Martin’s full engagement and creativity was again obvious when reflecting on the Toothpick task. When asked why he had taken the two toothpicks away that he had, he merely replied that:

“I had to take those two away!” (Martin’s voice indicated that he was surprised that I could even consider another possibility)

He went on to say that:

“What I was thinking was that I could take that one away and that one, and move those [pointing to a number of different Toothpicks], to give me two triangle boxes!”

Far from being hampered therefore, by the constraints of the puzzle before him, Martin was able to creatively construct (as a purely cognitive exercise) alternative ways of reaching a conclusion. After all, although the shape of the boxes was implied as the objectives of the puzzle were outlined, it was never clearly articulated!

Martin’s use of strategies is consistent with that of most high achievers and his creative thinking and full engagement with each task suggests that he uses strategies to further his own interest in the task and solving problems, as much as to draw them to a subsequent completion. Wendy on the other hand, although initially pleased at having been selected to complete these tasks, was easily distracted, lacked enthusiasm and motivation, and, upon determining their complexity, was anxious to complete them quickly. Her understanding about and use of strategies appeared to be minimal, and much in her personal demeanour and problem-solving behaviour suggested that Wendy was developing as a superficial or surface approach learner.
Cognisant of the fact however, that strategic behaviours alone may not be indicators of deep or surface learning as with the previous cases studies, some of the affective characteristics of these young learners have been observed, and consideration given to their learning environment.

**Factors Influencing Approaches to Learning**

**Attention**

Deep and surface learning pathologies testify to the fact that one of the significant variables influencing each approach is attention. Certainly Martin attended consistently to the tasks at hand and used his attention to translate what was already known about the types of problems he was engaged in for use in a novel situation. Martin was able to creatively construct ways of thinking, based on past experience (for example his discussion about a treasure map), paying attention to detail while cognisant of the whole.

Consistent with surface approach learning behaviour, Wendy demonstrated relatively little attention to detail, indeed her concentration throughout the entire episode suggested that attendance at many tasks would be minimal. Wendy’s goal certainly appeared to be merely to complete tasks rapidly, suggesting that her attention was directed toward the whole rather than on the most relevant aspects which may have ensured greater success.

**Factors Influencing Approaches to Learning**

**Motivation**

Although each child received similar verbal extrinsic rewards in the form of praise and encouragement, accompanied by smiles, nods, glances and the like, each also carried personal motivators when solving tasks. Wendy for example, was not motivated intrinsically to complete the tasks she chose. She was either unable or unprepared to invest time and effort into the
demonstration of strategic behaviours, such as ensuring understanding of the goal, planning the task or monitoring task demands. Possibly based on her albeit brief history of academic struggle, Wendy had developed a perception of her abilities in relation to an externally imposed set of standards. It is likely therefore, that even after only three terms at school, Wendy perceived herself as less able than many of her peers and was unwilling to expend extra effort on tasks she believed herself unable to complete.

Martin however, had a history of high achievement and his problem-solving behaviour suggested that he was intrinsically motivated to engage in challenging tasks for pleasure. He undoubtedly felt far more certain of his own abilities than Wendy and therefore, reasonably assured of a successful outcome. One of the characteristics of deep learners tends to be an appreciation of and respect for effort and challenge, perceiving learning and problem-solving activities not merely as means to an end, but as worthy ends in their own right. For Martin, problem-solving was intrinsically challenging and fun. He was motivated to use the sort of deep-processing strategies which enabled him to engage fully in each task, to self-regulate his own cognitive processes, and ultimately, to satisfactorily finish each task.

**Factors Influencing Approaches to Learning**

**Self-Concept**

Another important factor thought to correlate with the way students approach learning is the self-concept. For example, Covington (1992) and Sinclair (1991) note that learning and self-concepts are interrelated, and that low levels of self-esteem are linked with low levels of achievement motivation.

Wendy and Martin were each tested using the *Pictorial Scale of Perceived Competence and Social Acceptance for Young Children* (Harter, 1982; Harter
& Pike, 1983) (see sample Appendices C and D). Scores for each child were high, showing raw measures of 78 and 81 respectively (max 96) (mean for group M=82.3 SD. 9.9). A breakdown of the total measures into four component parts however, suggests that Wendy perceived herself to be less cognitively competent (score of 16), (M=20.7, SD.3.2), than she was accepted by her peers (score of 21) (M=21, SD.3.3), maternally accepted (score of 22) (M=19.9, SD. 3.4), or physically competent (score of 19) (M=20.5, SD, 2.9) (See Figure 8.6). Martin perceived himself as highly competent in cognitive pursuits (score of 24) (M=20.7, SD.3.2), competent socially amongst his peers (score of 23) (M=21, SD.3.3), but a little less so physically (score of 18) (M=20.5, SD, 2.9), and at home (score of 16) (M=19.9, SD. 3.4) (See Figure 8.6).

Given that Harter and Pike (1983) have determined that students with subscores ranging between 12 and 18 are in the medium range, then it might be assumed that Wendy’s cognitive competence subscore of 16 may be a reflection of her underachievement at school, which has already begun to undermine her academic self-concept. Certainly, underachievers and surface approach learners tend to develop negative self-concepts regarding their ability to learn if this is not promptly checked. They tend to be more anxious than high achievers, fear failure more readily, are impulsive in the way they approach tasks, and often appear defeated almost before tasks are begun.
Figure 8.6
Pictorial Scale of Perceived Competence and Social Acceptance for Young Children - Martin & Wendy

Martin displayed none of these characteristics possibly as a reflection of the way he perceived himself based on his past academic performance. While many young children hold high and often unrealistic beliefs regarding their abilities, Martin’s cognitive subscore of 24 did indeed accord with his high achieving status in the classroom, his ability to think creatively and use strategies to maximise his efforts on problem-solving tasks and indeed his performance outcomes.

Factors Influencing Approaches to Learning

Learning Environment

As part of the control group for Study 1, Martin and Wendy participated in a “best practice” classroom where although the teaching was generally considered exemplary by many standards, it did not reflect the principles underlying the teaching in the experimental groups. Examination of the videotaped teaching sessions, filmed as the teacher gave instruction in mathematics to her kindergarten classes shows a dedicated young women
committed to quality education. Martin and Wendy appeared to enjoy their developmentally appropriate environment which allowed them to participate in “discovery learning” experiences.

Two of the fundamental differences observed between this control class and those participating as part of the experimental group were that a great deal more teacher/pupil interaction was focused on management, and that reinforcement was centred on the child rather than on the task and its demands. For example, although most members of the class were involved, active, busy and well behaved, much of the ensuing dialogue dealt with management of the movement between tasks, discussion regarding turn-taking and aspects of the tools being used. While reinforcing language was frequently used, it was of the “good girl”, “good boy”, “nice try”, “fantastic colours” variety, which although positive in nature, did little to expand the cognitive understanding of the students within the class. Very few strategic behaviours were discussed and modelled within the classroom as the teacher spoke of task objectives and ultimate goals. Although the environment did not appear to be rushed, and there was considerable peer interaction while tasks were undertaken, it seemed that a greater emphasis was placed on the completion of the task than on the demands of the task itself.

**Summary**

Although Martin and Wendy each displayed strategic activity, Martin, a boy achieving in all subject domains at a consistently high level, appears to have developed a more extensive range of the higher-order thinking skills necessary for deep learning. Martin seems to perceive learning as a quest for understanding; viewing task mastery and problem-solving as personally challenging, valuable activities in their own right, and not just as means to an extrinsically rewarded end. Martin demonstrated his personal involvement
with each activity, constructing relevant meanings (for example, the pirate treasure map out of a Maze), out of an impersonal goal. His attention to detailed aspects of the whole, while keeping the whole in perspective, enabled satisfactory task completion. Already Martin has a repertoire of tools for thinking beyond the classroom environment; he has already developed some of the characteristics of deep learners.

Wendy however, a child from the same classroom, appears to have perceived learning in quite a different manner. Her poorly developed strategic understanding and minimal use of metacognitive strategies were insufficient to enable task completion to take place. Wendy did not display any of the organisational and planning skills necessary for self-regulation, and she appeared to be motivated to complete each task because it was required of her rather than for their enjoyment or challenge value. Given those characteristics, it seems that Wendy is developing as a surface learner. Wendy has already developed less than positive self-concepts, at least in the way she perceives her cognitive abilities. This is unlikely to improve within the current classroom environment unless her cognitive thinking is challenged and she is given the opportunity to develop and practice the sort of strategic skills which will enable her to set goals, plan, monitor and reflect on the tasks set for her.

Even in a positive, warm, developmentally appropriate classroom, students who do not have the opportunity to develop metacognitive, higher-order thinking skills at home or in some other context, may not develop them appropriately. Thinking skills must instead be explicitly taught, and regularly modelled and practiced if children are to develop as flexible, self-regulating learners. Teachers therefore, need to do more than reward positive behaviour. Transfer of information is more likely to take place when the teacher and
student form a collaborative partnership where expert thinking is articulated as it is passed on to the less experienced thinker. Rather than a developmentally appropriate classroom designed to allow the student to “discover” independently, the classroom is the perfect venue for an “assisted discovery” approach where knowledge can be shared.

CASE STUDY 4
Control Classroom 2
Dara and Daniel

Introduction
Aged five years and six years respectively, Dara and Daniel were both in the same kindergarten class at a primary school in Sydney. Like most young students in their first year of school, they were eager participators in classroom activities and seen by their teacher as intelligent, able children with the potential to achieve well. Like the children from previous classes however, there were differences in their academic outcomes with Dara achieving at a considerably higher level across all domains than Daniel.

As part of a previous experimental study (Study 1), during which time their class acted as part of a control group, Dara and Daniel underwent pre and posttesting using the TEMA 2 instrument (Ginsburg & Baroody, 1990) (Appendices A and B). The results of these tests endorsed the teacher’s perception of each child as either a high or low achiever. For example, although Dara’s pre and posttest raw scores did not change, they registered a high 35 each time. Daniel’s scores on the other hand, were 24 (pretest) and 21 (posttest), significantly lower than Dara’s. The control group pre and
posttest means were $M=26.8$, $SD=5.1$, and $M=29.6$, $SD=5.5$ respectively. Relative scores are shown in Figure 8.7

![Bar chart](image)

**Figure 8.7**
TEMA 2 Pre and Posttest scores
Control Group 2 - Dara & Daniel

*Performance and Behaviour on Problem-Solving Tasks*

Dara chose and completed five of the problem-solving tasks available and Daniel chose and completed three. Although metacognitive, self-regulating strategies are discernible in some measure on all tasks and are used by both children, only two tasks, the Maze (Appendix F) and the Number Triangle (Appendix H) are discussed.

Following repeated observation of Dara’s and Daniel’s problem-solving attempts, overt cognitive actions were not as readily discernible as with some other children. Certainly these focus children and indeed most of the class were less outgoing than some of their peers in other classes, less chatty in general and less willing to discuss the puzzles they were invited to complete. Nonetheless, they displayed some strategic action as they were confronted by the tasks, albeit at a minimal level.
Strategy 1 - Identifying the Problem

Neither Dara nor Daniel indicated verbally that they were clear about the goals of either the Maze or the Number Triangle tasks, although each child’s non-verbal behaviour such as their level of concentration and facial expressions, suggested that the requirements were understood.

During the explanation of the Maze puzzle, Dara’s concentration was intense and as various moves were demonstrated by the researcher, Dara followed each with her eyes. In a similar manner, Daniel’s concentration was also high as the puzzle goals were explained and suggested moves were demonstrated.

Similarly with the Number Triangle, when each child’s strategic behaviour was also non-verbal, although, as with the Maze puzzle, intense concentration was evident as the task goals were explained and strategies demonstrated.

Strategy 2 - Planning the Task

Once again it was difficult to discern any significantly overt planning action as the Maze task was regarded, although concentration levels were maintained. On one occasion before she attempted the task, Dara touched the Maze outline, but no verbal indication of her thinking was evident, although the prompt solving of the problem suggests that her planning was nonetheless quite efficient.

The Number Triangle, a more difficult task to undertake, had each child concentrating intently, however, there were neither non-verbal nor verbal cues to indicate any planning had taken place. Dara and David were both very eager to commence, although their lack of planning and possibly
understanding, quickly became apparent when the demands of the task became evident.

**Strategy 3 - Self-monitoring**

Following several observations of the videotaped data and close examination of the transcriptions, it was evident that most of the monitoring behaviours displayed by Dara and David, especially with the Number Triangle, were teacher rather than self-monitored. Dara however, approached the Maze puzzle with confidence after her silent appraisal, and solved it with one deliberate move.

Daniel’s attempts were a little more laboured, and it was only after several prompts by the researcher that he was finally able to complete the puzzle. For example, when Daniel had moved in and out an opening instead of simply moving through once, he was asked:

"how many times can you move through the openings?"

When he replied:

"one", he was further questioned about the moves he had made. When it was established that he had in fact moved in and out some of the openings several times, he was told:

"we can't move in and out each opening, so, let's go back, and look at the puzzle again."

A little later, when I suggested that we move in a certain direction, Daniel was instructed to:
“look carefully and think which way we could go to move through each opening only once.”

As previously mentioned, the Number Triangle proved to be a challenge for both children, however even Dara who after a shaky start, accomplished the task successfully and relatively quickly, displayed very few observable self-monitoring behaviours. When it was suggested that Dara check her results, she was unaware of any procedure for this. Having been reminded that it was possible to check by:

“adding two of the bottom numbers to form the middle number, and then the two middle numbers to form the top number,”

Dara repeated this procedure confidently with the remaining numbers in the triangle.

Daniel experienced considerable difficulty with the Number Triangle, and again, apart from directing attention to the task, most monitoring behaviours were teacher rather than self-initiated. Daniel found the concept of the Number Triangle difficult to comprehend, added to which he was unable to do more than very simple additions. When asked what we needed to add to two (2) to make three (3), Daniel replied:

“Eight!”

When it was suggested that two and eight would not make three, but rather made ten, Daniel thought again and finally said:
“One!”

Daniel was encouraged to check the sum after which he was able to write in the appropriate number in the circle provided. Completion of the remaining numbers within the puzzle however, was a task beyond Daniel’s current ability.

**Strategy 4 - Reflection**

Only when questioned by the researcher were reflective behaviours demonstrated. When asked why she had chosen to create the path through the Maze that she had so quickly, Dara’s reply was:

“Well I thought of moving there (pointing to another pathway), but then I moved this way.”

When Daniel was questioned about the Maze task, he simply shrugged.

Again, only Dara showed reflective behaviour following completion of the Number Triangle. At one stage at the commencement of the task, Dara made one small error. Upon reflection, when asked:

“When you did that, what were you thinking?”

Dara replied:

“I added those, I thought they were linked!”

Daniel made no comment when asked to reflect on his performance.
While Dara and Daniel used some observable strategies to assist in the completion of their problem-solving tasks irrespective of their current academic performance, at first glance their strategy use appeared to be minimal. In almost every instance the strategies observed were non-verbal. Although cognition is most frequently non-verbal, in fact it is evident only when thinking is verbalised or expressed in overt facial or hand gestures, such covert behaviour made it difficult to discern the possible learning orientation of these children.

Mindful that learning approaches are also characterised by a range of intrinsic and extrinsic factors and not strategic behaviour alone, Dara’s and Daniel’s actions and experiences in some of these areas need consideration. As previously noted, attention, motivation, self-concepts and the learning environment are all major contributors to perceptions held regarding the goals associated with learning and school participation. Intrinsically motivated students, inspired to think and learn for the thrill of the exercise will attend with greater interest, exert greater effort and frequently enjoy greater success than many of their peers. On the other hand, students completing work only to meet an externally imposed standard are more likely to adopt a pragmatic approach and to invest minimal effort resulting at times in a mediocre performance or possible failure.

**Factors Influencing Approaches to Learning**

**Attention**

Although both Dara and Daniel attended when tasks were presented, at least one significant difference became immediately apparent; the difference in performance. In spite of the performance contrast, it was nonetheless difficult to visually discern differences in their attention levels. At the same
time, however, it was because of variations in performance that it was permissible to assume that differences in attendance to task details took place. Certainly it has been found that the ability to attend selectively to task-relevant aspects of the environment is of considerable benefit, and that attention is useful for translating knowledge into performance (Eysenck & Keane, 1996). Eysenck and Keane also noted that poor strategy use and low achievement are characteristics of low attending students.

**Factors Influencing Approaches to Learning**

**Motivation**

As with attention, the motivation of these children was difficult to discern. Therefore, while determining motivation can be only conjecture at this point, it is known that motivation is closely related to attributional processes. These too may be linked to feelings of success or failure which are frequently acquired in the classroom when children are allocated ability groupings or as a result of assessment. Based on their previous academic records therefore, Daniel may have perceived himself as cognitively deficient, while Dara is more likely to have perceived herself as cognitively competent. Poor perceptions of personal ability, especially when measured against an external standard tend to make students less inclined than some of their peers to invest energy in and to persevere with complex tasks. As positive attributions are only acquired through consistent academic encouragement and experience of success over time, the development of attributions which encourage intrinsic motivation, require a very special teaching approach.

**Factors Influencing Approaches to Learning**

**Self-Concept**

As previously noted, students with positive self-concepts are more likely to use sophisticated learning strategies and perform better than students with
poor self-concepts (McCarthy & Schmeck, 1988). Each child’s overall self-perceptions were measured by the *Pictorial Scale of Perceived Competence and Social Acceptance for Young Children* (Harter, 1982; Harter & Pike, 1983) (see sample Appendices C and D). Their scores were high, showing raw measures of 83 and 88 respectively (max 96) (mean for group M=82.3, SD. 9.9). When the total measures are broken into four component parts we note that Daniel and Dara perceived themselves as cognitively competent (scores of 24 and 23) (M= 20.7, SD.3.2), accepted by their peers (scores of 23 and 22) (M=21, SD.3.3), and maternally accepted (both scored 21) (M=19.9, SD. 3.4), although Daniel saw himself less overall physically competent (score of 16) (M=20.5, SD, 2.9) than Dara (score 21) (Figure 8.8).

![Figure 8.8](image)

**Figure 8.8**
Pictorial Scale of Perceived Competence and Social Acceptance for Young Children - Dara and Daniel
Factors Influencing Approaches to Learning

Learning Environment

While teachers participating in the intervention programme (Study 1) had been encouraged to explicitly teach about and actively model the use of metacognitive, self-regulatory strategies and to encourage deep approaches to learning as they taught mathematics, teachers in the control groups, such as the classroom within which Dara and Daniel were participants, employed current “best teaching practice”. Although the teaching practices employed in the control classrooms were considered exemplary, there were significant differences evident between the groups. Like the classroom mentioned in Case Study 3 - Control Group 1, this classroom was also busy, active and harmonious, albeit very controlled and remarkably quiet.

Observations of the videotaped interactions during mathematics classes, showed a dedicated, highly organised teacher whose classroom was a model of peace and order. It was not surprising therefore, that Dara and Daniel were reserved and self-controlled, having spent the previous three terms (their entire school lives) in such a tranquil environment. The children responded well to their teacher’s direction, obviously secure in this calm, predictable atmosphere.

It was not the calmness, tranquillity or predicability that gave cause for concern in this classroom. Indeed, achieving such an atmosphere has been a desired goal of many teachers, having been perceived as the perfect environment for the effective transfer of knowledge. Observation of the interactions within this classroom revealed a solid behavioural approach to learning with reinforcement based on a system of rewards for orderly behaviour, task completion, correct work habits and good manners (the “good boy, good girl” approach adopted by the classroom teacher illustrated in the
previous case study). Dara and Daniel, along with the other members of their
class understood that well mannered children did not chatter, but rather
worked quietly at their own tasks, raising their hands if assistance was
required.

Summary
While it is apparent, both in performance outcomes and learning behaviours,
that each of these students has adopted a qualitatively different approach to
thinking, learning and problem-solving, determining whether learning is
approached at a deep or surface level is more difficult to discern. Little has
been gleaned regarding attention and motivation, and each child’s self-
concept has been assessed as being high, particularly in the sub-category
related to cognitive performance. The only clue to the quiet, passive approach
to tasks adopted by each child, aside from the fact that they might well be
reserved individuals, has been found within the classroom context itself. The
well ordered, well mannered group of children who make up this classroom
do not seem to have had their thinking challenged in the same manner
evidenced in other classrooms, nor have they regularly experienced a
“metacognitive” “scaffolded” type of instruction.

Regarding again the premise that acting, thinking and feeling are inextricably
linked (Prosser, 1993), the problem-solving behaviours displayed by these
students would appear to suggest that they viewed learning more as “what”
the finished result should be, having followed the correct procedures to reach
that goal. Less emphasis appeared to be directed toward “how” and “why”
tasks are completed. It is therefore, of concern that even Dara, currently
achieving considerably better than some of her peers, may nonetheless have
already perceived school based learning not in terms of meaning and
understanding but in the more shallow terms of meeting behavioural and
institutional requirements and finishing tasks in the quietest, most efficient manner. Daniel presently underachieving, may never be given the opportunity to redress or overcome areas of misunderstanding unless he is explicitly taught about and given the opportunity to practice the type of strategies which enable more successful learning to take place. From a sociocultural perspective, greater interaction between teacher and student, and collaboration amongst peers with the opportunity to share ideas, experience more expert thinking and test strategies is imperative, if such learning is to occur.

**Summation of Case Studies**

Focusing on the learning behaviours of high and low achieving students from two of the experimental and two of the control classrooms, these illustrative case studies have dealt with the qualitative voices which in many cases reveal perceptions of learning held by individuals. Case studies have been seen as an appropriate methodology when studying educational interventions or innovations (Lancy, 1993). They describe personal experiences and behaviours and have been compiled through a variety of sources. Because of the considerable personal involvement in the study, I have adopted an evaluative position and made assumptions based on previous documented research regarding learning approaches in addition to the more detailed and comprehensive observations of videotaped behaviours, transcribed discourses, teacher discussions and field notes.

Each of the children discussed in these case studies has been an active participator in developing understandings about the world by building upon not only genetic but also the sociocultural constraints and resources imposed upon them or available to them. As "apprentices in thinking" (Rogoff, 1990),
it is the sociocultural context within which they have spent their years that has provided the impetus for such development. Of course for the majority of their young lives these children will have shared experiences with their parents and possibly a range of carers at either Preschool or Day Care. Of significant importance however, have also been the experiences shared at school, albeit brief experiences over three terms of one year.

Perceptions of learning develop as a response to a range of experiences (Biggs, 1989), and even when there are similarities in the teaching approach, individual students, even those within the same class, tend to perceive learning in qualitatively different ways. The learning pathologies of the eight students described in these cases studies reveal a range of attentive behaviours, motivations, self-concepts and of course learning environments. Of significant interest are the differences in strategic behaviour displayed by each of these students; differences, according to Marton and Saljo (1976) which may reflect students’ intentions regarding set tasks. An effective use of higher-order strategies, designed to create links and aid understanding suggests that students perceive learning as an interpretive process, a planful use of resources for enhancing meaning. As a corollary to this, students developing as superficial or surface learners interested largely in meeting educational or institutional demands, are more likely to use low-order strategies or none at all.

Ideally of course, all students will develop deep approaches to learning, approaches which have as their goal, meaning, understanding and the ability to transfer knowledge across domains. In reality, such goals are often elusive, an ideology which bears little reality for many students. Unfortunately, many of the poor problem-solving actions, already evident in
some of the students in this study are predictors of their future thinking and learning behaviours.

Of vital interest to this study, is the belief that effective learning behaviours can be encouraged within the classroom. If teaching is to benefit all students and equip them to live and work gainfully in an ever changing society, then thinking as a curriculum offering must be put firmly on the reform agenda. In the following chapter (Chapter 9), issues arising from the observations of students’ learning behaviours and descriptions of their problem-solving attempts noted in the case studies will be discussed.
Chapter 9

DISCUSSION

In the previous chapter (Chapter 8), some of the differential perceptions about learning held by the children who participated in this study were described in greater detail in four illustrative Case Studies. From these Case Studies, the magnitude of the diversity of learning characteristics displayed by students is evident and range from the frequency of the use of strategies, to the types of strategies used and their effectiveness in problem-solving activity. Additionally, it has been found that levels of achievement both influence and are influenced by the use of strategic behaviours and that these in general, also appear to be consistent with approaches to learning which suggest that deep or surface understanding may already be present in the very early school years. Other factors characteristic of the diversity present amongst students include attitudinal factors, motivation and self-perceptions, along with the quality of teacher/pupil relationships and the general learning environment. Moreover, the results seem to indicate that the explicit teaching of strategic behaviours using a cognitive apprenticeship model, even after such a brief period of instruction, does appear to influence strategy use.

Chapters 7 (Results) and 8 (Illustrative Case Studies) both made reference to Study 1, which like this study (Study 2) recognised the crucial role of the sociocultural context for effective teaching and learning. Study 1 was essentially a quantitative, explorative endeavour, which sought to determine the efficacy of delivering mathematics lessons in an environment which supported and encouraged higher-order thinking. Although numerous studies in the past have explored the value of instructing small groups or
individual children in the use of metacognitive strategies, few have looked at teaching "metacognitively" in a whole classroom context. While individual and small group tuition is obviously highly desirable from an economic and management perspective, individualised teaching on a large scale is neither economically viable nor practically possible given staffing and financial constraints.

Study 1 examined changes in the mathematics performance of five classrooms of children after a period of "metacognitive", "scaffolded" teaching intervention. Additionally, it sought to shed light on the most practical and efficacious method of delivering instruction to a class group of children, while emphasising the use and importance of the strategic behaviours necessary for the application of facts and skills in problem-solving situations (Ashton & Elliott, in press).

The pretest scores achieved by eight (four experimental and four control) classroom groups of children using the TEMA 2 (Test of Early Mathematical Ability - Edition 2) instrument (Ginsburg & Baroody, 1990) (Appendices A & B), and their subsequent posttest scores following the period of experimental teaching were analysed and briefly discussed. For the purposes of this study (Study 2), which seeks to determine some of the qualitative determinants of academic behaviour in the early school years, the quantitative results of Study 1, not only provide group means and individual scores but help to contextualise Study 2. Additionally, the problem-solving behaviours of a number of individual children based on their previous participation in either the experimental or control group are of vital interest, and the voices of the participants along with their personal characteristics have been allowed to speak for themselves in the illustrative Case Studies (Chapter 8).
More specifically then, this thesis (Study 2) has sought to address a number of important questions relating to the metacognitive, self-regulatory strategies students use when solving problems. One goal was to determine whether children almost at the end of their first year of school had begun to develop any of the strategic behaviours thought to assist with learning and problem-solving, and if so, to determine the kind of strategies used and how they were displayed. The second goal, bearing in mind the inextricable link that strategic behaviour has with the affective attributes of students, was to determine whether the strategic activity displayed in these early school years indicated a trend toward a deep or surface learning approach, while the third goal sought to determine whether there were any qualitative differences evident in the strategic behaviours of the children who had been in the “metacognitive” as opposed to the control teaching groups.

Phenomenography as an investigative tool, has sought to ascertain these qualitative differences in the learning approach adopted by very young children. As the early school years are a formative period in the development of the efficient learning behaviours so necessary for the critical educational demands to come, the perceptions regarding learning gained within the first year of school may have lifelong implications. Community expectations of school have become more stringent and educators are obliged to impart significantly more than a given set of skills which are no longer sufficient to meet the flexibility demanded by workplace technology and communication. Students must be encouraged to develop the skills to think and to adapt their cognitive abilities to meet a range of expectations across numerous domains. In this study, phenomenography has been used firstly to ascertain the “way” students perceive learning rather than “how much has been learned”, and whether these perceptions indicate a desire for meaning and understanding
(deep learning approaches), or hold learning as merely a means to an end (surface approaches).

As deep and surface learning approaches, coupled with numerous affective characteristics are linked to strategy use, it quickly became apparent that even amongst children in their first year of school some of the behaviours associated with deep and surface learning approaches were evident. Study 2 has revealed, therefore, that from a very early age the way children perceive learning, either as the reproduction of learned facts for institutional requirements or the application of strategies to assimilate existing knowledge with new to give meaning, is already influencing their learning endeavours.

This chapter (Chapter 9) discusses the important aspects and issues arising from the general results (Chapter 7) of Study 2, as well as the more detailed aspects of the learning behaviours mentioned in the illustrative Case Studies (Chapter 8).

**The Use and Frequency of Strategic Behaviours**

The importance of self-regulation in learning to academic achievement has been well documented (Anderson, 1989; Berk, 1992; Corno, 1994; Schunk & Zimmerman, 1994), and learners are perceived to be self-regulating when they are “metacognitively, motivationally and behaviourally active participants in their own learning processes” (Purdie & Hattie, 1996). Self-regulating students who believe they exercise control over their own learning endeavours have been found to consistently achieve considerably greater success in their academic pursuits than those more dependent on teacher direction and extrinsic motivators (Bandura, Barbaranelli, Caprara, & Pastorelli, 1995). It became very clear therefore, that several of the young
children in this study, even though they were only five and six years of age and with just three terms of formal tuition behind them, had already begun to exercise such control over their own learning processes.

**Strategic Behaviour**

Clearly, children who enter formal schooling at the age of five years, already know a great deal about the world, their own beliefs and about the conditions of knowledge (Ertmer, Newby & MacDougall, 1996; Olson & Astington, 1993). However, as with students in previous studies (Bandura, 1993; Schunk, 1989; Zimmerman, 1994; 1995a) the children observed here have further developed a belief in the efficacy of the use of some of the strategic thinking behaviours necessary for successful learning and problem-solving. Strategic behaviours are procedures that guide students as they attempt to complete tasks such as reading comprehension, writing and mathematics (Rosenshine, Meister & Chapman, 1996). Bandura et al. (1995) suggest that when such beliefs exist, then the psychosocial processes which influence academic functioning are more diverse. For example, they note that perceived self-efficacy based on beliefs regarding strategy use has been found to be a much stronger predictor of academic achievement than self-concepts about ability (Bandura et al., 1995). This, coupled with other psychosocial elements such as positive overall self-concepts, attention to vital task elements and intrinsically determined motivation, suggests that some of the students in this study were also well on the road to becoming deep learners. Such students seek meaning from assigned tasks and learning endeavours through the use of higher-order cognitive behaviours.

It must, of course, be recognised that sociocultural environments other than school may also have influenced students' perceptions of learning, therefore, school alone cannot be commended, nor be held entirely responsible for the
learning behaviours and perceptions of these students. Obviously, as other researchers note (Diaz, Neal & Vachio, 1991), previous experiences in the preschool or at Day Care, along with prior as well as ongoing experiences within the home environment, where scaffolded support may have been received whilst undertaking cognitive endeavours with significant others, have also encouraged conceptions of learning.

Nevertheless, for at least six weeks the experimental classroom environments within which eight of the children were given mathematics instruction (for example, Timothy and Andrew - Case Study 1; Susie and Anna - Case Study 2) should have significantly reinforced perceptions of learning as a strategic activity. Following training, each of the teachers in the metacognitive classrooms explicitly articulated process learning goals and taught in a manner which encouraged extended thinking and strategic behaviour for meaning and understanding. In a similar manner, the teaching delivered in the control groups within which the remaining eight students worked (for example, Martin and Wendy - Case Study 3; Dara and Daniel - Case Study 4), are also likely to have reinforced the learning perceptions previously held, also reflecting numerous beliefs about learning objectives.

Although all sixteen students in this study demonstrated some awareness of strategic behaviour, the differences in their approach to the use of strategies and the frequency of metacognitive strategy use, suggests that their differential learning environments may have already had some bearing on learning behaviour.

To ensure that high achieving, intrinsically motivated children such as Andrew (Case Study 1-Experimental Group), and Martin (Case Study 3-Control Group) will continue to hold perceptions of learning and problem-
solving as a discovery of meaning, rather than the reproduction of learned facts for assessment purposes, the classroom environment must be such that these perceptions continue to be facilitated. If, as Borkowski, Carr, Rellinger and Pressley (1990), along with Ertmer, Newby and MacDougall (1996) suggest that one of the marks of high achieving, deep learners is a vast repertoire of strategic skills, then teaching about strategies, well-matched to specific tasks, as well as the opportunity to practice the use of these strategic skills should be a priority for every classroom.

Although the development of understanding is possibly an articulated goal of most classroom teachers especially in the early school years, the pressure to prepare even kindergarten children for the rigours of examinations based on a knowledge of learned facts in the years to come has become an additional goal. Certainly there can be no denying that a knowledge of facts and mastery of certain skills may be a necessary component of assessment for determining a student’s suitability for higher learning or employment. If however, students perceive school-based learning entirely in this manner, based on the explicit or implicit demands within the classroom, then learning for meaning may be limited. Students who are not regularly taught about and given the opportunity to observe strategies and collaborate dialogically with more expert thinkers, may perceive learning as shallow and fail to be equipped for the rigours of a society which is regularly increasing its emphasis on the ability to access, process and transfer information (Ertmer, Newby & MacDougall, 1996).

Not surprisingly, given the young chronological age and immature developmental stage of the students participating in this study, the strategies most frequently found to be used by the children were relatively fundamental, especially when placed in the context of the more sophisticated cognitive
behaviours discussed in Sternberg’s (1990) metacomponent list (see Results - Chapter 7). As strategic behaviours develop with maturity, slowly and over time, even simple strategies, for example, being sure of the demands of the problem, planning procedures, monitoring task demands and reflecting upon actions, indicate that there is already significant metacognitive awareness present in some children. If strategic behaviours are to continue to mature, thereby enabling students to reach their fullest learning potential, instruction must be conducted with the development of metacognitive components in mind.

**Frequency of Strategy Use**

Although all students in this study displayed some strategic behaviour, as previously noted, the differential nature of strategy use, its frequency and efficacy varied markedly.

In most cases, strategic behaviour was more a characteristic of the high achieving rather than the low and underachieving students. Nevertheless, while the actions of some of the high achievers were obviously carefully calculated to ensure the greatest possible success with their task endeavours, successful completion of tasks did not appear to be the most pressing motivator. Strategy use occurred most frequently amongst high achieving students, irrespective of the teaching/learning environment within which they had developed. In other words, the high achievers from both the experimental and control classrooms were the most frequent metacognitive strategy users, demonstrating behaviours which indicated their growing competence as self-regulating learners. That is not to say of course that the low and underachievers did not also use strategies, however, there were significant differences in the efficacy of their actions and the frequency of such use.
While high achievers tended to use the full range of identified strategies (establishing goals, planning moves, monitoring behaviour and finally reflecting on outcomes) to regulate their problem-solving, low achievers did not display this to the same degree. Low and underachievers were inclined to attend while the goal was articulated and possibly indicate a rudimentary plan but, they were often deficient in monitoring thinking as the task proceeded and poor at reflecting on their performance. Of considerable interest to his study however, was that students who had participated in the experimental teaching programme (Study 1), displayed considerably higher frequencies of metacognitive strategic behaviour irrespective of their high or low achievement status, than the combined high and low achieving students from the control groups. The efficacy of placing students within a rich metacognitive teaching environment is discussed in more detail later in the chapter.

Deep and Surface Approaches to Learning

Additional to the support that metacognitive, self-regulating strategies lend to the learning/problem-solving process, they play a significant part in the development of deep approaches to learning and have been found to be vital for the adaptive, flexible ways of thinking necessary for future work roles. As Jones and Idol (1990) note, the societal and commercial changes occurring at such a rapid rate in the latter part of the 20th century have necessitated a shift in focus from manufacturing to information and services. This, they argue, has resulted in a greater dependence on the human brain and the capabilities of the intellect, than there has ever been in past generations. With a touch of irony however, Jones and Idol (1990) lament the fact that the human resources available to meet the growth of these mind-expanding tasks is simply not available and without a determined effort by educators to
address the deficit, then our ability to access these new services will be seriously limited.

Slade (1995, p.37) commenting on an Australian report by Don Anderson to the Senate Standing Committee on Priorities for Reform in Higher Education, said of university graduates that their “critical and analytical capacities are limited [and] their ability to confront and argue a case is limited”. Biggs (1985) has noted that the deep approaches to learning (thinking for the transfer of meaning) required for challenging tasks tends to decrease with age, at least at the tertiary level. He suggests that this may be a reflection of the institutionalisation of students and insecurity regarding graduate employment, but goes on to note that deep learning reaches its lowest point at around 22 years of age. Schofield (1996) has reported similar trends and recognises the need for research attention to be focussed on a higher plane of cognitive functioning. He notes that by training students to think analytically about their own learning and problem-solving processes, students are more able to take control of their thinking and learning experiences. Of significant importance here is that students trained in this manner have been found to attribute success and failure to self-controllable factors, thereby increasing their autonomy as learners (Schofield, 1996).

As one of the significant goals of most learning endeavours is ultimately self-regulation, the importance of deep, strategic understanding for the long-term academic welfare of the student cannot be underestimated. Moreover, when considering the far reaching effects of the development of strategic behaviours in this ever expanding, mind challenging society, the urgency of early metacognitive training must not be overlooked. No longer is the “product” emphasis acceptable, although there are still supporters of instruction which focuses exclusively on knowledge acquisition, who argue
that the development of facts, plus information regarding problem-solving results frequently in cognitive overload (Sweller, 1990). Instead, educational institutions must develop as their goal the student's capacity for higher-order thinking. To this end, Jones and Idol (1990) have said that,

We must improve students' capability to acquire, analyse and apply complex information; to locate, communicate and produce information effectively; to solve problems quickly and efficiently; and to be committed to lifelong learning (p. 3).

This of course is consistent with the thinking of others for example, Nickerson, Perkins and Smith (1985) who, also concerned about the teaching of thinking, said that on the one hand knowledge is essential to the acquisition of thinking, but on the other, thinking is also essential to the acquisition of knowledge. Similarly, Evans (1991) referring to the work of Glaser (1984), supports Jones and Idol's position, stressing the importance of the process nature of thinking and problem-solving for deep knowledge and understanding.

Furthermore, while the teaching of thinking and problem-solving skills is imperative if the needs of both the current and future generations of learners are to be addressed, such instruction must be situated within the specific problems and functional contexts embedded in each domain. Jones and Idol (1990) note that instead of being merely disseminators of information, effective teachers must have as their goal the transfer of thinking skills for deep, self-regulated learning.

Acting as models, decision makers, mediators, strategists and collaborators, the teachers participating in the experimental component of this study were
enthusiastic in their efforts to improve both their own professional practice and their students' cognitive capabilities. Situating metacognitive instruction within a specific domain context (mathematics) was intended to encourage children to see vital links between theoretical precepts and their practical outcomes. Although most of the students in both groups would have already had some strategic knowledge, children in the experimental groups were encouraged through scaffolded problem-solving exercises, to develop an understanding about controlling their own learning processes for greater efficiency, deeper understanding and enhanced academic performance.

**Inhibitors to Strategic, Deep Approach Learning**

Much research has indicated that although cognitive instruction has the potential to substantially alter the capabilities of the learner, novices and poor learners apparently do not develop this repertoire spontaneously given the instruction delivered in most classrooms (Derry, 1990; Idol, Jones & Mayer, 1991). Allington (1991) even suggests that many current instructional practices are as likely a source of surface learning and low achievement in children as any inherent psychological or physiological deficits. He goes on to give a number of reasons for this, describing three, along with the serious consequences they may have on all learners but especially those experiencing academic difficulty. Firstly, Allington (1991) notes that frequently students are given insufficient time to acquire the learning desired. For low achieving students this not only results in achievement falling behind schedule, but it is a problem which compounds year after year. Instructional activities which are selected to “fit” the time allocated, inevitably mean that completion of tasks will never be possible for some students.

This was indeed found to be the consistent experience of a number of children in one of the participating groups in this study and a problem
encountered by numerous students in most groups from time to time. In a previous project undertaken (Ashton, 1993) which explored the perceptions held by underachieving students regarding integrated or withdrawal remedial programs, it was found that withdrawal was often preferred by underachievers as the slower pace offered in a quieter environment with fewer students enabled them to complete tasks which would otherwise never have been completed. Of even greater importance to the study at hand, however, is that insufficient time allocated to learning tasks means less modelling and explanation, with fewer opportunities to practice which in turn leads to slower movement through the curriculum or less learning overall (Allington, 1991).

Secondly, Allington suggests that the differential nature of the instructional tasks most frequently offered to low achieving students is marked in that there is usually little emphasis on higher-order comprehension or thinking skills. The focus of instruction for low and underachieving children appears to encourage lower-order thinking (Allington, 1991). Although such teaching is based on the assumption that once this is mastered, then progression may occur, Allington (1991) suggests that this may in fact be more damaging to students. He argues that frequently the instruction offered to low achievers is neither of sufficient quality or quantity to alter their learning status.

Finally, Allington (1991) notes that for most students the quality of teaching is an influential aspect of their learning. Significant differences in student outcomes have been found amongst classes where teachers can effectively explain or model cognitive processes to those where teachers cannot (Duffy, Roehler, Meloth & Vavrus, 1986). Furthermore, Bloome (1986) believes that messages regarding learning are often confused, and that children may be tempted to focus on what they suppose the teacher desires rather than on the
domain specific meanings being conveyed. Young children especially are frequently motivated toward producing responses which will win the teacher's approval, hopeful of a secure position in the class.

Also discussing the antecedents of poor learning, Idol, Jones and Mayer (1991) note that students are frequently hampered by misconceptions about goals and strategies. In addition to this, they lack the flexibility to adapt learned strategies in novel situations, fail to detect errors when they occur and adopt ineffective problem-solving tools. In a similar manner, Paris and Winograd (1990) argue that students in general are also poor at intrinsically monitoring their own thinking. They suggest that young children often mistakenly believe that they understand what they hear or read, thereby developing an illusion of comprehension which when tested, is unfounded.

Furthermore, Stipek, Feiler, Daniels and Milburn (1995) have noted that didactic, teacher-controlled instruction which has as its goal, assessment and performance tends to undermine children's intrinsic interest in learning. Moreover, studies by Katz (1988), and Elkind (1987) indicate that children's perceptions of self-competence are also eroded by didactic teaching approaches which lead to an unwillingness to take academic risks. There appears to be some correlation between systematic assessment procedures, instructional approaches and the type of resource material selected for students. Stodolsky (1988) notes that while considerable pressure is exerted on students to perform well academically (especially in mathematics), in many classes little cooperation or collaboration is encouraged, and (notably in the later years) few concrete materials are provided. When students are exposed to such limited instructional approaches and resources, negative attitudes are likely to develop. Very few strategies and minimal resources
coupled with didactic teaching methods can result in students' perceiving themselves as unable to learn (Stodolsky, 1988).

In recent times, even research from Eastern and Third World countries, previously strong advocates of didactic teaching methods, has urged a reconsideration of educational goals. Professor Bacchus, a keynote speaker at the Educational Research Association of Singapore Conference in 1995, has said that the quality of education will only improve when the efficacy of schools is increased through enhancing students' cognitive learning. He goes on to note that quality education means providing an education that will better equip students to deal with the realities of life both now and in the future (Bacchus, 1995). Many current teaching strategies he argues, still fail to meet these goals as they encourage rote memorisation rather than process understanding. The instructional strategies used by teachers must empower and challenge students to take responsibility for their own learning and to raise expectations of themselves thereby developing more confidence in their own abilities (Bacchus, 1995).

Not only didactic teaching approaches, but also the focus on assessment from an earlier age has been thought to inhibit strategic, deep approach learning behaviours. A frequent criticism of assessment tasks has been that they signal what is important for teachers and parents, thereby giving (in some cases) erroneous messages to students about the goals of learning. It is also argued that such tests place too much emphasis on factual knowledge, and relatively little on the processes involved in effective problem-solving (Linn, 1991). If students are to regard learning as something which is exciting, challenging and stimulating and as meaningful and relevant to life, then teachers and institutions may need to move away from static assessment tasks that stand alone from the learning process. Rather, as Linn (1991) suggests, educators may be required to move toward a more dynamic process for
assessment which gives insight into student cognition, revealing the process by which a response to a problem or a question is constructed. To tap and examine cognitive processing, a system of interviews, journals, observations of students as they undertake problem-solving tasks, student monologue and dialogue, and role play, may all be required (Rowe, 1991). If encouraging learning as a deep, cognitively rich endeavour is a valued outcome of instruction, then methods of assessment must be created which detect the presence of the important process components of thinking, problem-solving and learning (Rowe, 1991) without shifting the focus to basic skills and facts.

Interestingly but not surprising, irrespective of the group within which they had previously received their tuition, it was the higher achieving students who tended to show the least regard for institutional conformities. Although throughout the teaching sessions no reference was ever made to assessment by either the experimental or control group teachers, a review of the videotaped data has suggested that students are still likely to have perceived differential learning goals. For example, while amongst the experimental groups, discussion nearly always focused on strategic behaviours, cognitive actions were modelled and the process of learning and problem-solving was emphasised, this had only been a characteristic of these classes for six weeks. Moreover, although feedback was judicious, given in response to academic effort, affirming cognitive rather than behavioural actions, when attention was directed toward classroom management, it was generally aimed at the less attentive, lower achieving students.

Amongst the classes in the control groups, “best practice” teaching included “discovery learning” situations where concrete activities set up for students reinforced the more didactic, explanatory teaching sessions previously given. Here, while classrooms were busy, active and happy environments within
which to work, the principal emphasis was always on task completion and meeting the goals established by the teacher. Attention was more frequently directed toward behavioural management and classroom protocol in the control classes and once again, it was generally the lower achieving students who were the recipients of such attention. Praise and reinforcement were frequently used to reward good manners, completion of tasks, neatness and other positive work habits, rather than academic effort and cognitive behaviours.

In both experimental and control classes, a hierarchy existed amongst the students with the high achieving students accorded differential treatment to their peers, reinforcing Allington’s (1991) research. Although ability groupings and high achieving students were less clearly visible amongst the experimental classes, in most cases (when able to connect individual students from the class with their current performance level following discussion with the classroom teachers) it was the higher achieving students who were asked more cognitively challenging questions, given longer to respond and rewarded more for academic effort. The low and underachieving students encountered less challenge and were frequently given less time to answer even when engaged in interactive discussion. These students often failed to receive adequate explanation and were regularly unable to complete tasks, especially when expected to move on a rotation basis with their ability group. This supports Covington’s (1992) findings which highlight the inequitable system operating in many of our schools and suggests that the way instruction is delivered in the classroom may in fact be serving to maintain underachievement rather than alleviate it.

It is hardly surprising therefore, that perceptions about learning goals differed between individuals. In some cases lower achieving students indicated that
the completion of tasks and meeting classroom expectations were of paramount concern. In a modest way this was demonstrated while undertaking one of the problem-solving tasks, when one little girl (see Susie - Case Study 2) suggested that writing her name was the next most important step in its process. This same child was extremely anxious about winning the approval of the teacher by doing the task and covering all steps, the “right way”, unlike some of the high achieving students who appeared totally unconcerned about teacher expectations or indeed in several cases, whether tasks were completed at all.

*The Development of Strategic Behaviours for Deep Learning*

Although it was satisfying to note that students who had been participators in the experimental “metacognitive” teaching programme used relevant strategies more frequently than did students from the control classes, strategy instruction must still be viewed as a long term affair, according to Brown and Pressley (1994) and Pressley (1995). Undoubtedly effective problem-solving and self-regulatory strategies need to be offered as part of general classroom practice throughout the whole school year, and indeed over a number of school years and in all subject domains. Pressley (1995) for example, notes that development of self-regulation occurs over years and decades and indeed he suggests that real expertise in academic cognition is not likely to occur *readily* even in university undergraduates. Although strategic behaviours were clearly evident amongst the children participating in this study, and were used more frequently by those students who had been specifically trained and encouraged to use them, it is unlikely they will survive or be enhanced without continued instruction.

Nonetheless, some debate continues regarding strategy training and the assumption that transferable competence can be developed via instruction has
been questioned. Pressley (1995) suggests that people do not transfer or use flexibly the strategies they have just been taught as efficiently as they might. He notes that even amongst students who have experienced specific strategic instruction, there are deficiencies, and he suggests that there are many reasons why some students simply do not display self-regulation. It may be for example, that when a new strategy or concept competes with an old one, the old one is preferred, rather than exert the effort necessary to master new approaches, even though the old strategy may be ultimately less effective. Additionally, old strategies and knowledge are more readily accessible than new, and therefore more likely to come to mind during problem-solving than those more newly acquired (Pressley, 1995). Pressley goes on to say that even when a strategy is learned, understanding does not necessarily follow, arguing that rich conditional knowledge as well as procedural knowledge is necessary. Furthermore, the ability to carry out a strategy is not necessarily synonymous with understanding the utility of the strategy and lastly, Pressley notes that knowing how to carry out a procedure does not mean that the learner also has knowledge about adapting strategies to meet new circumstances (Pressley, 1995).

English's (1991) conclusion to her research regarding strategy instruction suggests that some young students, even without the benefit of strategy training, appear to have a repertoire of informal problem-solving processes. These, she believes, they employ in conjunction with knowledge already acquired to solve novel tasks, provided the context is meaningful to them.

Like the students in English's research, all children in this study had already developed (to a greater or lesser extent) a repertoire of strategic behaviours irrespective of their previous strategic training in the classroom. What English (1991) implies in her findings but fails to acknowledge, is that
strategy training is frequently received by students in contexts other than school. As previously noted, the development of strategic behaviours is not exclusively the prerogative of the classroom. Therefore, if she is arguing for an intuitive development of strategic skills, it must be remembered that these skills have possibly been acquired during social discourse in other supportive learning environments.

Christensen’s (1991) research supports Pressley’s findings but draws further conclusions. She noted in experiments dealing with mathematics and the use of instructional strategies, that while children in both a strategy instruction group and a drill and practice group used specific thinking strategies, the drill group were more efficient overall. Christensen emphasised, however, that the children who modified given strategies and invented their own strategies as a consequence of practice, were more effective strategic learners than those students who acquired them solely through instruction. According to Christensen (1991) some of the thinking strategies taught in the classroom obviously did not fit comfortably into student’s existing cognitive organisation, yet it appears that students had not yet acquired the ability to modify them to meet their own requirements.

Without doubt, those students participating in this study who personalised their strategic behaviours (see Andrew - Experimental Case Study 1 and Martin - Control Case Study 3), thereby giving the whole task relevance and meaning, displayed significantly greater strategy use and were more successful in their performance outcomes than those students who used taught strategies alone. Obviously, strategy training isolated from context and without due consideration of the learner is insufficient. Students must therefore be encouraged to not only develop strategic behaviours but to take
control of the learning process by modifying strategies to fit more comfortably with their personal cognitive styles and learning needs.

In spite of this, there is little doubt that some students appear to use strategies intuitively, while others especially those scaffolded through higher-order cognitive endeavours, develop strategic behaviours through training. As a general rule of thumb however, the younger the child, the more strategy instruction will be required (Brown & Pressley, 1994), and the more consistent the strategic instruction and the younger the age at which this begins, the more efficient the learning.

Jones and Idol (1990) have discussed the continued debate about the specific location of strategy instruction which argues on the one hand for adjunct skills courses and on the other for instruction which is firmly anchored within content domains. Clearly there are arguments supporting each point of view, but there is also considerable agreement for the position which supports the need for both approaches concurrently (Jones & Idol, 1990). Teachers need to explain and model effective strategies, especially with students at risk who may require extra coaching and guided practice. Additionally, attention may need to be directed to providing procedural, conditional knowledge and transfer training (Jones & Idol, 1990; Brown & Pressley, 1994). Teachers and students together need to model the use of strategies, thinking aloud as tasks are undertaken, probing and questioning themselves and one another. Rosenshine, Meister and Chapman (1996) note the importance of question generation to the fostering of comprehension and self-regulation. They suggest that students trained to self-question will eventually acquire a heightened self-awareness of their comprehension adequacy, will lead to enhanced recall of information and assist in the control of premature and faulty conclusions. Questioning techniques facilitate understanding and help
monitor tasks by detecting difficulties as they arise (Brown & Pressley, 1994). Irrespective of conflicting data regarding strategy training, there is consistent evidence, according to Jones and Idol (1990, p. 527) which suggests that “young children and less proficient students can be taught the same processes and strategies as those used by more successful learners”. Pressley (1995) has succinctly summarised issues regarding the debate about strategy acquisition:

What I do not believe, is that any one experience, or even a few experiences, with one of these mechanisms can do much. All of the evidence pertaining to the development of really sophisticated self-regulated thinking points to years of experience, years that undoubtedly are filled with histories of reward, with tasks of varying difficulty, transfer opportunities following proceduralisation of skills, and occasions when the benefit of using strategies and new concepts have been salient (p. 209).

While self-regulation of the learning process is necessary for the development of deep learning approaches, deep learning is multidimensional and interactive with a number of primary dimensions (Nickerson, 1990). Positive dimensions or factors are crucial to deep learning, while negative dimensions may result in the development of surface learning perspectives. Some of the factors thought to be integral to the learning process include developmental readiness, attention, motivation and self-concepts.

**Developmental Readiness**

Implicit in any discussion about teaching and learning is the developmental readiness of the students involved. Obviously it would be pointless to engage very young children in dialogue about concepts far beyond their level of cognitive understanding. Rarely has a five year old developed the thinking
abilities characteristic of her parents, nor in most cases the skills of her ten year old sibling. Piaget (1952; 1976) noted this when he saw children as active constructors of their own knowledge gained as they manipulated and explored the world.

As Ebbeck (1995, p.3) notes, Piaget’s ideas regarding cognitive development “have stimulated more research on children’s thinking than any other single theory”. Still acknowledged as a great contributor to cognitive research whose theories continue to inform much debate, Piaget nonetheless failed to recognise the importance of social interaction to cognitive development. In a strict Piagetian sense, children should be provided with the opportunities, experiences and activities designed to facilitate growth at a predetermined rate. Moreover should theoretically, be taught nothing, for every time a child is taught something, that child is prevented from discovering it herself (Ebbeck, 1995, discussing the work of Piaget).

Developmental readiness, therefore, from a Vygotskian perspective differs markedly from that of a Piagetian viewpoint. While Piaget (1952; 1976) believed that direct teaching stifled the natural learning which takes place when the child is developmentally ready, Vygotsky (1976; 1978; 1996) argued that interaction with expert learners is likely to result in enhanced learning at any age.

Recognising the importance of Vygotsky’s socially mediated process for learning, this study has therefore, been less concerned with the developmental readiness of the participating students in a Piagetian sense, than in their social environment, and the teaching style adopted to guide children through individual “zones of proximal development”. As Ebbeck (1995) notes, when the opportunities and challenges offered by the environment are appropriate
for a particular child, then development will be enhanced irrespective of the child’s age or predetermined stage.

**Attentional Components**

Self-regulating learners develop attitudes or mental positions which significantly modify the learner’s motivation for and consequent engagement in learning tasks (Marzano, 1991). Marzano notes that students’ attitudes to learning are likely to increase or decrease the attention directed toward specific tasks, but of course the opposite is also true, and the attention paid to tasks may also be a reflection of a student’s approach to learning. In a recent study conducted by Ertmer, Newby and MacDougall (1996) noticeable differences in the attentive behaviours of students were found. When approaching difficult tasks, some students reflectively attended to and purposefully controlled their own thinking, whereas others seemed to act more automatically, reacting to external factors rather than thoughtfully responding to internal ones. Ertmer et al. (1996) noted that the students who adopted process goals appeared to persist more with difficult tasks and use facilitative strategies to circumvent potential difficulties.

Alexander (1995) believes that attention to tasks is often contingent upon the student’s existing subject-matter knowledge and level of interest. She goes on to suggest that what motivates students to attend is often tied to the moment and the task (situational interest) rather than any deep seated interest or personal involvement. Gaining and maintaining the attention of students for effective self-regulation requires their engagement at a personal level through the provision of challenging, interesting and relevant materials. According to Zimmerman (1995b) however, self-regulation of the learning process is extremely demanding, especially in the face of fatigue, stressors and competing attractions. The ability to mobilise, direct and sustain effort, he argues, can only be developed within an environment supportive of self-
regulatory attempts, thereby increasing the sense of self-efficacy and personal agency. This is especially so in the early school years when learning behaviours are developing within a complex, highly enticing environment, rich with competing stimuli.

The students reported on in this thesis demonstrated a variety of attentive states, and directed attention in numerous ways as problem-solving tasks were explained and undertaken, within environments selected for their quietness and lack of competing stimuli. The most academically successful students displayed the greatest attention to tasks, selectively transferring information from sensory information storage (recalling past problem-solving experiences) to working memory. Marzano (1991) reminds us that at the most fundamental level, we attend to the stimuli that are salient at the time, and certainly all children displayed considerable concentration while tasks were explained and objectives outlined. Once it was suggested however, that control of the problem-solving task was to be relinquished by the researcher and given to the student, in some cases attentive behaviours altered significantly. Mindful of absolute objectivity, attentive behaviours were frequently difficult to observe. Nevertheless in most cases, it was the high achieving students whose observable attention to task directed them to set goals, plan outcomes and monitor their own behaviour. Indeed, Marzano (1991, p. 417) believes that attention is “goal driven”, and that without the establishment of clear objectives students are unlikely to direct and focus attention on the learning process.

Almost certainly, the students who directed their efforts toward the transfer of knowledge by attending selectively to concepts and their defining attributes, not only were more successful at solving problems, but also displayed a deeper approach to learning. Mindful of the fact that deep learning
approaches are associated with good academic performance, attention to task
detail through strategic behaviours, positive self-concepts and internally
derived motivation (Biggs, 1985), it is possible to assume that the attentive
behaviours of some of the five and six year olds in this study reflect an
approach to thinking and learning at a level beyond that of many of their
peers.

Motivational Components

While each participant in this study appeared reasonably happy to initially
attempt the problem-solving tasks before them, some, typically the lower
achieving students, began to lose interest almost as soon as the demands of
each task became known. Even when rules, strategies and problem-solving
behaviours have been articulated by the teacher and encouraged within the
classroom, motivation for their use appears also to be necessary (Feuerstein,
Rand, Hoffman, Egozi & Ben Shachar-Segev, 1991). Of course such
motivation may be applied extrinsically, however the primary goal of
teachers encouraging self-regulation and deep learning is for students to
respond to the appeal of the task itself. Hergenhahn (1988) even goes so far
as to suggest that extrinsically applied motivation can reduce a student’s
motivation to learn entirely.

Although in most preschools it would be unusual for children to experience
consistent failure, for some students, consistent failure is a mark of the school
years (Stipek, 1993). Within most early childhood settings the inability to
complete tasks or master skills is frequently viewed and accepted as part of
the normal course of learning. The nature of the support given in these
situations means that children would rarely attribute failure to personal
inadequacy such as ability or effort. Although from the age of around three
years children begin to develop expectancies of success, the generally high
rating of their own abilities is displayed in the preschooler's willingness to expend time and effort on tasks (Stipek, 1993). Stipek (1993) goes on to note, that once a system of extrinsic awards and punishments is introduced into the learning environment, then children are set up to experience comparative assessment. From this time onwards, students' perceptions of themselves are liable to modification which may result in negative feelings regarding their ability and control.

Students negatively motivated appear to hold the view that a task cannot be completed for a variety of reasons often resulting in off-task behaviour (Ames & Ames, 1991). In most cases, negatively motivated students are low achieving students who attribute their failure to the fact that "they have never been told to learn..." (a particular task or way of doing things). This suggests that for many students, especially those experiencing difficulty, that everything that is known is dependent on external sources of information. Feuerstein et al. (1991) have concluded that this has serious consequences for the outcome of tasks where even simple problems may result in failure, simply because students are unwilling to risk experimentation of ideas on something about which "they have never been told". This phenomenon of extrinsic application according to Zigler and Butterfield (1986), is fairly typical of low achieving children. Consequently it becomes imperative, if generalisation and transfer are to take place with lower achievers, that the message be conveyed, that students themselves are the generators of information and must be engaged in discovery and creativity.

Hergenhahn (1988) notes that reinforcing one's personal goals results in the reinforcement of intrinsic motivation. Teachers, he argues, have a great responsibility to help students formulate the type of goals which are neither too easy nor conversely too difficult to achieve. Intrinsic motivation, or as
Biggs (1985) terms it, an internal locus of control, seems to be implicated in the development of deep approaches to learning. The motivation to exercise control over the learning process involves a metaprocess involving the use of a range of strategic options. A personally held belief in the ability to exercise such control, is prerequisite to the deployment of strategic options such as identifying problems, planning tasks and monitoring cognition (Biggs, 1985). This as Biggs notes, is motive-strategy congruence and it reflects clearly in the performance outcomes of the some of the students in this study. Ertmer et al. (1996) note that a motivational component of self-regulation is its perceived value to academic outcomes. When academic tasks are valued, students are more willing to expend the time and energy needed to become proficient at the task, which again in turn sustains motivation.

The well motivated, high achieving students in this study tended to select strategies that were congruent with their motivational state and used them to successfully monitor problem-solving and in most cases to effectively complete tasks. Interestingly, in instances when tasks were not satisfactorily completed, this appeared almost irrelevant to two of the high achieving students participating. These students, while not necessarily able to articulate their motivation, had adopted process goals, demonstrated through the use of learning strategies related to “attending, self-monitoring and deep processing” (Ertmer et al., 1996). They were willing to experiment with the information already known about such tasks, thereby creating new meanings and understandings irrespective of whether their efforts led to a successful outcome.

Poorly motivated students, in most cases also underachieving students, used strategies that were not always congruent with their motives. This of course did not mean that these students were always unsuccessful in their
endeavours, but concurs with Biggs’ (1985) study where it was noted that when such students used strategies, they appeared to be used with little or no metacognitive involvement on the part of the student. Ertmer et al. (1996) suggest that these students have probably adopted product goals which are associated with short-term and surface-level processing strategies. Brown (1978) discusses this phenomenon, noting that while students often use strategies as short-term props to learning, they appear not to involve any metacognitive insights on the part of the learner.

Biggs (1985) concluded in his studies with 14 and 16 year olds that two quite different mechanisms seem to be involved when dealing with motivation and congruence. At one extreme, he suggested that the strategy use of extrinsically motivated students tends to resemble “techniques” which involve little or no metacognitive awareness. At the other extreme however, the strategic behaviour of intrinsically motivated, high achieving students suggests a high level of metalearning and is generally most effective (Biggs, 1985). This is consistent with the findings of Ertmer et al. (1996) who noted that students tended to display patterns of strategy use which reflected the type of goals adopted.

’Self’ Components

As Covington and his colleagues (Covington, 1985; 1989; 1992; Covington & Omelich, 1984) have noted, those students in school who appear to be academically capable are often the most highly valued by the teaching staff. Self-worth however, when tied to achievement data is not always this positive, and indeed can be for some a risky business.

At this stage of their academic training, most of the students participating in this study appeared to hold healthy overall perceptions of their own abilities
and performance irrespective of their actual achievement, however as Ames and Ames (1991), Bornholt (1997) and Slavin (1997) have indicated, these perceptions of self are subject to change over time as children get older. Added to this, self-concepts are thought to be multi dimensional, based on a wide range of evaluations of different and independent behaviours rather than on concepts of a whole (Marsh & MacDonald Holmes, 1990). Self-concepts may be discrete yet interrelated and can be based on perceptions held regarding school, the family, peers and sport, amongst others (Bornholt, 1997; Elliott, 1997).

In the first year of school, many children may hold unrealistically high evaluations of their own competence, however, as they progress, such self-perceptions tend to decline and begin to fit more with their actual performance. For students who constantly fail and for those who attribute such failure to low ability, the results are often low expectancy of future success, a sense of hopelessness, shame and poor self-concepts (Ames & Ames, 1991).

There are numerous teaching strategies which can be employed to enhance student motivation and self-concept, and such enhancement should be a characteristic of even the youngest classes (Bornholt, 1997; Elliott, 1997). Ames and Ames (1991) suggest for example, that teachers must avoid social comparison, reduce public evaluation with its emphasis on success and grades, and use a variety of assessment procedures to evaluate meaningful learning. Added to this must be an emphasis on student involvement in the learning process through the use of cooperative learning methods, and peer tutoring following an apprenticeship model. Students too, should be encouraged to make choices regarding the method of learning, pace and where practical, content.
Ames and Ames (1991) also suggest that there should be a focus on effort rather than exclusively on performance. While error must be acknowledged, it should always be used as a learning point from which to move forward, and to this end, positive academic feedback which recognises and reinforces effort, should be a characteristic. Teachers, they argue, must promote within children a belief in their own competence, especially in conjunction with the use of cognitive strategies, and to increase students' chances for success, strategy training must be provided along with cooperative team learning to support individualised instruction (Ames & Ames, 1991). Elliott (1997) sums up the teacher's role in the enhancement of self-concepts within the classroom. She notes that children need to be shown individual guidance within specific task domains. Furthermore, tasks need to be manageable and achievable, aided by concrete assistance where necessary, with demonstrated and modelled strategies. She goes on to note that to enhance academic self-concepts, the learning environment must also provide consistent experiences and patterns of interactions, thereby building trust in the personal feedback necessary for positive self-esteem.

Within this study, students' perceptions of their own competence and social acceptance (measured using the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children - Harter, 1982; Harter & Pike, 1983) indicated that even amongst the underachievers, healthy overall self-concepts exist. Following examination of the subscores of each students' overall score, a different trend began to emerge, however, especially in relation to cognitive competence. Of the eight (four experimental/four control) students who were found to be underachieving in academic areas, only two scored in the high range, while the remaining six were found to have scored in the medium range for the cognitive subscale. Amongst the eight high achieving
students (four experimental/four control), all were found to score highly on this subscale.

As we are aware, perceived self-efficacy in relation to any given situation comes from a variety of sources which may include personal accomplishments or failures, observation of another’s success or failure and verbal discourse (Hergenhahn, 1988). Although a child may be temporarily persuaded to attempt or avoid a task, ultimately it is their direct or vicarious experiences with achievement or defeat which will most strongly influence their self-concepts.

For the students in this study after just three terms at school, their experiences within the classroom in competition with many peers have been sufficient to establish self-perceptions concerning cognitive competence. Hergenhahn (1988) notes that students with high perceived self-efficacy are generally more willing to experiment, accomplish more and persist longer at tasks than students with low self-efficacy. Such students are also more at ease with learning and problem-solving situations because of the control they are able to exercise over life events. The corollary of course to this is that underachieving students often display anxiety and tension, fearing events over which they believe they have no control (Hergenhahn, 1988).

It would appear that for six of the eight underachieving students in this study there already seems to be a trend toward negative self-perceptions regarding academic abilities. As self-appraisal of success or failure during the early school years is largely based on educational outcomes (Heyman, 1990), for some of these underachieving students, repeated failure to achieve academically has resulted in negative perceptions of their cognitive abilities at this stage.
Durrant, Cunningham and Voelker (1990) note that academic self-esteem is of major concern to educators. They fear that a self-perpetuating cycle of failure seen as endemic amongst some children will continue to arouse feelings of helplessness not evident in the behaviours of higher achieving students. According to Covington (1989), learning is as much contingent upon the learning environment and pupil/teacher relationships as it is on the physiological and psychological makeup of students themselves. He goes on to suggest that given the right conditions for learning, academic failure should decrease while self-concepts are enhanced, thereby creating a perpetuating cycle of success rather than endemic failure (Covington, 1989; 1992).

Of significant importance to this study is the way that self-concepts appear to influence a student’s ability to exercise control over learning experiences and the role they play in the development of deep learning approaches. In self-worth theory, Covington (1985) views achievement behaviour as an individual’s attempt to maintain a positive self-image of ability and competence. He goes on to note that students who maintain effort-related attributions are also likely to aggressively use strategies in order to gain success. Conversely however, students who have poor effort-related attributions tend to believe that success or failure is outside their control, and consequently their strategic behaviour tends to be apathetic. Borkowski et al. (1990) believe that self-concepts can promote student’s progress toward self-regulation. They note for example, that students with positive self-concepts who believe in their own abilities are likely to process new information strategically enabling later retrieval for further application. Dweck (1986) makes a similar point when he notes that students who hold negative self-concepts are unlikely to access new information efficiently, often avoiding strategic behaviours and learning challenges.
From repeated observations of behaviour, and self-concept scores gained by the sixteen students in this study it seems that self-held perceptions of cognitive competence are likely to have already influenced personal growth to a significant degree. The students holding positive personal beliefs regarding their ability to succeed on problem-solving tasks used a greater range of strategic behaviours and used them more frequently and with greater confidence than students holding more negative personal beliefs. As one of the determinants of student-held approaches to learning, positive self-concepts need to fostered in the classroom if deep, challenging learning is to occur.

Creating Positive Learning Environments to Foster Deep Learning

Given that an increasingly essential component of education is the need to teach thinking, much recent research has been directed toward that goal (Biemiller & Meichenbaum, 1992; Bransford, Vye, Kinzer & Risko, 1990; Nickerson, 1990; Olson & Astington, 1993). As Jones and Idol (1990, p.513) have said, “for any given task, thinking must be situated within and draw upon multiple knowledge sources...from cognition, metacognition, experiences and self-beliefs”. Instructional processes must include elements of both general as well as domain specific knowledge, however, sustained thinking must involve the orchestration of that knowledge for successful processing to occur.

Entwistle and Marton (1984) have suggested that teachers need to be challenged to reconceptualise their role within the teaching-learning process, as were the teachers participating in the experimental teaching programme of Study 1. The most effective teachers displayed both empathy and expertise
as they guided students’ learning and thinking with sensitivity. Paris and Winograd (1990) note that the classroom environment should be such that teachers and students feel comfortable discussing their thoughts and feelings about learning with one another in order to promote metacognition, self-regulation and increased motivation. The classroom should be “a supportive, thinking community” as O’Flahavan and Tierney (1991, p.57) term it, where learners feel comfortable hypothesising and testing their theories, taking risks and reflecting upon others’ risks, and both challenging and accepting divergent perspectives.

Observations of the videotaped data gathered from three of the four experimental classrooms where “metacognitive” support was a consistent feature suggest that over the period of intervention, an ease developed regarding discussion, questioning and responding to cognitive challenges. As teachers and students became more familiar with what was initially quite a different approach to teaching for them, a greater freedom to explore developed and enthusiasm both for the subject under discussion and for the method of tuition increased.

O’Flahavan and Tierney (1991) have suggested that the teacher’s role should be dynamic rather than didactic, deciding when it is most appropriate to intrude in the environment and when best to retreat. Teachers need to develop judgement about when to reduce authority and input and merely to provide support. It is critical obviously, that they neither retreat to the point where learning is filled with frustration nor sabotage student learning by removing students’ decision making powers altogether. In other words, there are two major decisions constantly required of teachers. The first they note is task choice, a line of inquiry begun preferably by the student, but which may require modification, through brainstorming, discussion or some other means.
The second, relates to *locus of control*, or the degree to which the teacher, rather than the learner, retains control over the overall task. As already noted, student independence and initiative are the desired, long term goals and teachers must exercise judgement regarding the best way such goals are to be realised (O'Flahavan & Tierney, 1991).

Elements of decision-making regarding both task choice and locus of control were evident amongst teachers in the study. In most classes, while the broad subject for mathematical discussion had been predetermined, specific lines of inquiry were often followed depending upon interest and motivation. Considerable time was allowed for "discovery learning" by both experimental and control groups. Following "metacognitive" training the teachers participating in the experimental project were more inclined to "assist discovery" by asking leading questions, making suggestions and articulating their own cognitive behaviours on matters of interest and outlined curriculum. In most cases in experimental classrooms, the locus of control initially rested alternatively with the teacher and the students. However, as student-responsibility for learning in the experimental classrooms was a major goal, the responsibility for learning was relinquished, at least partially, by the teacher as soon as students were thought to be ready to assume independent control.

Clearly of course, all classrooms displayed differences. Amongst the control group, while there was always an abundance of concrete tasks designed to reinforce discussed material, students were encouraged to work within fairly rigidly prescriptive guidelines. For example, in most control groups, the important elements of a topic were usually explained by the teacher to the entire class with students taking the passive role of listener. This was most frequently followed by the rotation of small, ability-determined groups
between prescribed activities designed to focus on stated objectives and to reinforce the discussion. Irrespective of whether students then completed tasks at each table or not, they were expected to move on to the next activity with their small-group peers after a given signal. Sadly, this meant that for some of the students, perhaps due to painstakingly methodical work, lack of thorough understanding about the task or even extended interest in an element of the task, activities set for the day would never be completed.

Conversely, the introduction of new material to students in some of the experimental classrooms was accomplished quite differently to the previous example. On several occasions the introduction of a new mathematical topic involved the participation of every member of the group. In one instance, the heights of two little girls were compared (see Results - Chapter 7), and discussion regarding measurement ensued. While monitoring and acknowledging the contribution of the high achievers, this teacher demonstrated extraordinary skill in drawing out responses from children less extrovert and less competent, rewarding their cognitive efforts and challenging the entire group to expand their thinking. Later, in pairs based on friendship or proximity rather than ability, students were assisted by their teacher and assisted one another in a discovery of measurement. Such was the interest and the enthusiasm for this task that it continued until all students had been questioned, allowed to give explanations and thoroughly emersed themselves in the activity. In this and other such class activities, the focus of the lesson was always on the process. Because of the range of variables present in these activities, at no stage were students ever required to give the "correct" answer, nor was there an expectation of submission to established conventions.
According to Paris and Winograd (1990) there are four major overlapping approaches (direct explanation; scaffolded instruction; cognitive coaching; and cooperative learning) which when employed by teachers are designed to facilitate the social exchange of shared knowledge. These elements were certainly featured in the training sessions delivered to teachers participating in the experimental programme (Appendix E). Like metacognition and self-regulation, however, proficiency in these teaching approaches develops through repetition and with experience. Nonetheless, even after a relatively brief period of training, the teachers in the experimental classrooms demonstrated significant qualitative differences in their teaching goals. Using a combination of the teaching approaches discussed in the “metacognitive” training sessions (Appendix E) with Paris and Winograd’s (1990) techniques, possibly aided the delivery of information about declarative and procedural knowledge to students from the experimental groups. Certainly, as already noted, incidences of strategic behaviour were higher amongst this group than were found in the students from the control classes.

Teaching Metacognitive Skills

Direct Explanation

Almost certainly sufficient instruction about tasks was given, enabling students to complete their work in the control classrooms. Frequently lacking though, was direct explanation about the sort of strategic behaviours characteristic of expert learners. For example, such explanations might deal with the critical features of a specific strategy, why a strategy should be learned, how a strategy might best be used, when and where such a strategy should be used and how to evaluate the use of the strategy (Idol, Jones & Mayer, 1991; Paris & Winograd, 1990). Not only however, should direct explanation or instruction emphasise when, where and how to use strategies,
along with why they should be used, but should also include the gradual transfer of responsibility for learning from teacher to student, focus on constructing meaning and the giving of both cognitive and metacognitive instruction (Idol, Jones & Mayer, 1991). Moreover, Paris and Winograd (1990) have found that some of the benefits of the use of direct explanation include helping students decompose difficult tasks, equipping them with useful tactics for problem-solving, and identifying learning goals and effective ways of reaching them. Furthermore, direct explanation encourages teachers to think about the cognitive demands of the task, and not just outline objectives, and finally, Paris and Winograd (1990) note that direct explanation is economical as it is an efficient way of reaching large groups and whole classes. Although direct instruction was a feature of the teaching in both experimental and control groups, only in the experimental classes was clear, consistent and frequent information about strategy use and its value to proficient learning outlined.

*Scaffolded Instruction*

As discussed in Chapter 3, scaffolded instruction is the prominent role of dialogue between teacher and student. The purpose of such dialogue is to provide the learner with just enough support and guidance to achieve goals that are beyond unassisted efforts, or within the ZPD (Wood, Bruner & Ross, 1976). It includes a number of components such as recruitment, reduction in degrees of freedom, direction maintenance, marking critical features, frustration control and demonstration (See Chapter 3). Scaffolded instruction however, requires teachers who are empathetic, knowledgeable and skilled in guiding students in dialogue. Although some expert teachers may ably impart information about cognitive strategies, others may in fact require training to enable skilled transfer of information for effective meaning (Paris & Winograd, 1990).
Assuming that the preservice training offered to teachers in New South Wales adequately equips them to support the cognitive demands of the students in their classrooms, may be a major miscalculation of the current situation. This was highlighted when observing the teaching behaviours of the participants in this study. Each of the teachers from both the experimental and control groups were selected by their respective principals as exemplary practitioners in their field, but the teaching methods employed often failed to meet the needs of individual learners. Although each teacher displayed warmth, care and concern for the personal and educational well-being of their pupils, prior to the instruction given to the teachers from the experimental classes, the degree to which scaffolding characteristics were evident amongst either group was minimal. While an understanding and an accommodation of individual needs is implicit in any discussion on “best teaching practice”, it must be argued that if the individual needs of students are not being met through the support of their cognitive efforts, then “best practice” must be re-evaluated to embrace this consideration.

**Cognitive Coaching**

According to Paris and Winograd (1990), cognitive coaching includes mutual dialogues, direct explanation, modelling and encouragement. Paris’ research (Paris & Oka, 1986) has highlighted the value of cognitive coaching with young children where metaphor, materials and discussion have been found to promote children’s understanding about strategies. The use of metaphor in reading such as “Be a reading detective” and “Planning your reading trip”, accompanied by posters and worksheets upon which mental actions are represented, has been found to result in significant improvement with metacognition, strategy use and error detection (Paris & Oka, 1986; Paris & Winograd, 1990). Although there are many parallels between mathematics and reading in terms of the use of metaphor, no cognitive coaching
techniques of this nature were articulated during either experimental or control sessions. The use of metaphor was obviously a feature though, of various teaching domains within several classrooms and evidence of such use was found on display posters and charts around the rooms.

Paris and Winograd (1990) suggest that there may be three aspects of cognitive coaching which contribute to the effectiveness of metacognitive instruction. Firstly, the common goals held by teachers and students during instruction encourage cooperation and mutual striving which results in enhanced performance and satisfaction. This was most clearly evident in the experimental teaching session on measurement (see Results - Chapter 7) when an initial goal was first articulated and demonstrated by the teacher and subsequently embraced with enthusiasm by the students. Such was the degree of involvement and mutual striving toward what became a common goal, that the resultant performance and satisfaction levels were extremely encouraging. Secondly, challenge levels, degrees of difficulty and expectations can be monitored through the ongoing assessment of students’ levels of performance, and thirdly, cognitive coaching encourages mutual regulation of thinking. When cognitive coaching becomes a feature of the classroom, students as well as teachers have the opportunity to discuss their thoughts and feelings about the thinking process, thereby minimising misconceptions before they become entrenched (Paris & Winograd, 1990).

**Cooperative Learning**

A final instructional approach, cooperative learning, firmly challenges the notion of didactic teaching where independent seat work is encouraged and where instruction is delivered by the teacher to large classroom groups (Webb, 1982). Cooperative learning, when knowledge is both given and received, has been found to result in higher achievement than didactic
approaches. When advice offered is questioned, the dialogue which results tend to challenge cognition, thereby helping individuals to restructure their ideas. Paris and Winograd (1990) suggest that disagreements amongst group members may encourage a new perspective on previously held information or force a search for new information.

Approaches to learning by students are frequently affected by the way academic tasks are presented to them as well as by the powerful affects of assessment procedures. According to Entwistle and Marton (1984), there needs to be a fundamental shift away from some of the more mechanical aspects of learning, and indeed a movement toward developing a focus within students to take conscious control of their learning activities.

Compared to many children in classrooms where didactic teaching approaches are utilised, students in child-centred and collaborative classrooms have been found to be more highly motivated, rate their abilities more favourably, have greater expectations for success, and, when presented with a range of tasks, tend to select those which extend and challenge thinking (Stipek et al., 1995). Stipek et al. (1995) go on to note that an effective, socially collaborative learning environment frequently results over time in less dependency on adults for permission and approval which in turn engenders confidence and pride in personal accomplishments.

Overall, encouraging deep learning approaches within the classroom involves a complex blend of an encouraging learning environment which enhances the self-concepts of its members and superlative teaching. Strategic teaching is a hallmark of cognitive instruction, note Idol, Jones and Mayer (1991), who go on to say that the strategic teacher must be both a thinker and decision maker. Strategic teachers have well developed knowledge structures for goal
planning and assessment; they are expert at linking new information and instruction to previous lessons and to prior student knowledge. Strategic teachers ensure that students understand “why” and “how”, as well as “what”, and they anticipate and plan for difficulties in individual learning. Additionally, strategic teachers draw upon a rich knowledge base enabling them to determine priorities and to know how best to organise and represent conceptual material. More than this, strategic teachers are mediators of the learning experience, guiding the thinking of the learner toward appropriate learning goals which ultimately encourage independent learning. Furthermore, strategic teachers must also be cognitive models, thinking aloud as problems are undertaken. Finally, according to Idol, Jones and Mayer (1991), strategic teachers plan for student misconceptions which are frequently so strong that they can prevent conceptual change from taking place. Misconceptions tend to persist largely because the type of instruction given in many classrooms encourages cognitive engagement at a superficial level, encouraging students to regurgitate information without any real learning. Strategic teachers therefore, may need a period of direct instruction, specifically to articulate about the ideas which have changed.

Reducing Academic Differences

The self-regulatory behaviours of high and low achieving children have been found to be qualitatively different in a variety of ways (Biggs & Moore, 1993; Borkowski, 1992; Covington, 1992; Schmeck, 1988). Schofield and Ashman (1987) note for instance that the cognitive competence of gifted children resembles the information processing procedures of competent adults more closely than those adopted by their lower achieving peers. Students with high level ability and performance, while not always excelling in every domain, nonetheless do excel in high level planning, metacognitive
and simultaneous processing functions (Schofield & Ashman, 1987). Furthermore, high achievers, according to Biggs and Moore (1993) tend to adopt a deeper approach to learning, by displaying a more thorough understanding of the importance of cognitive strategies, while they frequently concern themselves with the process of a task, rather than the end product, to ensure its successful conclusion. Low and underachievers on the other hand are often more concerned with rapid completion, and reproducing mastered facts than with the successful use of strategies, thereby contributing to a more surface approach to their learning and problem-solving.

This study has undoubtedly reinforced the research which suggests that high and low achieving children differ significantly in their approach to learning, strategic behaviour, self-regulation and problem-solving abilities. It has also indicated that metacognitive training can increase strategic understanding even within a short period of time. Obviously such instruction must become a consistent feature of all classrooms, within all teaching domains, if some of the more negative affective characteristics of low achievers are also to be modified. Factors such as attention, motivation and self-concepts will only serve to enhance learning once the student recognises the value of strategic effort, to the learning task.

Teaching instruction which facilitates the development of the cognitive and metacognitive attributes which lead to deep learning have as their goals, teaching for understanding in all subject areas, and helping all students learn how to learn (Biemiller & Meichenbaum, 1992; Idol, Jones & Mayer, 1991; Simmons, Fuchs & Fuchs, 1991). How this is accomplished however, to reduce differences in academic performance amongst individuals requires a “dual agenda” approach (Jones & Idol, 1990). This view suggests that while the primary focus should be on content objectives, they should be supported
by a repertoire of objectives for specific strategies that will assist in the learning of the content objectives.

In some institutions, meaningful strategic instruction has been the prerogative of high achieving students, with rote methods generally encouraged for lower achievers. Idol, Jones and Mayer (1991) argue however that cognitive and metacognitive instruction actually helps lower achieving students acquire the prerequisite knowledge they need. In fact, they suggest it is the lower achieving students who are most likely to benefit from such instruction, and indeed skills might take longer to develop or not be acquired at all under normal instruction methods. Entwistle and Marton (1984) note that while there is basic consistency in deep approach learners, there will inevitably be some variability and that it should not be a surprise that certain tasks or teachers may influence students to vary from what may otherwise be a habitual way of approaching learning.

In a recent study looking at teaching environments, Peterson, McCarthy and Elmore (1996) proposed a number of hypotheses. Firstly, they suggest that the beliefs, understanding and behaviours of teachers contribute significantly to the teaching and learning about specific problems in the classroom. Secondly, they note that if teachers see themselves as learners working continuously to improve their own practice, then effective change is more likely to occur, and thirdly, while research and structures may provide opportunities for teachers to learn new practices and new strategies for student learners, these in themselves will only become effective if embraced by each. Obviously, simply knowing about a more effective teaching style therefore is insufficient for real changes to occur.
Prosser (1993) has suggested that if deep level approaches to learning are necessary for full understanding of even the content material, then teaching sessions must be delivered in a manner which will encourage all students to develop the concepts and processes associated with this type of approach. This goes back to Idol, Jones and Mayer’s (1991) detailed suggestions for the development of effective, transferable, teaching strategies. Collins (1991) too, believes that modelling and explaining are vital aspects of an effective delivery manner. He suggests that there are two kinds of modelling which are important for education; modelling the processes of the world and the modelling of expert performance. He goes on to note that the benefits of modelling include; seeing expert solutions to problems set by the students; integrating what happens and why it happens; and most importantly, making visible the parts of a process that are not normally seen (Collins, 1991, p.125). This is imperative if differences between children are to be reduced and if the cycle of learning difficulty is to be broken.

**Summary and Conclusion**

Students from each of the classes participating in this study have demonstrated that approaches to learning and problem-solving are reflected in a multitude of learning and affective behaviours. Interestingly, while the reality of taught material has been the same for each child in any given class, learning phenomena as displayed and observed in the behaviours of the sixteen students have been qualitatively different.

From a phenomenographic perspective, when examined within the established hierarchy of learning attributes thought to be characteristic of deep and surface learning (see Chapter 7 - Table 7.9), it has been possible to determine how some of the children in this study approach learning tasks. By
focusing on the *process*, some students have attempted to gain meaning from their endeavours, whilst others adopting a *product* goal, have approached tasks with this end in mind. Reviewing the work of Crawford et al. (1994), Marton (1994), Marton et al. (1984) and Prosser (1993), has suggested that there are many consistencies and similarities to be found between their own research findings and those of this study in terms of the perceived direction toward learning. As conceptions about learning are usually inseparable from the displayed behaviours accompanying learning tasks, then by looking at the process students have engaged to solve problems, their approach to learning has been discernible.

If the way students display ("how") their understanding about the goal of learning is a reflection of "what" they have experienced in the classroom, then this obviously has tremendous implications for teachers. By directing teaching endeavours toward the acquisition of deep understanding (Biggs, 1988a; 1988b; Biggs & Moore, 1993), negative learning approaches may be challenged. Through explicit training in the use of higher-order cognitive techniques as well as the implicit use of such techniques within a supportive, scaffolded, collaborative learning environment, then the deep learning focus already adopted by some students will flourish, while surface approaches may be redirected. In this way, learning approaches are more likely to reflect the goals held and articulated by the teacher.

Deep approaches to learning were evident in the students who used higher-order thinking *strategies* to set goals, plan tasks, organise and monitor learning and problem-solving and finally reflect upon their performance for future planning. Some students were actively able to construct new knowledge from what was already known and apply it in the case of the novel tasks presented. Deep approach learners *attended* selectively to relevant
aspects of tasks and focused their efforts on strategic, effective behaviours. In addition to this, deep approach learners were intrinsically motivated to use these deep-processing strategies because effort and challenge were viewed as valuable ends in themselves.

Students seen as deep approach learners had both positive overall self-concepts, as well as high perceptions of their own cognitive competence. Not only were they frequently successful in their learning and problem-solving efforts, but the environment within which they worked tended to support and encourage this perception through placement in high ability groups, rewarding feedback and cognitive support. Most of the high achieving students in this study appeared to perceive learning as a discovery of meaning for enhanced understanding. While many children were still developing the ability to self-regulate their learning, including some of the high achievers, two children in particular were developing considerable competence in this area already having at their disposal a range of metacognitive strategies to transfer understood concepts to novel situations.

Surface approaches to learning were also evident amongst a number of students typically those experiencing academic difficulty. Amongst these students fewer strategies were discernible suggesting disrupted organisational and planning abilities and low level goals. A variety of attentive behaviours were evident, however few appeared to focus on important task elements. In most cases students were motivated extrinsically, having already perceived institutional demands as being more valued than intrinsic process goals.

Although the students who displayed many surface approach characteristics held high overall self-concepts, six of the eight underachievers held only moderate perceptions of their own cognitive competence. Surface approach
students were not only less successful overall on tasks, but in some cases registered no surprise or disappointment when this occurred. The environment within which they learnt, although theoretically identical in many respects to that of their deep approach counterparts, was perceived as offering different, less academic rewards, lower ability groupings and a more didactic interaction with teaching staff. Many of these students already perceived school attendance and learning as chores to be undertaken, because “all children attend school” and the teacher's word is not to be questioned. At the extreme, although not articulated frequently in the kindergarten years, learning is seen as memorisation of facts and the development of skills for future reproduction often for the purpose of assessment.

Reflected in a range of characteristics therefore, deep and surface approaches to learning can already be observed in the learning behaviours of the sixteen very young children who have participated in this study. Prosser (1993, p.30) however, has suggested that if we wish students to continue to develop and change their conceptions of phenomena from a surface to a deep approach, then “we need to be aware of and seek to change students’ experiences of teaching sessions”. Prosser goes on to say that teachers need to be clear in their understanding of the importance of engaging in certain activities, and must have a clear focus for their behaviours before endeavouring to change thinking. Stipek et al. (1995) support Prosser (1993) suggesting that when instructional approaches focus on objectives for cognitive enhancement, then students have been found to rate their abilities higher, had higher expectations for success, selected more challenging tasks, showed less dependency on adults for permission and approval, displayed greater pride in their accomplishments and seemed to worry less about school.
It has been argued (Entwistle & Ramsden, 1983; Ramsden, 1988b) that intervention strategies for students experiencing difficulties academically need to be aimed both at students and at teachers. Students require programmes which are designed to increase their metalearning capability and their awareness of different strategies, while teachers need to reassess their evaluation methods and professional skills in curriculum design and teaching (Ramsden, 1988b; 1995).

According to Ramsden (1988b), a necessary condition for improving student learning is to attend to the three contextual domains of evaluation, transmission and curriculum. Ramsden argues further however, that the most important of these is evaluation, and he notes that an examination is a revealing statement by a teacher about what is considered important in a course of study. It must be remembered too that teachers instructions are never received completely passively, whether in university courses or in preschool. Students will frequently adapt to a context by trying to deliver what the teacher is predicted to reward (Ramsden, 1988a).

Teaching students to become more aware of their own motives and resources and to select and use them appropriately is a component of such activity by teachers. This may involve teaching subject content in such a manner that the general structures that students use to interpret specific content are directly addressed (Ramsden, 1988a; Slavin, 1997).

Ramsden (1988b) and Slavin (1997) have proposed a relational view of teaching and learning, suggesting that (1) learning is about changes in conceptions, (2) learning always has a content as well as a process, (3) improvements in learning involve relations between learners and subject
matter, not just teaching methods and student characteristics, (4) and improving learning is about understanding the student's perspective.

Firstly, while being able to repeat facts and formulae to obtain correct answers on occasion is necessary, it is not what education is essentially about, and viewing learning in this manner is inappropriate (Slavin, 1997). Learning is about the quality of understanding, not the quantity of information able to be reproduced. Secondly, the process of learning (or "how") cannot be separated from the outcome (the "what"). If learning is about changes in conceptualisations, then it is illogical to separate these two associated elements. The notion that students can be taught about how learning is accomplished as something quite separate to what is being learned needs to be re-evaluated. The third aspect of Ramsden's relational view of learning focuses on relations between students, what they are required to learn and what teachers do. It is concerned with student's conceptions of subject matter and how these can be changed. Finally, relational views of learning explore the student's perspectives. Performance on tasks may vary, not always because of a weakness in teaching but because of hidden imperatives that derive from an individual's perceptions and experiences (Ramsden, 1988b).

**Collaborative Dialogue**

Unquestionably the children in this study depended on many conversational interactions with teachers to support their learning and development and even to a lesser extent with me as we undertook problem-solving tasks. The students from the experimental classes were supported for six weeks prior to the undertaking of a range of problem-solving tasks by rich dialogue, or were "scaffolded" to use that metaphor, in an expert/novice learning environment (Bruner, 1966; 1985; Florio-Ruane, 1991; Wertsch, 1991). Contemporary
research has highlighted the importance of “scaffolding” children’s learning, enabling them to participate in problem-solving with conversational support before they can solve problems unassisted. Palinscar and Brown (1984) for example have noted that teachers who engage in scaffolded dialogues with students as they solve problems provide information and models that are supportive of real understanding and growth. In a similar manner, Diaz et al. (1991) note that effective mother-child interactions characterised by scaffolded dialogues which not only support academic inquiry, but serve to motivate and attribute success to factors within the child and to effort, also lead to greater learning and understanding. If therefore, perceptions of learning as a deep, meaningful endeavour are to endure, then the focus of instruction must reflect the importance of discovering meaning by asking “why” and “how” in an environment which fosters and supports such inquiry.

Hogan and Pressley (1997a) understand that becoming a proficient scaffolder takes time and suggest that teachers begin to develop the necessary skills. Firstly, they note that teachers need to examine their beliefs about the teaching/learning process; secondly, they need also to listen to their dialogues, examining their methods of inquiry, discussion and monitoring; thirdly, teachers must internalise a framework for scaffolding devising strategies such as setting goals, focusing attention, prompting responses, and fourthly, they need to work on creating a pervasive atmosphere of thoughtfulness which encourages and celebrates thinking. In addition to this, teachers need to create a structure that works for scaffolding, and to make scaffolding strategies explicit to students. Finally, Hogan and Pressley (1997a) suggest that teachers like students must practise, reflect and welcome mistakes as part of the learning process.
In conclusion, this chapter had discussed the findings of the research focus of this study, highlighting the educational implications of collaborative learning within a cognitively rich sociocultural environment. The development of the strategic behaviours which allow active participation in problem-solving, and the part they play in the adoption of deep or surface learning approaches has also been noted. Of significant importance to current learning endeavours, as well as future behaviours is a renewed understanding about the purpose of teaching, the role of the teacher in the classroom and the way differences in learning outcomes can be minimised.

While it is evident that even five year old children at the very threshold of their academic lives already understand a great deal about metacognitive strategies, the skills and understandings involved in shared thinking must continue to be developed until they become part of each individual child’s repertoire of learning behaviours.

In the following chapter (Chapter 10) the study will be drawn to a close with a summary of the central points of the thesis and implications for future educational practice and further research.
Chapter 10

CONCLUSION AND IMPLICATIONS FOR EDUCATIONAL PRACTICE AND FURTHER RESEARCH

In the previous chapter (Chapter 9) considerable discussion followed the findings of this study in relation to students' learning attributes and the quality of teaching programmes. This chapter (Chapter 10) brings together the findings of the research discussed in the thesis and considers the implications they have for educational practice, linking them with contemporary literature.

Conclusion

The results of the research show that even very young children in the first year of their academic life have developed some understanding about the use of strategic behaviours by the end of the third term, although the extent to which these are used and the contribution they make to the overall learning experience varies considerably. Noteworthy but not surprising is the recognition that students who are already achieving at a high level, display significantly greater awareness about the use and efficacy of metacognitive strategies than students whose academic performance has been compromised. Furthermore, following phenomenographic analyses of a range of personal factors intrinsic to learners, such as motivation, attention and self-concepts, it has been determined that these factors, coupled with their strategic
understanding, may indicate that the approach to learning adopted by some of the children is clearly at a deep level. The corollary to this of course is that some of the children already appear to be displaying the types of characteristics indicative of surface learning, an approach which unless hastily mediated, is likely to result in further learning deficits and continued poor performance outcomes. In most cases, the children already experiencing learning difficulties and poor performance use few strategies, attend poorly to relevant aspects of tasks, show little motivation for school related activities and display some self-concept anomalies. Surface learning, or a focus on repetition and learned facts is therefore, a pragmatic approach for children perceiving learning in this manner.

Perhaps one of the most significant findings of this study was demonstrated when the strategic and affective behaviours of students who had previously participated in the experimental programme (Study 1), were compared with those of the students who had been part of the control groups. Students who had been part of the experimental teaching focus designed to give effective "metacognitive" instruction during mathematics lessons over a six week period showed greater strategic awareness, irrespective of their achievement status, than those students who had not had "metacognitive' training. Although cognisant of the fact that socially mediated experiences other than those occurring in the classroom may also have contributed to the strategic understandings displayed by the experimental group students, in some cases, the number of strategies displayed more than doubled those found amongst control groups.

From the results one may logically conclude that strategic training in domain specific contexts can result in a greater awareness of, and inclination to use metacognitive strategies for more effective learning. In addition to this,
favourable consequences in the affective domain, especially as a result of the positive outcomes which may result from strategy use, are also likely to be forthcoming over time. Obviously six weeks is an insufficient period to produce enduring results in this area, as concepts regarding the 'self' which may influence attention and motivation are slower to change in response to environmental factors than learned behaviours (Beane & Lipka, 1984; Covington, 1992). Indeed, according to Borkowski, Estrada, Milstead and Hale (1989) even learned strategic behaviours are inclined to diminish without continued encouragement and use. Therefore, if the quality of student learning in our schools is to be improved thereby equipping students for the rigours of an increasingly cognitively challenging society, rigid, didactic teaching practices must be confronted and modified to assist the learner to become more flexible in dealing with novel learning and problem-solving demands (Candy, Harri-Augstein & Thomas, 1994).

Trigwell and Prosser (1991) have suggested that improvement in the long-term quality of learning outcomes will inevitably result from the establishment of academic environments which foster deep approaches to learning and problem-solving. Such an academic environment will recognise the importance of the teacher as the facilitator and mediator of cognitive understanding where expert thinking is demonstrated and modelled in a variety of contexts. Frequently however, based on the institutional and behavioural expectations which are often articulated and exemplified in the classroom, the environment may be perceived by students as one which encourages an approach to learning quite contrary to that actually held by the teacher. A significant change in the approach to teaching and the way desired knowledge is imparted to students is obviously required therefore, if the quality of learning for the majority of students is to improve. Some of the prerequisites and antecedents for successful change within the classroom
have been noted by Levine and Cooper (1991). While Trigwell and Prosser (1991) suggest that only by intentionally setting out to improve the quality of learning by the explicit as well as the implicit use of metacognitive strategies within the context of regular tasks in the regular classroom, will strategies have any chance of success, Levine and Cooper give a broader range of suggestions.

They note for example, that if classroom innovations to improve instruction in thinking are to be successful, they will require large scale, whole school undertakings, encompassing all domains with support from all teachers. Teachers should be offered support, encouragement and materials where appropriate, as well as the ongoing training necessary to continue to implement change (Levine & Cooper, 1991). Levine and Cooper go on to state that because the teaching of thinking skills is complex, requiring difficult changes in the behaviours and attitudes of teachers and students alike, manageability must be a major consideration. Attention needs to be given to planning time, class sizes, administration, staff development and the adaptability of classrooms and other time demands. Predictable obstacles such as students’ preferences for lower-order thinking skills, low-level teaching materials, as well as teacher preferences for easy-to-teach lessons, should be recognised and addressed in advance. Of major importance, according to Levine and Cooper (1991), is a reappraisal of assessment goals. Attempts to encourage deep learning approaches will be greatly impeded if assessment continues to focus on low-level skills.

Another method of encouraging deep learning, according to Candy et al. (1994) is to give students the opportunity to reflect on their own academic performance. This requires more than simply allowing time for reflection or even prompting students to engage in critical thinking. Candy et al. (1994)
suggest that reflection may be facilitated by providing some sort of behavioural record (possibly video), through which the learner may be taken conversationally. During this time, prompting, probing and inquiry on the part of the teacher may encourage students to express the thinking behind their actions and their use of strategies after which modification may be possible. Candy et al. (1994) note that the teacher’s role in behavioural monitoring must diminish as students themselves assume greater control of the monitoring process.

Of course provision of the support mechanisms necessary for the encouragement and development of deep learning approaches in many cases requires significant restructuring of the learning environment. Such fundamental restructuring with its focus on teaching thinking through collaborative dialogue is indeed a complex and difficult process which cannot be guided effectively by simple prescription or preconceived formulae. It is indeed a challenge, as Levine and Cooper (1991) put it, not to be undertaken lightly! A challenge nonetheless, but as Jones and Idol (1990) suggest, along with Candy et al. (1994), such change is imperative if we are to transform children’s learning and improve student performance.

Change is also essential if we are to address the situation described by Edwards (1991) which indicates that even after twelve years of instruction, the best products to emerge from high schools show impoverished thinking skills. Roehler and Cantlon (1997) support Edwards’ views, noting that beliefs in a fixed knowledge base must be modified to take into consideration the demands of an ever changing social community which requires its members to be self-reliant, adaptive problem-solvers. Measures taken to implement change have resulted in a multitude of commercial programmes designed to enhance thinking in the classroom. Considerable judgement
however, needs to be exercised when considering the variety and range of ‘thinking’ material. Each brings with it a different approach to the development of thinking skills, focusing on direct teaching, or discussion, dialectic, heuristic or assessment practice, and without judicial appraisement, programmes may in fact serve to confuse rather than encourage their use (Edwards, 1991).

For example, Edwards (1991) discusses de Bono’s CoRT programme (de Bono, 1984) and the Instrumental Enrichment (IE) programme of Feuerstein (Feuerstein, 1980), both of which are designed to provide mediated learning experiences. When commenting on the use of commercial instruments such as these, Edwards notes that each of these products promotes a “content free” approach to strategy development, encouraging habits of mind and specific thinking techniques which may be applied in any subject area to be transferred when required. Equally compelling on the other hand, are those researchers who argue that strategy development must be embedded in content (Jones & Idol, 1990), and who suggest that the skills learned in one domain are rarely transferable for use in another.

Scaffolding has been consistently recognised as an effective instructional tool for supporting students’ learning (Bruner, 1985; Diaz, Neal & Vachio, 1991; Roehler & Cantlon, 1997; Rogoff, 1990; Wood, Bruner & Ross, 1976), and has been found to be a significant factor in reducing the differences in academic outcomes amongst children experiencing difficulty (Gaskins, Rauch, Gensemer, Cunicelli, O’Hara, Six & Scott, 1997). Children cannot avoid learning according to Bouwhuis (1991), while information continues to register, whether in formal learning environments or vicariously. Learning systems, therefore, must capitalise on the natural propensity of children to acquire knowledge. Gaskins et al. (1997) believe that as intelligence is
learnable teachers must provide students with the scaffolding, experiences, strategies and time for reflection that each one requires to be a successful learner. To this end, teachers need to be able to recognise each student’s level of competence with respect to content knowledge and strategies, then scaffold the development of each in a way that “moves students toward the goal of behaving and thinking intelligently” (Gaskins et al., 1997, p. 71).

Hogan and Pressley (1997a) note that as each student will require a different optimal level of support, teachers must be as aware of the needs of students as they are of the content material under discussion. The level of support or prompting will vary according to how close or proximal the next skill or knowledge level is for them. The potential of computer assisted technologies to meet individual student needs is gaining greater recognition in schools, and considerable research in recent years (Bouwhuis, 1991; Elliott, 1991; 1993; Elliott & Hall, 1994; 1997; Hall & Elliott, 1992; Henderson & Cunningham, 1994; Salomon, Perkins & Globerson, 1991) has highlighted the way computers assume the role of the more knowledgeable peer or adult in the support of learning within the zone of proximal development (Henderson & Cunningham, 1994). As with other expert/novice situations, the computer as a tool is used in partnership with the learner, supporting where necessary, cognitive efforts however, leaving the ultimate control in the hands of the user. As Salomon et al. (1991) note, while computer supports may offer the user alternative approaches to problem-based situations, they still invite mindful consideration on the part of the learner. In the early school years especially, computer technology has capitalised on young children’s thirst for knowledge along with their interest in novel display (Elliott & Hall, 1997). Intellectually challenging material presented in a visually stimulating manner is frequently more conducive to knowledge acquisition than many traditional learning tools and teaching methods (Bouwhuis, 1991).
Borkowski et al. (1990) note that irrespective of the method of development, an enormous amount of strategic learning must take place before students become efficient, competent higher-order thinkers. Therefore it must follow that strategic learning, focusing on the development of powerful cognitive tools must be encouraged in the earliest school years. A crucial aspect of strategy development through social interaction is dialogue and Hogan (1997) describes this as the way that “members of the intellectual community (teachers and learners) talk with one another” (p.1). She notes that strategic learning can only be accomplished through a system of instructional scaffolding whereby the thinking patterns of experts are revealed to novice learners.

In a recent meta analysis conducted by Hattie, Biggs and Purdie (1996), which sought to identify features of interventions designed to enhance student’s learning, it was concluded that while intervention programs were effective across all age groups, “it is the youngest children who accrue the greatest benefits across all outcomes” (Hattie, Biggs & Purdie, 1996, p.126). They go on to note that study skills training becomes less effective as the child moves through the upper primary and tertiary levels. This tends to support Biggs’ (1985) research which suggests that deep learning approaches decrease with age, reflecting possibly the high focus placed on institutional assessment in the higher school years. This of course, supports the point that learning behaviours can and indeed must be developed at an early age, especially when the research suggests that attempts to modify established behaviours in later years frequently meet with considerable resistance. While Semb and Ellis (1994) note that student ability and other factors such as socioeconomic status are also clearly indicators of academic performance, they go on to say that instructional strategies have a greater impact than most other factors. Strategies which promote higher levels of thinking and which
actively engage students in the demands of a task, result in better long-term retention and therefore, ultimately better academic outcomes.

**Implications for Educational Practice**

The findings of this research are consistent with other sociocultural studies in educational and developmental psychology and focus attention on the importance of student learning that is self-regulated, independent, relevant, process oriented and directed toward meaning rather than solely for assessment purposes (Biggs, 1988a; 1988b; Biggs & Moore, 1993; Dweck, 1986; Dweck & Elliott, 1983; Schunk & Zimmerman, 1994; Zimmerman, 1994). When directed toward the attainment of these goals however, teaching must be delivered in an environment which draws upon many sources of knowledge, where, to quote Jones and Idol (1990), “the learner is seen holistically reflecting cognitive, affective and physical characteristics in multiple environments that influence and guide the process of learning as well as what is learned” (p.528). Furthermore, Stephenson (1991) believes that strategic teachers who present tasks which elicit the use of higher-order procedures are in turn creating an environment of “higher-order cognitive holding power” (p. 150). This higher-order cognitive activity not only results in immediate behaviour, but can also be successfully called upon in the future when new problems arise.

Young children especially need to develop the management skills necessary for effective learning which encourages a deep and lasting transfer of knowledge within and across domains. Behaviours cultivated in the early school years impact significantly on learning in the higher school years. Students need to be able to set their own learning goals, persist in the face of
failure and adopt intrinsic standards for success. Paris and Winograd (1990, p.43) believe that “the cognitive consequence of self-regulated learning is that students become enabled to select and attack problems strategically, while the motivational consequence is that they feel empowered to be successful and thereby invest effort in relevant and challenging tasks”.

Hattie et al. (1996) note that there are enormous implications here for practitioners which depend largely on the kind of outcome desired. While Paris and Winograd (1990) suggest that the enhancement of students’ understanding of academic tasks and learning processes are appropriate goals for instruction, they must be linked to the larger goal of self-regulated learning, and the development of deep understanding. If therefore, the goal of teaching is to enable students to retain accurate detail (and mnemonic strategies involving imagery, keywords, and associations are highly effective for this purpose), then perhaps the goal is shortsighted. While there can be no dispute that the accurate retention of procedures, facts and formulae is in many cases sensible and productive, if the kind of outcome desired calls for understanding and application in novel contexts, then more complex strategies are required (Hattie et al., 1996).

Bandura, Barbaranelli, Caprara and Pastorelli (1995) go even further. They along with Brown and Pressley (1994), say that although the pragmatics of self-regulation have been addressed in terms of the selection of appropriate strategies, recognition of the utility of cognitive strategies and the correction of deficiencies, students must also be encouraged to develop a firm belief in their own motivation and learning activity. It is only then, suggests Bandura et al. (1995) that students will have the staying power which will lead to enhanced performance.
Noting that one of the qualitative differences discernible in high achieving students as compared to many of their peers, is their ability to access high level planning, metacognitive strategies and simultaneous processing functions, Schofield and Ashman (1987) say that it is imperative that these become the focus of attention in the educational context.

Effective instruction therefore, must reflect a twofold agenda. Curriculum goals while directed toward the gaining of domain specific knowledge should at the same time include thinking processes/strategies, such as collaborative skills and the development of productive self-systems (Jones & Idol, 1990). The importance of cognitive dialogue within the classroom must be stressed, ensuring collaboration with teachers and other students. Teacher and student modelling, coaching, dialogue, explanations, guided practice, generating questions and self-questioning must all become features of the new dynamic classroom, if the higher-order thinking skills necessary for deep learning approaches are to be adopted (Bandura et al., 1995; Biggs & Moore, 1993; Hogan & Pressley, 1997a; 1997b; Jones & Idol, 1990; Paris & Winograd, 1990). Jones and Idol (1990) suggest that such teaching and learning foci differ markedly from most traditional schooling which tends to emphasise the learning of basic skills and isolated facts. It is also in contrast to traditional teaching which has as its focus, assessment of learning and didactic instructional methods.

Although the research for this thesis has been conducted through the observation of teaching and learning behaviours in school contexts, it must be remembered that the teachers perceived to be most effective (those in the experimental groups) were given specific instruction in the development of higher-order thinking prior to being observed. Following a long association with schools and classroom teaching practices, it is concluded that most
teachers, including the teachers from the experimental groups prior to training, as well as the teachers in the control groups, do not teach in ways consistent with that advocated by sociocultural and strategy-based research.

The Need for Effective Teacher Training

Teachers rarely model metacognitive understanding, develop creative learning environments or empower their students with a sense of enthusiasm and a desire for challenging inquiry (Hine & Newman, 1996). There are possibly several reasons for this, as Jones and Idol (1990) note, which may be worthy of future research. Preservice and inservice teacher training institutions tend to focus for example, on the acquisition of knowledge about facts and skills, rather than on the development of strategic behaviours to foster either trainee teachers’ own deep learning or for later use to encourage deep thinking within the classroom. Secondly, the existing values, beliefs and policies in schools are quite different from those proposed by this and other research. As Hine and Newman (1996) note, teacher education programmes have not on the whole systematically incorporated either the theory or the pedagogy of a cognitive-skills emphasis, especially for primary teachers. For example, as teachers have traditionally been information providers through teacher-directed instruction, the notion that dialogue which allows students to control questioning, be encouraged in the classroom, is at odds with that tradition. Another stumbling block appears to be the focus on instruction which is driven by assessment measuring isolated skills and facts (Jones & Idol, 1990). In a climate where teacher accountability is demanded, and the production of students with high assessment scores is encouraged, then a change in teacher focus is unlikely to occur rapidly.
A third reason for the lack of teacher modelling in this area is that some are not convinced that sociocultural, apprenticeship models have merit. Implicit in research which highlights the importance of the sociocultural context for educational training is the belief that all children can learn, even those who are currently struggling and being supported by remedial programs (Jones & Idol, 1990). Some teachers, perhaps as a result of years of frustration with underachieving students, are more sceptical about such teaching and learning possibilities. Moreover, as education in Australia is constantly under scrutiny, considerable modification in teaching programmes in recent years, has placed teachers under a great deal of pressure to adapt to meet these changes. Some teaching practitioners have even felt that a number of new programmes have been introduced merely for the sake of change itself, a situation which has possible given rise to a mistrust regarding serious educational investigation.

If teacher modelling is to include the sort of behaviours which encourage students to be self-regulating of their own learning and problem-solving, then not just schools but teacher training programmes must also change their teaching foci. Lepper, Drake and O’Donnell-Johnson (1997) in a study exploring the scaffolding techniques of expert tutors discovered that the most effective tutors not only encouraged students to learn more of the content material under discussion, but found they were also instrumental in increasing interest and enthusiasm. They noted that the most capable teachers were both sensitive and responsive to the needs of individuals, whilst at the same time maintaining a firm grasp of the specific subject under discussion. One important component of an expert tutor’s approach was to ascertain students’ current levels of understanding, determining and clarifying misconceptions, in order to select problems which would prove challenging but not impossible for students within the “zone of proximal development” (Vygotsky, 1978; Wertsch, 1991).
Furthermore, expert tutors were found to directly challenge students with comments such as,

“This is really tricky...do you think you could do this one?”

Teachers also sought to increase curiosity and reflection with questions like,

“Do you think we could do this [task] the same way as the other one?”

Alternatively, they offered students choices on how to proceed, such as,

“Shall we try it this way [suggest method], or do you think the other way [method] would be better?”

Finally, teachers used problem-solving opportunities to label and give information regarding the nature of the problem to come. For example,

“Today we are going to focus on the combinations of numbers that add together to make ten” (Lepper et al., 1997).

To create expert tutors like those discussed in the previous study (Lepper et al., 1997), teacher education programmes must equip preservice teachers to act as effective models able to pass on to young children the skills and strategies designed to challenge and extend thinking about learning. Instructional techniques such as those discussed above, along with the methods used by the teachers (Appendix E) participating in the experimental component (Study 1) of the research reported on in this thesis, are used with this objective in mind.

Moreover, research suggests that a concentration on the development of children’s affective qualities is imperative if motivation to tackle the demands of tasks is to increase. Training programmes therefore, must show preservice teachers how to enhance feelings of self-confidence and self-esteem amongst
their students. This is especially important for students experiencing difficulty and who frequently display poor self-concepts and little confidence in their own abilities (Lepper et al., 1997). In addition to this, rather than providing less complex material to students experiencing difficulties, preservice teachers need to be taught to be judicious in their selection of complex tasks, ensuring success but offering no compromise on challenge. Furthermore, preservice teachers must be encouraged to be sensitive to the interest level of children, ensuring their active involvement in tasks, and finally, they must be taught how to instil in their pupils a sense of self-regulation and self-efficacy or intrinsic rather than extrinsic control.

Idol, Jones and Mayer (1991) have suggested that the type of change necessary within the classroom which will encourage students to adopt deep approaches to their learning and problem-solving, will only be possible if preservice training institutions, in-service programs and textual and electronic media materials focus on cognitive instruction. Hogan (1997) notes that there has been an upsurge of interest in recent years in forms of instruction which capitalise on the social nature of classrooms. English (1991) extends this thinking however, and suggests that early school curricula need to capitalise on children’s potential for learning by providing an environment which will sustain the child’s development both through those early years and well beyond into higher education. Too frequently the initial enthusiasm brought to the early school years is sabotaged by poor teaching practices and environments.

Considerable experience leads many researchers to the conclusion that much potentially valuable understanding is lost because learners have not developed the skills to deal effectively with their learning encounters (Candy et al., 1994). Unless this situation is redressed, of even greater consequence,
is the perception of learning as the product of a period of compulsory schooling which frequently culminates in success or failure following a major examination.

Study Limitations

Although this research has highlighted some important findings and the results have significant implications for teaching practices for reducing the differences in the learning outcomes between children, and possibly for the structure of preservice teaching programmes, there have been limitations to the study which require mention.

Firstly, the students selected for participation in the research were chosen from a small range of independent schools, having similar socioeconomic status, cultural backgrounds, within the same geographical area. Although this allowed for control of a range of variables, the small sample size and limited range of schools within a specific area has meant that considerable further research will need to be conducted, possibly with larger samples, before the results can be more generalisable. For example, although Study 1 considered variations in the posttest mathematical scores of over two hundred (219) students, this thesis reports on Study 2 which was conducted with just sixteen (16) students. The very nature of qualitative research however, often restricts the number of participants to that which is manageable. Lack of funding for research assistance generally imposes heavy time and workload commitments on the researcher whose responsibility it is to manage and undertake all tasks.

Additionally, independent schools were selected because of their general commitment to educational research. While this was undoubtedly of great
benefit to this study and to this researcher, it is recognised that it may not be reflective of all schools within New South Wales. The teachers selected for participation were eager to further their personal skills and professional development and to increase their understanding in order to support the learning of their students. Furthermore, by their very nature, many independent schools reflect the values and beliefs of the families represented therein. Frequently synonymous with higher socioeconomic status is a valuing of educational enterprise with positive expectations for student success, often encouraged by parents, collaborating with their children in a range of contexts. It is necessary therefore, to recognise that some of the students in this study may also not be entirely representative of those in other schools.

Moreover, although changes in strategic learning behaviours were evident at the conclusion to this study, six weeks is undoubtedly too brief a period for long lasting change. A far longer period is clearly required for the long-term development of effective strategic behaviours, and an awareness of when, where and how they assist in self-regulation and deep learning. This may be especially so amongst students experiencing difficulty, and therefore, a longer period of experimentation may give even more positive results in future research.

Finally, the phenomenographic methodology employed in this study attempted to ascertain qualitative differences in perceptions of learning from the student’s perspective through language and actions while undertaking problem-solving tasks. Prior to the study however, no attempt had been made to encourage children to talk about their learning or problem-solving behaviours openly, resulting in limitations in discerning metacognitive and self-regulatory function. Future research might try to redress this situation,
thereby giving students not only the strategic skills necessary for complex thinking, but the ability to discuss this thinking with others.

Future research

The body of research based on the recognition of the importance of the sociocultural context for learning is continually expanding and informing educational debate. Although a great deal of this research has focused on the importance and the development of metacognitive strategies and their significance to self-regulation, the research on deep and surface approaches to learning in the early childhood years is clearly lacking. Thus there is considerable scope for further research in determining the approaches to learning adopted by children in both the early school years as well as children in the years prior to commencement of school.

The results of this thesis have indicated that even very young students are aware of and adopt a range of metacognitive strategies during their early school years. The very nature of and articulated philosophy within the training given to (Early Childhood) preservice teachers equips them to work at a personal level with individual children (Ashton & Elliott, 1995; Elliott & Irvine, 1984). Early childhood trained teachers who obtain employment in primary schools often continue to adopt this individualised philosophy, scaffolding learning within the sociocultural context of the school to assist students develop understanding about learning at a deep level. Research is needed, therefore, to explore the learning behaviours of children from classes where teachers have adopted practices which scaffold learning from the commencement of the school year, especially if these children have also been part of a scaffolding environment in the years prior to school.
Longitudinal studies are obviously required to determine the efficacy of training students in the development of metacognitive skills for self-regulation and deep perceptions about learning. Such training must begin in the first year of school with special attention paid to students who appear to have early learning difficulties. The antecedents of low achievement are often apparent in the preschool years. Therefore, if such children are identified at the commencement of school and effectively scaffolded through their early learning endeavours by expert teachers with the skills to develop metacognitive strategies, then difficulties in understanding concepts may be dealt with before they obstruct future learning.

Furthermore, future research must include an assessment of preservice teacher training programmes, especially primary training programmes, where the procedures characteristic of early childhood training which encourage scaffolded support of learning are not usually emphasised. To redress this situation, especially given the overwhelming support for scaffolding in the literature, preservice and inservice sessions must clearly explain and demonstrate the efficacy of such teaching practices. Instruction must detail how students can acquire the skills and strategies for problem-solving, how they can become self-regulating learners and how, through appropriate teaching foci, students can develop deep, rather than surface perceptions about learning goals. This type of research is also important for the preservice teachers themselves, many of whom will hold perceptions about learning reflective of their own learning experiences. As many schools, colleges and even universities still emphasise the acquisition of knowledge for assessment purposes, it is not surprising that graduate teachers fail to fully understand higher-order teaching goals, nor do they recognise the efficacy of strategic learning behaviours.
A similar but much larger study to that documented here could be undertaken within a single school, across all grades following a comprehensive teacher training programme, using a longitudinal design. As strategy development takes many years to become an automatic, internalised response to problematic situations, then the scaffolding behaviours of the teachers across all grades would build upon and reinforce those acquired in earlier classes. Such a study may also pretest students' strategic practices prior to the commencement of school, and retest at the completion of each year. This would then serve as a pretest for the successive year, continued in this manner for each grade. A school similar in composition and variable factors to that selected for the experiment could act as a control group.

To more readily apply the findings of this and future research, it may be necessary to replicate the study with a larger student sample, across a range of schools, geographical areas, socioeconomic groups and with a diverse cultural mix. These variables alone often influence perceptions about learning and have been found to frequently either enhance or demolish motivation and self-concepts.

Furthermore, if phenomenographic methodologies are to be employed with very young children in future research projects, students must be encouraged to discuss their thinking, to engage in “private speech” and to understand the reasoning behind displayed metacognitive actions. Of course, previous studies have demonstrated that self talk or “private speech” serves a critical purpose in self-regulation and problem-solving.
Summary of Thesis

The search for more effective teaching and learning outcomes continue to provide the impetus for research in education. This study has highlighted certain areas of interest and other areas of concern which need to be addressed if learning outcomes are to be improved, especially for students who are experiencing difficulty. The early school years are undoubtedly the most crucial in a child’s life, as they constitute the years when the foundations of academic expertise are being laid. Many of the learning behaviours adopted in these early years will continue to impact on the way students perceive the goals of learning and influence motivation and beliefs regarding attributions of success or failure throughout their school lives.

Given that the sociocultural context within which each student learns is a major determinant in the successful development of positive learning behaviours, the natural social environment of the school classroom and the teaching methods employed by the classroom teacher, have been viewed as critical factors in the learning discussed in this thesis. Furthermore, recognising the role that metacognitive understanding plays and its contribution to self-regulation of the learning process (surely one of the most desired goals held by teachers), the metacognitive strategies used by early learners have also been examined. Metacognitive strategies along with a number of affective attributes, such as attention, motivation and self-esteem have been assessed to determine whether even very young children perceive the purpose of learning and subsequently learn in qualitatively different ways. Although research has explored the deep and surface approaches to learning held by high school and tertiary education students, the perceptions of children in the early childhood years have rarely been the subject of such research.
This thesis began in Chapter 1 with an introduction to theories regarding teaching and learning, beginning with the Greek philosophers Plato, Socrates and Aristotle (Bowen & Hobson, 1987; Edwards, 1991), who were urging cognitive training as far back as the sixth century BC. This tradition has continued throughout the centuries, resulting in numerous “definitive” learning perspectives, peaking in the nineteenth and twentieth centuries. Three broad theoretical perspectives have been highlighted and emphasised (a) behaviourist, (b) humanistic, and (c) cognitive approaches.

Cognitive approaches to learning with their emphasis on the “internal mental processes which lead to knowing” (Berk, 1991, p.207) have been the subject of this study. More specifically, it has adopted the theoretical viewpoint of the Russian psychologist, Lev Vygotsky (1976; 1978; 1996), who argued that learning involves an internalisation of a range of social signs which largely develop through social and cultural relationships. The external guidance which is initially provided by more expert learners through mediated activity is gradually internalised to become part of the learner’s own repertoire of cognitive behaviours.

Chapter 2 essentially reviews the work of John Biggs and some of his colleagues and highlights their research regarding the learning approaches adopted by students (Biggs, 1985; 1987; 1988a; 1988b; Biggs & Moore, 1993; Entwistle, 1991; 1993; Marton, 1994; Trigwell & Prosser, 1991). They note that learning tasks are generally approached with one of two intentions in mind. For example, when faced with a reading task students might set out to either remember the words used or to discover the real meaning. Strategies for tackling the tasks such as rote learning procedures, or those designed to create links for better understanding, are then chosen according to their intention.
Biggs notes that strategic behaviours often reflect the perceptions held by students regarding learning. He goes on to say that rote learning strategies are often adopted by students concerned about accurate reproduction of learned information to meet institutional requirements. These students he suggests, may be surface approach learners, unlike some of their contemporaries who choose to adopt deep learning approaches. Deep learners frequently adopt a planful approach to learning, choosing metacognitive strategies to assist with the demands of complex academic tasks, having as their goal meaning and understanding rather than rote memorisation. Some of the affective characteristics of learners (attention, motivation, self-esteem) are also discussed in Chapter 2.

Chapter 3 further describes the literature regarding the sociocultural approach to cognitive development. More specifically, it notes the importance of collaborative dialogue in scaffolding learning (Wood, Bruner & Ross, 1976; 1986), the way such support assists with the development of metacognition (Borkowski et al., 1989; Flavell, 1976; King, 1989; Siegler, 1991), and how metacognitive understanding contributes to self-regulation (Borkowski, 1992; Brown & Palinscar, 1982; Schunk & Zimmerman, 1994).

“Scaffolding” has been adopted as an appropriate metaphor for the type of instruction which supports children’s problem-solving endeavours as they move toward self-regulation. It is characterised by a number of features displayed by the tutor (parent, teacher or more able peer) to maintain on-task behaviour and retain the interest and motivation of students. Teachers who engage in this type of instruction frequently emphasise an understanding about metacognition, thereby encouraging the development of “an awareness of one’s own cognitive processes and the self-regulation and the orchestration of those processes in relation to learning tasks” (King, 1989, p.367). Self-
regulated information processing requires an understanding of the value of
the use of metacognitive strategies. Such strategies become automatic
providing sufficient time is devoted to strategy training and students are
given opportunity to practice their use across a range of subject domains.

Of significant concern in any discussion about learning are those students
whose task performance does not accord with their perceived potential
capabilities. Chapter 4 therefore, focuses on the qualitative differences in
learning approaches displayed by high and low achievers in the classroom
and how more effective teaching methods might possibly reduce some of
these differences. Some of the antecedents of low achievement have been
discussed and demonstrate that while intelligence is undoubtedly a
consideration for some children, factors such as self-concepts, attributions of
success and failure and classroom instruction may be of even greater concern
(Borkowski, 1992; Borkowski et al., 1990; Borkowski & Thorpe, 1994;
Covington, 1992; Meece, 1994). Of special interest to this study is the
literature which notes that specific skills deficits, minimal metacognitive
understanding and poor self-regulation are consistent characteristics of low

The chapter continues by discussing the literature related to support for low
and underachieving students and concludes that strategic understanding can
be taught, although its acquisition is contingent upon a number of factors.
Firstly, strategy knowledge requires time, consistency and practice, and
should be acquired through both explicit as well as implicit instruction.
Students need to understand the types of strategies appropriate to tasks, when,
where and how they might be used and especially their effectiveness in
altering negative outcomes. As most low and underachievers appear to hold
surface approaches to learning, classroom instruction must emphasise process
skills and then reinforce their use with consistent academic feedback, irrespective of initial outcomes.

Chapter 5 draws together the research discussed in the literature reviewed in the preceding chapters and outlines the three questions addressed in this thesis. As much of the literature available on deep and surface approaches to learning has reported on research with older students, this study has tried to determine whether very young children, also hold deep or surface learning approaches. Firstly therefore, the metacognitive, self-regulatory strategy use of children in their first year of school has been observed. The nature of these strategies and the frequency of use during problem-solving has been detailed.

Secondly, as the way students solve problems is inextricably linked with the way they perceive learning goals, strategic behaviours, linked together with student’s affective characteristics were rated against a hierarchy of deep and surface learning characteristics to determine their approaches to learning.

Thirdly, given that the focus of classroom instruction is so important to the development of deep, strategic, self-regulatory learning behaviours, the learning characteristics of students who had previously participated in an experimental learning programme where metacognitive skills were emphasised, discussed and practiced, were compared with those of students from a control group.

The methodology employed in the study (Study 2) has been outlined in Chapter 6. Within this chapter, some aspects of a previous ARC funded, quantitatively analysed project (Study 1), integral to the research discussed in this thesis, have also been discussed. Study 2 however, has been conducted
within a qualitative research paradigm using a phenomenographic methodology.

Sixteen students, aged five and six years of age, in their first year of school, participated in the study. Eight of the students had previously had metacognitive, self-regulatory training during mathematics lessons most days of the week over a six week period. Of these eight students, four were high achievers while the remaining four experienced some academic difficulty. A further eight students displaying similar characteristics to those participating in the experiment, had not had any specific metacognitive training prior to testing.

Students’ cognitive behaviours were videotaped as they undertook a range of mathematical problems, following which videotaped data were transcribed and subjected to repeated viewing for analysis. Phenomenography was used as a method of investigation to determine variance in approaches to learning. Based on the literature and following observation of the videotaped data, differences in the behaviours of students were characterised in terms of their categories of description.

Mindful of the three research questions outlined in Chapter 5, the findings to come from this research were detailed in Chapter 7. This chapter showed that irrespective of their current achievement levels or the type of instruction each child had received, all displayed some strategic behaviour, although there were significant differences evident between individuals. After repeated observation of the data, four strategies (identifying problem, establishing goal, self-monitoring performance and reflecting on task) were found to have been consistently used. The students who had displayed high achievement on
a range of tasks used the identified strategies more frequently and with greater success than the underachieving students.

Strategic activity has been found to be just one of a range of factors inherent in deep approach learning. Effective strategy use however, when linked with students’ attention to detail, intrinsic motivation, positive self-concepts and a scaffolded learning environment seems to be a vital predictor and influencer of deep learning. The results indicate that some of the students in the study have already begun to approach learning as a tool in the acquisition of meaning and deep understanding. Conversely, minimal strategy use when linked with negative affective characteristics and a more didactic learning environment, suggests that some students already appear to view learning as a surface endeavour.

Furthermore, the results seem to indicate that the students who had had some training in metacognitive strategy use, regardless of their actual performance outcomes, displayed greater strategy use than the students who had received no training at all.

Chapter 8 enables the reader to take a clearer and more intimate look at the learning behaviours displayed by some of the students participating in the study. In this chapter, four Case Studies detail the learning behaviours of eight of the students (four of whom had received training and four who had not). Case Studies allow the “voices” of the participants to speak for themselves and describe more fully the learning actions and the learning perceptions of the students described herein.

In Chapter 9, the results were discussed in the light of other recent research. Certainly, it is acknowledged that very young children, even with just three
terms of school-based education behind them, already know something of the sort of behaviours necessary for successful learning and problem-solving. All students know a little about strategies which appear to be used to some extent by most children. What is important, however, is that the classroom becomes the sort of environment that encourages, promotes and indeed, necessitates the use of the higher-order thinking skills which will equip students for the demands of their school life. Moreover, development of the sort of strategic, self-regulating, deep learning behaviours which will equip students to be flexible learners is necessary to deal with the requirements of our rapidly changing technological society.

This chapter, Chapter 10, concludes the thesis and notes implications for educational practice and future research. This study has demonstrated that many learning behaviours have been formed by the end of the first year of school and possibly even prior to the commencement of school. Certainly the learning behaviours of students are clearly linked with their performance outcomes. However, as the students who had experienced metacognitive training displayed greater strategic awareness than their contemporaries in regular classes, the study also suggests that learning behaviours can be modified, even after only six weeks of tuition.

Obviously, if metacognitive training is to be effective in the long-term, it must be a feature of every subject in every classroom. This has significant implications for both educational practice and teacher training if the differential outcomes evident amongst children are to be curtailed before they influence further learning. The teaching practices in the early school years must firstly build upon the knowledge students have already acquired in other sociocultural contexts. Secondly, teachers must not assume that teaching practices which may appear logical to them will be recognised as such by
their students. Therefore, explicit discussion about the skills and strategies that enhance thinking and learning and about the goals of any learning endeavour must become a characteristic of teaching methodology. Without such discussion, students are likely to continue to develop superficial rather than deep understanding about the purpose and goal of academic tasks.
REFERENCES


Appendix A

Examples of Pictures and Questions
TEMA 2 (Ginsburg & Baroody, 1990)
NUMBER THIS IS.” Continue with same instructions for Cards 12-2 and 12-3.
Scoring: To pass, a child must correctly read all three numerals.

WRITING SINGLE-DIGIT NUMERALS
(Formal)
Materials: Worksheet
Procedure: Say, “I’M GOING TO TELL YOU SOMEBODY, AND I’D LIKE YOU TO WRITE THEM ON THE WORKSHEET HERE. (Point to space 13.) THE FIRST NUMBER IS SEVEN.” Pause for the child to write. Then say, “THE NEXT NUMBER IS THREE.” After the child has written the number say, “THE LAST NUMBER IS NINE.”
Scoring: To pass, the child must write all three numerals correctly. Reversed numerals—for example, ¥ for 7—are considered correct. Penmanship is not a consideration; sloppy numerals are acceptable.

CONCRETELY MODELING ADDITION WORD PROBLEMS (Informal)
Materials: 10 pennies, chips, or other small countable objects.
Procedure: Say, “I’M GOING TO TELL YOU SOME STORIES ABOUT JOEY AND HIS MONEY. IF YOU WANT, YOU CAN USE YOUR FINGERS OR THESE PENNIES TO HELP YOU FIND THE ANSWER.” If a child does not use fingers or pennies and responds with an incorrect answer, give the following prompt: “USE YOUR FINGERS OR THESE PENNIES TO FIGURE OUT HOW MUCH FIVE PENNIES AND TWO MORE ARE.” After giving each of the problems below, put any pennies used back into a single pile. Each time do not tell the child whether the answer is right or wrong. Stop testing after the child misses two questions.
A. “JOEY HAS ONE PENNY, AND HE GETS TWO MORE. HOW MANY DOES HE HAVE ALTOGETHER? IF YOU WANT, YOU CAN USE YOUR FINGERS OR THESE PENNIES TO HELP YOU FIND THE ANSWER.”
B. “JOEY HAS FOUR PENNIES, AND HE GETS THREE MORE. HOW MANY DOES HE HAVE ALTOGETHER? IF YOU WANT, YOU CAN USE YOUR FINGERS OR THESE PENNIES TO HELP YOU FIND THE ANSWER.”
C. “JOEY HAS THREE PENNIES, AND HE GETS TWO MORE. HOW MANY DOES HE HAVE ALTOGETHER? IF YOU WANT, YOU CAN USE YOUR FINGERS OR

THESE PENNIES TO HELP YOU FIND THE ANSWER.”
Scoring: To pass, a child must correctly answer at least two of the three problems.

15. WRITTEN REPRESENTATION (Formal)
Procedure: Say, “HERE IS A PICTURE OF SOME DOGS. (Show child Card 15-1.) USE THIS PAPER AND PENCIL TO SHOW ME HOW MANY DOGS THERE ARE.” If the child draws pictures of dogs, ask, “CAN YOU SHOW ME ANOTHER WAY WITHOUT PICTURES?” If the child responds to Problem 15-1 by drawing tallies, lines, marks, circles, or a numeral, repeat the procedure with Cards 15-2, 15-3, and 15-4.
Card 15-2: “HOW MANY CATS ARE THERE?”
Card 15-3: “HOW MANY LIONS ARE THERE?”
Card 15-4: “HOW MANY TIGERS ARE THERE?”
Scoring: To pass, a child must draw the correct number of tallies, lines, marks, circles, numerals (but not pictures) for at least three of the four problems.

16. CONCEPTION OF MORE (Informal)
Scoring: To pass, the child must get four out of four problems correct.

17. COUNTING OUT LOUD: 21 (Informal)
Procedure: Say, “I’D LIKE YOU TO COUNT OUT LOUD FOR ME. I’LL TELL YOU WHEN TO STOP.” If the child is silent, say, “COUNT OUT LOUD LIKE THIS WITH ME: ONE, TWO, THREE ... YOU KEEP GOING NOW BY YOURSELF AND COUNT UP AS HIGH AS YOU CAN.” If the child counts correctly, stop him or her at 42 (since this is relevant for Item 28). If the child stops his or her correct counting before 42, ask what number comes next and then urge the child to continue. Consider the item completed when the child makes his or her first error or if the child stops and maintains that he or she can count no higher.
Scoring: To pass, the child must count to at least 21 without error. (If the child counts to 41 without error, give him or her a pass on Item 28, also.)
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COUNT AFTER ME: II (Informal)

Procedure: Say, "NOW WE ARE GOING TO DO COUNT AFTER ME. I'LL SAY SOME NUMBERS AND YOU SAY THE NUMBER THAT COMES NEXT. LIKE IF I SAY, 'ONE, TWO,' YOU SAY THE NUMBER THAT COMES NEXT." If the child is silent, say, "GO AHEAD, YOU SAY..." Either "three" or "three, four" is considered correct. If the child is still silent, say, "THREE." For all children, then say, "YOU ALWAYS SAY THE NUMBER THAT COMES NEXT."

A. "TWENTY-EIGHT, TWENTY-NINE,..."  
B. "FORTY-EIGHT, FORTY-NINE,..."

Scoring: To pass, the child must get both items correct by saying "thirty" or "thirty, thirty-one" to A and "fifty" or "fifty, fifty-one" to B.

II. MENTAL NUMBER LINE II (Informal)


Procedure: Show Card 31 and, pointing to the practice box, say, "NOW, LET'S DO THIS. HERE IS A SIX. WHICH IS CLOSER TO SIX, FIVE OR NINE?" If the child seems confused, say, "IS FIVE CLOSER TO SIX OR IS NINE CLOSER TO SIX?" If the child is correct, say, "THAT'S RIGHT, FIVE IS CLOSER. IT'S ONLY ONE WAY FROM SIX; NINE IS THREE AWAY FROM SIX." If the child is wrong, say, "NO, FIVE IS CLOSER. IT'S ONLY ONE WAY FROM SIX; NINE IS THREE AWAY FROM SIX." After this practice trial, show the test items in order like this:

A. Say, "HERE IS A THIRTY-TWO. WHICH IS CLOSER, TWENTY-FOUR OR SIXTY-TWO?"

B. Say, "HERE IS AN EIGHTY-FOUR. WHICH IS CLOSER, FIFTY-ONE OR NINETY-SIX?"

C. Say, "HERE IS A FOURTY-EIGHT. WHICH IS CLOSER, TWENTY-THREE OR FIFTY-FOUR?"

D. Say, "HERE IS A SIXTY-FIVE. WHICH IS CLOSER, FORTY-NINE OR NINETY-NINE?"

E. Say, "HERE IS A SEVENTY-ONE. WHICH IS CLOSER, FORTY-NINE OR EIGHTY-FOUR?"

Scoring: To pass, the child must be correct on four of five problems. The correct answers are (A) twenty-four, (B) ninety-six, (C) fifty-four, (D) forty-nine, (E) eighty-four.

32. ENUMERATION: LARGE (Informal)

Material Needed: Cards 32-1 and 32-2

Procedure: Say, "COUNT THESE DOTS WITH YOUR FINGER, AND TELL ME HOW MANY THERE ARE. DO IT CAREFULLY." If the child does not point with the finger, say, "MAKE SURE YOU TOUCH EACH DOT AS YOU COUNT." Show the child Card 32-1 and after he or she completes it, Card 32-2.

Scoring: To pass, the child must indicate that Card 32-1 has 14 dots and that Card 32-2 has 16 dots. Further, the child must obtain the correct answer by counting each dot once and only once. If by accident, the child gets a right answer by counting some dots twice and skipping others, he or she does not receive a pass.

33. COUNT AFTER ME: III (Informal)

Procedure: Say, "NOW WE ARE GOING TO DO COUNT AFTER ME. I'LL SAY SOME NUMBERS AND YOU SAY THE NUMBER THAT COMES NEXT. LIKE IF I SAY ONE, TWO, YOU SAY THE NUMBER THAT COMES NEXT." If the child is silent, say, "GO AHEAD, YOU SAY..." Either "three" or "three, four" is considered correct. If the child is still silent, say, "THREE." For all children, then say, "YOU ALWAYS SAY THE NUMBER THAT COMES NEXT."

A. "SIXTY-EIGHT, SIXTY-NINE,..."  
B. "EIGHTY-EIGHT, EIGHTY-NINE,..."

Scoring: To pass, the child must get both items correct by saying "seventy" or "seventy, seventy-one" for A and "ninety" or "ninety, ninety-one" for B.

34. COUNT BACK FROM 20 (Informal)

Procedure: Say, "NOW I WANT YOU TO COUNT BACKWARDS, LIKE WHEN A ROCKET BLASTS OFF. FOR INSTANCE, 'THREE, TWO, ONE, BLAST-OFF.' NOW YOU COUNT BACKWARDS, STARTING FROM TWENTY."

Scoring: To pass, the child must say, "Twenty, nineteen, eighteen, seventeen, sixteen, fifteen, fourteen, thirteen, twelve, eleven, ten, nine, eight, seven, six, five, four, three, two, one." Self-correction acceptable.

35. SUBTRACTION FACTS: N-N (Formal)

Material Needed: Card 35

Procedure: Say, "NOW I'M GOING TO SHOW YOU SOME TAKE-AWAY PROBLEMS. TELL ME QUICKLY WHAT YOU THINK THE ANSWER IS. HERE IS A PRACTICE PROBLEM." Show the child Card 35, part A, 2-1 and say, "HOW MUCH IS TWO TAKE AWAY ONE? JUST TELL ME WHAT POPS INTO YOUR HEAD WHEN I SAY, 'HOW MUCH IS TWO TAKE AWAY ONE?'" After the child answers,
Appendix C

Examples of Questions
Pictorial Scale of perceived Competence and Social Acceptance
for Young Children (Harter, 1982; Harter & Pike, 1983)

<table>
<thead>
<tr>
<th>School Grade</th>
<th>Kindergarten</th>
<th>First</th>
<th>Second</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child's Name</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Statement</th>
<th>Score</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Good at numbers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Has lots of friends</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Good at swinging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Mum lets you eat at friends</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Knows a lot in school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Others share their toys</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Good at climbing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Mum takes you places you like</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Can read alone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Has friends to play with</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Good at bouncing balls</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Mum cooks favourite foods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Can write words</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Has friends in the playground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Good at swimming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Mum reads to you</td>
<td></td>
<td></td>
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<tr>
<td>17. Good at spelling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Gets asked to play with others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Good at running</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Mum lets you stay overnight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Good at adding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22. Others sit next to you</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. Good at skipping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24. Mum talks to you</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments
Appendix D

Examples of Pictures
Pictorial Scale of perceived Competence and Social Acceptance for Young Children (Harter, 1982; Harter & Pike, 1983)

This boy doesn't have a lot of friends to play games with.
Do you have:
Hardly any friends to play games with
OR
A few friends

This boy has pretty many friends to play games with.
A lot of friends to play games with
OR
Pretty many friends

1
2
3
4
Appendix E

Training Session for Teachers
Designed for use with Experimental Programme
Alison Elliott - (1991; 1993; 1994a; 1994b)

THEORETICAL FRAMEWORK OUTLINED

According to sociocultural perspectives on cognitive development, scaffolding children's learning through interactions with competent others serves to mediate thinking and problem-solving. This scaffolding process provides ongoing stimulation and motivation for learning, as well as support of a more metacognitive nature. Subsequently, the metacognitive strategies may be internalised to become part of the learner's independent repertoire of competencies for application in similar contexts (Rogoff, 1990; Vygotsky, 1978).

Metacognition refers to the information children have about their cognitive processes and the control and orchestration of problem-solving activity, or self-regulation. Metacognition is often referred to as thinking about thinking.

Self-regulatory strategies are those actions and processes that involve purpose, agency, volition and instrumentality and are seen in overlapping experiences that engage young children in talking about their problem-solving strategies, and monitoring and regulating their own thinking and action.

In early mathematical activities, metacognitions involve problem specification, forward planning, revising and evaluating strategies, checking outcomes, and developing and testing new strategies to address deficiencies.

Relatedly, metacognitive teaching serves to extend new learning by linking it with existing knowledge and facilitating proceduralisation of declarative (knowing that) knowledge. Procedural knowledge (knowing how) refers to the procedures and strategies that are used when performing an activity.

Despite growing recognition of the important role of metacognitions in skilled mathematics performance and indications of their increasing importance as the child progresses mathematically, rarely are metacognitions explicated in classroom mathematics teaching.

Implementation
Metacognitive teaching strategies have been implemented in a range of small group teaching contexts. But, to be really useful, they must be able to be implemented in regular classroom settings. In this study, we are trialing the implementation of a metacognitively enhanced teaching approach by regular classroom teachers.
Key features of the metacognitive approach will be the explication of metacognitive knowledge and strategies focusing on, for example, task orientation and goals, planning, monitoring and evaluating problem-solving, together with strategies (eg. attention to positive aspects of the problem-solving process, and positive feedback on use of appropriate problem-solving strategies) designed to enhance individual’s perceptions of their self-competence in a mathematical domain.

Complementary teacher and peer interaction, as well as the learner’s own structuring of the activity, will be expected to generate the discourse that serves to support and mirror knowledge and thinking.

**SCAFFOLDING COGNITIVE ACTIVITY**

*Expectations of the teacher*

Your role as the teacher is to implement strategies consistent with the ideas described below drawing on your knowledge of the teaching/learning process, knowledge of the children, and your general practical wisdoms about teaching approaches and the classroom context.

For the purpose of the study all children need to participate in mathematics sessions for a six week period (at least 3 sessions, half an hour each per week). These will generally be on a whole class basis although children will probably work in smaller groups on tasks suited to their achievement levels.

We need to know what material is being covered on a week by week basis.

Social interaction also holds the key to children’s learning according to Vygotskian perspectives on learning. Social interaction is viewed as a catalyst for cognitive development.

A major emphasis in each session should be on communication in both small groups and whole class settings. This reflects the contemporary view that mathematics is both a social activity and an individual constructive activity. Your role is to initiate and guide communication about mathematical ideas and thinking processes, focusing on procedures children use in problem-solving, strategies for thinking about problem-solving, and strategies for controlling thinking.

*Specific Teaching Foci*

(i) **Mathematics tasks**

Mathematics tasks to be those typically taught in the kindergarten year.

(ii) **Metacognitive strategy training**

The metacognitive teaching approach aims to inform children explicitly and implicitly about the existence and use of metacognitive knowledge and strategies involved in mathematical problem-solving. It focuses on explicating strategies such as problem and goal identification, active monitoring, reflecting, discussing and reasoning through direct instruction such as demonstrating,
telling, and explaining, and less overt procedures such as modelling, questioning, prompting and cuing.

Teaching foci are directed toward extending children’s knowledge by rectifying discrepancies between an individual’s response and the ideal situation, through minimising frustration and encouraging risk in problem-solving, and by demonstrating, modelling and explaining an idealised version of the problem’s solution.

Especially important to this approach is the use of both teacher and child language to scaffold the construction of mathematical ideas and strategic processes.

Selected teaching sessions will be videotaped. The purpose of the videotaping is to enable fine-grained examinations of the nature of the metacognitive guidance, children’s responses to the guidance, their use of metacognitive strategies in their problem-solving, and their organisation of idea networks. Analyses of video transcripts will focus on responses to metacognitive strategies (where appropriate), and self-activation of metacognitive strategies such as initial problem representation, planfulness, monitoring, reflection and evaluation.

**TEACHING STRATEGIES**

Teacher scaffolding involves careful guidance of children’s efforts within the zone of proximal development (that is the area/zone between what children can do with help [actual development], and independently [or potential development] through the use of techniques such as direct guidance and explanations, verbal and non-verbal cues and questions, demonstrations, and modelling.

Specifically, children might be encouraged to focus on goal and problem identification and clarification, planning actions, sustaining mindful and purposeful problem-solving, evaluating actions and specifying a rationale for decisions. Reflection on action is especially important.

Teacher scaffolding is also enhanced through collaboration with more expert peers. Classroom groupings can be arranged to comprise learners of varying abilities who can assist and support one another. Over time and with practice, children complete tasks and solve problems independently.

*Direct Guidance* means specifying what a child must do in a particular situation. For example: *Now count one by one. Point to the first number. OK, now point to the dog...*

*Explanations*, especially in conjunction with demonstrations and modelling, assist children interpret information or actions. From both teacher and child.
**Cues and Questions.** A less directive strategy asks children to elaborate and clarify their thinking and reflect on their thought and actions through the use of cues and questions. For example: *What would happen if we move that up just a bit? OK, now a bit more? What happened?.... Now think about what's next.... Can you remember what we did last time?*

**Demonstration and modelling** of appropriate problem-solving strategies provide children with an idealised representation of a workable solution. This involves explanations and demonstrations with explication of the model's thought and reasons for a given action. For example, *Look I'll show you.....(teacher counts each sheep, pointing to each one to emphasise the process of one-to-one correspondence).*

Here the expectation is that the learner will imitate the action.

**SOME STRATEGIES TO ENCOURAGE IN CHILDREN**

**Goal and Problem identification and clarification:**

The purpose of goal and problem identification and clarification is to help children determine what's required in the activity and encourage them to think about the global problem as well as each step of the problem. For example, the teacher may say:

*Let's decide what has to be done here.*
*Where do we have to end up?*
*What do you want it to look like when you've finished?*
*What do we have to do first?*
*So what do we have to do?*
*OK, now let's work that out; which way first?*
*You show me what we have to do now!*

**Planning Actions**

The act of planning is important to the ultimate self-regulation of problem-solving. Children need to think in advance about what they are going to do in each task. They need to think about what they already know. Where are they heading? Where do they start? What specific steps must be taken en route? Ask children to articulate their reflection and planning. Ask them why they have chosen a particular route/step/action.

**Sustaining mindful and purposeful problem-solving**

Strategies for keeping children “on track” are critical to problem-solving success. These are mainly verbal in nature and are usually operationalised by:

1. **(a) breaking tasks into smaller steps/manageable chunks and helping the child sequence them toward the desired goal;**

2. **(b) actively monitoring learner progress.** For example, questioning the child if she stops short of the final goal or left out an important step. *What happens next? What should you do now? Why did you do that? What else could you have done?* Asking children to answer such questions provide implicit cues to assist thinking processes;
(c) providing immediate and academically oriented feedback. For example: Have another look. What has happened? Does that look right? (Child responds) So what should we do? Think carefully!

(d) providing lots of praise for thoughts and ideas as well as correct solutions: For example: Clever boy, that was a thoughtful move. Remember that good thinking is about the process as well as the product.

(e) encouraging children to use prompts, cues and mnemonic processes within the environment. Can you remember that? (Talking about a square). Think about a box. Does it look like a box?....What was that number. It’s the same as your age. What’s that? What else is like that?....What colour now? Is it the same as Josh’s jumper? How can we remember that?
Encourage children to self-question.

(f) minimise frustration
An important long-term aim is to encourage self-appraisal and self-management.

(g) linking/bridging to the known/familiar. For example: What else has four legs? How old will you be in three years? Can you remember.....(some link)....?

**Predicting**
For example the teacher might say:

What happens next? What might happen if I do this?

**Evaluating actions and specifying a rationale for decisions**
Evaluating or explaining actions help children review the process of solving a problem. For example:

Why that way? Tell me why you did that? Think back, why did you start there? Where else can you start? How else could you do this?

Which is better?

This focus is useful in encouraging children to develop a greater awareness of the strategies that are successful or unsuccessful in solving problems.
Appendix F

Maze Puzzle

Children are required to move through each opening, both internal and external, going through each only once. Therefore steps cannot be retraced and once moved through, an opening cannot be used again. There is no mandatory starting point.
Appendix G

Toothpick Puzzle

Children are required to state how many squares they can see when the match pattern is formed.

Children are then asked to move two matches only to leave behind two complete squares (i.e. without any appendages).
Appendix H

Number Triangle Puzzle:

Children must determine the missing numbers in this number pattern and show that they understand the relational aspects of the pattern and how the linkages connect.
Appendix I

Numerical Sequence Puzzle

Children must find the missing numbers in the number sequence.

2, 4, _, 8, 10

1, 3, 5, _, 9
Appendix J

Numerical Addition

Students are asked a number of questions relating to a hypothetical walk with their pets. Can vary the number of pets and legs. Students may be able to add without the use of concrete materials or may require paper, buttons or other aids.

Some examples of questions may be:

* If you went for a walk with your dog and with my dog, how many legs altogether would there be walking?

* If my dog lost one of his legs but he was still able to walk with you and your dog, how many legs would there be then?

* If your dog and your cat and a bird went for a walk together, how many legs would there be altogether?
Appendix K

Measurement Puzzle

This exercise was designed to encourage children to think creatively of ways to measure. No rule or tape was supplied, so children had to devise alternative ways of measuring.

Some of the questions asked of children:

* How tall are you now?

* What do you need to measure your height?

* If you haven’t got a ruler, how else could you measure your height?

* If I wanted to see whether or not you were taller than another person, what would I do then?
Appendix L

Mirror Image Patterning

Children are encouraged to recreate the mirror image of the half pattern on the page.
Appendix M

Graph

This is used to determine children’s understanding of graphs, and why they are used.
Appendix N

TRANSCRIPTS OF TAPES WITH TEACHER INTERACTIONS ON WHOLE CLASSROOM BASIS - EXPERIMENTAL CLASS 2 - 17/11/94

The children have been asked to sit in a circle on the floor with the teacher who is also sitting on floor.

This lesson follows another where the children were counting by addition.

Teacher: I have some skittles now, but we are not going to do addition this time...we are not going to add groups of numbers together. You see if you can work out what I am doing. I'm going to put.....(places some skittles [small sweets] on the paper)

Several children: Can I have one!
Teacher: I think I'll just see if they taste nice (puts one in mouth)......Mmmm, they do!

Children: Ohhh!
Teacher: Alright, I want someone to come up and count how many skittles I have on my piece of paper here. Edwina? (other children say me! me!)

Edwina: (moves skittles as she counts) 1.2.3.4.5.6
Teacher: Right Edwina. You may choose one to eat...choose any one to eat...pop it in your mouth. (Edwina chooses one and begins to move back....) Edwina, I haven't said to go back yet. How many are left?

Edwina: Five
Teacher: What did you do with those skittles?

Another child: She took one away, put it into her mouth...
Teacher: So, she took one away and how many are left? I'll just get Jackie to come over and check. We had 6 to start with and took one away...How many left?

Jackie: Five.....(she arranges them in a row)
Teacher: Alright Jackie, would you like to take one and put it into your mouth and take another one for a friend?

Jackie: Two
Teacher: Alright, then take one and put it into your mouth and take one for a friend......quick!! How many have we taken away from 5 now? How many have we just taken away?

Jackie: Two
Teacher: How many are left?
Jackie: Three
Teacher: You're sure? O.K. then go back!
(calls to another child Gemma to come)
Gemma, we have three skittles now...
Put one in your mouth....How many are left?

Teacher: Two
Teacher: So, three take away one....there's two left!
Teacher: Alright, go back Gemma
(calls Nicolette)
Teacher: I want you to take two away...put one in your mouth and one
for a friend....
Teacher: Alright, how many are left? Nicolette, that's important!
Nicolette: None!

Another child: Zero!
Teacher: Oh, yes, Zero or None!
Teacher: Alright, what are we actually doing then?
Children: Counting skittles!
Teacher: Can someone also say anything more about that?
Teacher: We are counting skittles....do they taste nice? Put them into
your mouth when you get one!
Teacher: Lauren?
Lauren: Well, um it's maths and it's helping us to count more!
Teacher: Helping you to count is it? Alright!
Andyandra: We are counting skittles and taking them away and eating them!
Teacher: That's right we are counting skittles and we are taking them
away to eat them....
Teacher: Does it have to be skittles we take away when we do some
maths like this?
Children: No!
Teacher: (putting more skittles on paper) What is a good number to start
with Katie, what number would you choose to start with?
Katie: Five
Teacher: Are there five there?
Katie: Yes
Teacher: How many would you like to take away?
Katie: Two
Teacher: You want to take two away? Alright!
Teacher: You now put one in your mouth and one to a friend!
Teacher: How many are left Katie, before you give it to your friend?
Katie: Three
Teacher: Three! (affirming her answer) Make sure you choose a friend
who hasn't had a skittle.
Teacher: So can we all say that...there were five, Katie took away two
so...how many were there left?
Children: Three
Teacher: Alright, Bronnerly....would you like to choose a number to start
with?
Bronnerly: One!
Teacher: Want to start with one?
   O.K. I’ll put these two back in.....
   Take it away...pop it in your mouth
   One take away one......?
   None? and Gabriella says Zero....both right?

Children: Yes!

Teacher: You don’t have to take just one or two away....you can do other numbers!
   (calls another child - name obscure)
   How many skittles?

Child: Three!

Teacher: Want to start with three....alright, over you come!
   How many are you going to take away?

Child: Three!

Teacher: You are going to take three away?
   Three take away three is.........?

Child: None!

Teacher: O.K. put one in your mouth and give one to a friend who hasn’t had a skittle!
   Put your hand up if you haven’t had a skittle....Quick...Don't make a noise though!
   Quickly Lisa, just choose two people quickly!

Teacher: Alright...how about choosing a bigger number this time
   Ladiette?
   How many are you going to start with?

Ladiette: Four

Teacher: Four? How many are you going to take away?

Ladiette: Three!

Teacher: Going to take three away? Well let’s see what four take away three is.....

Ladiette: One!

Teacher: One......Good girl!
   Would you like to put one in your mouth and would you like to give one (skittle) to two people....the girls with their hands up....Quick!!
   (some muttering about children putting hands up twice)

Teacher: Jackie, you’ve had one...don’t put your hand up please.
   Just put your hand up if you haven’t had a skittle yet.
   Who has not had a go yet and who hasn’t had a skittle?
   Lucy!!

Teacher: Can I choose a number for you or do you want to choose a large number?

Lucy: A large number.

Teacher: You choose a bigger number!

Lucy: Six

Teacher: Six, alright (puts skittles out)
   Is that right?
Another child: I think that's seven!
Teacher: Oh, do you? Good eyes!
      Let Lucy check, she's the one who's doing this one!
Lucy: 1,2,3,4,5,6,7!
Teacher: Whoops! How many do I take away to get six?
Children: One!
Teacher: Let me take one away! Matty you were right!
      Now how many are you going to take away?
Lucy: Six!
Teacher: You are going to take six away?
      Six take away six......What's left?
Lucy: None! Zero!
Teacher: Alright, put one in your mouth and one to somebody who hasn't
      had one....Lucy will go round!
      Put your hands up if you haven't had one. How many is Lucy
      going to give out?........If she has eaten one.....how many does
      she have left?
Children: Three!
      Four!
      Five!
Teacher: Five....how many left?
      (to Lucy) Did you just give out five?
      O.K. Eleanor, you haven't had one yet?
      Alright, how many do you want to start with?
Eleanor: Six
Teacher: You want to start with six? I hope you do a different sum this
      time!
      Is that right? (laying out the skittles)
      Better check I put the right number out.
Children: There's eight!
Teacher: Eleanor was the one who checked them and she found seven!
      O.K. how many are you going to take away?
Eleanor: Six!
Teacher: We just had that one, can you think of a different one?
      We have six here Hiliary (drawing her attention back to the
      task),
      How many do you think Eleanor should take away?
Hiliary: Five!
Teacher: (talking to Eleanor) Do you think five too?
Eleanor: Yes!
Teacher: Alright then...you can take away five...
      Six take away five....
      How many is left?
Children: One!
Teacher: You had better put one in your mouth and we'll put the skittles
      away for awhile because we've all had one!
Appendix O

TRANSCRIPTS OF TAPES WITH TEACHER INTERACTIONS ON WHOLE CLASSROOM BASIS - CONTROL CLASS 2 - 17/11/94

The teacher is seated on a chair with the classroom group assembled on the floor facing a board covered with sheets of butcher’s paper. One of the children (a boy) is standing beside her, with two cards in his hands.

T: I want you to join the cards together using the words “and” and “makes”.
Can you do that for me?
We’ll use some blutak here!
How many beetles do we have on the picture here? (Asks boy holding card in his hand)

Boy: Four!

T: (To class) Let’s count to make sure!

Class: (in unison) 1, 2, 3, 4!

T: OK, then what word are we going to use next?

Class: (in unison) “and”

T: And…… you find the word “and” (instruction to the boy standing)
So…… four…… and……

Class: (in unison) Two! (As teacher takes card from boy with two beetles pictured)

T: (Teacher places the card with two beetles on board followed by the word “makes”)

Child: (before teacher asks question) I think it makes six!

T: Six…do you think?
Find the number six for me (indicating for the boy to find a picture of 6 beetles from a pile of picture cards)

OK there we go!
Let’s read what we’ve got!

Class: (in unison) Four beetles and six beetles makes six beetles!

T: Fantastic
Could we write that in a different way?
How could we write that……..Duncan! (this was a reminder to a child to attend!)

Put your hand up please!

Child: We could write the numbers!

T: OK…..4 and 2 makes 6 (teacher writes this on board, and asks the boy assisting to now sit down)

Child: Darren’s not sitting on his bottom!

T: Sit down Darren!

Adriana, can you find the pictures of the sets of books?

Adriana: (looks for books and produces them)

T: Good girl!
T: So now we’ve found the two groups of sets of books!
We now have six books and zero books!
So, what do we do now?
What do we have to find out?
We’ve got to find out how many we’ve got?........

Class: (in unison) Altogether!!
T: (teacher places cards and words on the board with blutak and
looks questioningly at class)
Class: Six books and zero books makes six books!
T: Another six!
Let’s make sure that’s right!
Count!

Class: 1,2,3,4,5,6 and zero makes 6!
T: How can we write that one a different way too?
Class: With numbers!
6 and 0 makes 6!
T: Fantastic!
Now we are going to do our maths activities so go to your
table!
(Teacher then proceeds to explain activity sheets based on
group teaching session)

Some observations of teacher child interactions in small groups:

T: (asked child question but incoherent on tape)
C: (nods head, then teacher moves off to another group)

C: (brought pictures of dominos to teacher for inspection)
T: Good!

C: (counting with kidney beans, five red and five white spaces)
(showed calculations to teacher who tried to explain error)
(at this point the teacher’s attention was diverted when
questioned by another child)
(child with beans was not attended to again!)

C: (child with counters, selected five red and five yellow)
T: How many do you have altogether?
Let’s count them!
C & T: 1,2,3,4,5 and 6,7,8,9,10!
T: Good boy!

T: (reminded children to use concrete materials when some simply
doing mental calculations)
(others attended to material activity but did not transfer this to
paper!)
C: (showed teacher his kidney beans)
  Ten white and.......
T: How many red ones?
C: None!
T: Zero red makes.......?
C: 10 white beans!
T: Fantastic!
  I knew you could do a good job!

TRANSCKIPTS OF TAPES WITH TEACHER INTERACTIONS ON
WHOLE CLASSROOM BASIS - CONTROL CLASS 4 - 20/11/94

Teacher has whole class group seated before her and is reflecting upon a lesson
 taught on a previous occasion (last week). She has predetermined groups
 according to ability, and is explaining the procedure that each group must
 follow when they move to their respective tables.

  T: For the Green group - Hannah’s table
     You will have the “raisin bread game”
     You can take any number of raisins, but don’t go beyond ten!
     So, you can take 9,8,7,6 or....?
     Sit down Hannah!
  C: 5 or 3 or 2!
  T: or 5,4,3,2,or 1
     don’t take any more than 10 because you’ll have trouble fitting
     them on the little pictures of bread!
     You can put some raisins on this side of the bread
     and some raisins on this side!
     So you add the number you put on this side of bread, and on
     this piece of bread to see how many there are.....altogether!
     So....that’s a nice easy activity for the green group!!
  
  T: Now the Orange table - who’s in the Orange group?
     You’re playing the kidney bean game!
     You will each have a little cup like this (shows cup)
     How many beans do you think you’ll have in your cup Grant
     (drawing child back into group)

Children: (in unison)
  Ten!

  T: Not five, not eight!

Grant: Ten!

  T: You were right William, but you called out!
  (Teacher then proceeds to show children how to select beans,
  place them on prepared sheet and add beans and white spaces,
  to give ten!)
T: Now, the Purple group!
You have lots of different activities in ice cream cartons
You must take some from one carton and some from another
and then draw them on your paper (like this) (illustrates with
keys and shells)
And then you have to write....?
Phoebe?

Phoebe: I would write three keys on one side and two shells on the other
side, makes five altogether!

T: Good girl!
But that's a long way to do it....what's a shorter way?

Michelle: 3 keys and 2 shells makes 5

T: Good girl!
Now move quietly to your groups and I'll come around and help
you!

Observation of the teacher's interactions with the children in their groups
followed:

T: Do you understand what we are doing with these beans here?
(To child who had not yet commenced the task)

C: (nods head)

T: Good! (Moves off)

C: Look There are four raisins here!
And two raisins here!

T: How many have you got altogether?

C: Six!

T: Terrific!
Appendix P

Examples of transcribed material from videotaped interactions between students and researcher while undertaking range of tasks

TRANSCRIPTS OF TAPES - Timothy - Low Achiever - Aged 5 years
Maze Puzzle Experimental Class 1

Tim and Jean are seated at low table, Tim has been given a maze and a pencil

Jean: I've got this funny looking plan here and I would like you to think about it for a minute, because what I want you to do, is to draw a line going in and out of all the doors, but there's a trick, you can only go through each door one at a time [Jean demonstrates with pointer pen what is required]. Let's see if you can get them all, although you might have to think about it - what do you think you have to do first?

Tim: [Commences drawing but makes no comment].
Jean: You can only go through each door one time.
Jean: You didn't go out this one....
Tim: [Tim comes back without taking pen from paper and draws through the door] [Continues to draw quickly, without apparent thought or plan].
Jean: Mmmm [stops Tim].
Jean: O.K. what things have you done here? (Pause)
Tim: [Continues drawing].

Jean: What are some of the things that went wrong? (pause) [Shows Tim]
Jean: What happened there and what did you do over here? [Draws Tim's attention to extra lines through doors].
Jean: What did you do here?
Tim: That! [pointing to the picture].
Jean: Yes but what happened, what did you do here?
Jean: Remember I said you can only go through the doorway....how many times?
Tim: Once
Jean: One time - What happened here? - You went through the doorway......?
Tim: Two.
Jean: "Two times. Oh dear!"
Jean: "What happened here?, You didn't go through that doorway at all. It was a bit tricky wasn't it, to try and find that one"?
Tim: [Nods].
Jean: "What, um... What was hard about that"?
Tim: [Points to the line through maze] "Just going out and in all the times"
Jean: "Going out and in a number of times, that was hard was it"?
Tim: [Nods].
Jean: "Is there any way that you could plan to do it differently"?
Tim: "Yes".
Jean: "How could you have planned to do it differently"?
Tim: "Well I could start......" [Chooses different starting point].
Jean: "Would you like to have a go with another colour"?
Tim: "Start from here" [placing pencil at a point on the plan].
Jean: "Start from there...then what would you do:"
Tim: "And go around there...."
Jean: "But you've got to......" [shows Tim where to move through to].
Jean: "No.....you came in and out that door twice..." [again shows Tim]
Tim: [draws some unconnected lines - losing interest]
Jean: "Mmmm
It's a tricky one isn't it?
What about this one? [pointing to doorway]
And this one?

At this point several children arrive interrupting the session. Tim is distracted and the session ends.

TRANSSCRIPTS OF TAPES - Andrew - High Achiever - 6 years
Maze Puzzle - Experimental Class 1

Andy and Jean are seated at a low table, Andrew has also been given a maze and a pencil

Jean: Let me tell you what I'd like you to do with this.
This is a house plan that looks a bit like a maze, doesn't it?
What you have to do it to work out a plan for going in and out of every door (Jean demonstrates as she talks and says: "oh that won't work"),
without going through the same door twice.
Andy: [Looks very closely and attentively at plan and nods head].
Andy: Where do you have to go [clarifying the problem].
Jean: You have to go....you can start wherever you think is the best (place) and you have to only go in and out the doors once. There is a way you can do it by going in and out every door just once, by going through every door, but you've got to think about it, you've got to think which would be the best way to go in and out the doors.
Andy: [Traces through plan with finger] If I go like this, down there....I mean....I'll come through that....I mean.....I'll go down.....
Can I go though there and come through there and around like that?
Jean: You can go anywhere you like providing you go through every single solitary door.
Andy: Um, like that? [tracing constantly with finger]
Jean: You can, but you can't come out the door again when you go in.
Andy: No. I meant in and around up there.
Jean: Right, what, you came in from there, Yes
Andy: I came in from here and went up there, and I go straight up there, because I've come through that one.
Jean: Yes, or you could come through into these and in there and 'round there....
don't know [in questioning tone] don't know which would be the best way. Can you think of a way that you've got to do it? Alright, can you think? Have a go!
Andy: Can I go.
Jean: Yes, you may start whenever you like.
Andy: [Works silently with his pen]
Andy: Can you go through there twice.....to get back to there [points to where he started].
Jean: No, but you've already been through that door so you don't need to go through it again. You can come down into there....[pointing to the middle of the room]
Andy: Then make a diagonal....
Jean: And then you can stop. You've ended up in the room...that's all!
You can actually stop when you get into there.
You've done it! You've done it! Well done!
Look, you haven't got a single solitary door that you haven't been through.
[while retracing Andy's path] You've been through that one, you came through that one, been through that one, that one, that one, that one, came back in there, in there, through there, into that one, round there, through that, round there, into that one, into that one and then back into this room. You're brilliant!
How did you work that out?
Andy: Well, I thought if I came back through there I might be stuck trying to get back to there [points to starting point].
Jean: You don't have to finish where you start, as long as you finish without going through each door twice. And that's just what you've done....If you finish there....
Andy: Then why do carry it down through that one....
And if like you carried down through that one and stopped there and hadn't gone through that one, you would've had to have one through there and you'd be stuck, wouldn't you?
Jean: You would indeed be stuck, because you can't go through the same door twice.
Andy: And if you'd done all the doors and you had to go through there, you'd end up......
Jean: Yes, that's right, you would. But you started over here and you've done it absolutely perfectly.....you haven't gone through the same door twice... and you've gone through every single door.
It's very tricky to do that.
What made you start up there?
Andy: Well, I'd worked......Well I'd already worked out the way and that's where I started.
Jean: How did you work out the way?
Andy: I don't know, I just did it in my mind.
Jean: You just did it in your mind?
Andy: I imagined I was in my mind and then I did the way my mind.....so I knew it!
Jean: OK, so what made you start at that point.....
Andy: Because I done exactly the same sheet, and I tried every way and that was the way that worked.
Jean: And where did you try them, where did you try the sheet?
Andy: I started in every top one....... 
Jean: In your mind you did this, did you?
Andy: Beg your pardon?
Jean: Did you do this in your mind?
Andy: Yes.
Andy: And none of them worked, I couldn't get through every door...I had to go through that door there, twice I think.
Jean: Mmm, that's terrific, so what did you...when you were thinking about it in your mind.........what happened when you came to a spot that you couldn't go through?
Andy: Like if that....I had to go through that door, having gone through that one, I would have gone out through there.
Jean: Oh, right, all right.
And so why did you start at this point...you just felt that that was the best one to start at?
Would it have worked, do you think, if you had started say in the middle of your room.
Andy: If I'd started there, I'd probably have to go around here and right through here and come around here and how could I get out of that room.....there'd be no way!
I'd have to go down through there and couldn't go through there could I?
Jean: No, that's right because you can only go through the door.
Andy: Yeah...there'd be no doors I could go through there.
Jean: You've done that really well!
What would you have done if you didn't know how to do that?
Andy: I'd have just done it...I'd just....... 
Jean: You would have tried it would you? .....just made a few mistakes and then worked on those....is that what you would have done? 
What would you do if you were telling someone else to do it....... 
If you were giving a person who was not as clever as you, some tests? 
What would you tell them?
Andy: Well, I'd just show them with my finger around the whole track.
Jean: Would you give them any hints about how to think about it?
Andy: Yeah, a few. Like where you start and which room you finish in and those things.
Jean: What plans did you make before you started?
Andy: Don't know.
Jean: Don't know?
    What was the hardest part of it do you think?
Andy: Well, getting through there, because at that moment I thought I had to
go back through there and then I found the best way...so I tried kept
doing it and I didn't know I was allowed to stop there.
Jean: Right, OK....you though that you had to end up back outside where you
started?
Andy: I thought I had to end up where you started.
Jean: Where you started.....so perhaps I didn't explain that fully....
Andy: No..

TRANSCRIPTS OF TAPES - Susie - Low Achiever - 6 years
Maze Puzzle - Experimental Class 2

Jean and Susie are seated at a low table with a number of simple
mathematically based problem solving tasks between them. Jean has made
Susie feel at ease by discussing aspects of school friends and family.

Jean: Let me show you a special maze I have here!
      What does this look like to you?
Susie: A maze.
Jean: A maze........and there's a trick to this maze........
    You've got to be able to go through every door just once....or every
    hole just once
    Not twice......you can't go in it and out again
    You're just supposed to go through once.
Susie: Do I have to go there (pointing to specific areas)
Jean: You just have a look at it and try to work out a way that you can go
    through every door just once! (demonstrates with finger as talking)
Susie: Is this the door?
Jean: They are all doors...........all those spaces are
doors...........(demonstrates as talks)
    Where do you think that you might start it?............
    How do you think that you might go about it?
Susie: Where do you have to go?
Jean: You have to go through each door...........I don't care where you
    start........
    You can start wherever you think you should start.
Susie: I'll start here (points to spot).
Jean: You think you should start it there?
Susie: Yes.
Jean: What made you say that..............what made you decide you'll start up
    there?
Susie: Because there's a corner.
Jean: There’s a corner?

Susie: There’s one there and one there and one there.

Jean: Have you got a plan that you might go through.

Do you think there is a good way to try out where you might go?

Susie: Well, I can go down here and start and then go there and there (Susie is moving her finger around the perimeter of the maze)

Jean: Remember, you’ve got to go through the doors, like this (demonstrates)......

through the doors. Move your pen through the doors, through the doors....

right......through the doors (demonstrates again).

Susie: Should I do it that way?

Jean: You’ve got to go through the doors (models again)

Susie: Should I do it this way (moves around the perimeter)

Jean: Yes, you can start anywhere you like, but .......

No............you don’t do it like that!

Susie: Oh....here!

Jean: No, you can just move it through like that (models again)

Susie: OK

Jean: You can go through the room, but to go through the doors only once.

Susie: OK. Where should I start?

Jean: Anywhere you like.....where do you think you should start?

Susie: Should I go across there? (pointing to the opening which may be entered)

Jean: No, look, I’ll show you what I mean.......I’ll get one (a sheet)

What I have to do is to go through the doors can you see how my pen is going through the doors?

Susie: Oh.

Jean: Its going through the doors like this.....(demonstrates weaving through doors)

Susie: I see, you have to do it curly?

Jean: Yes, you have to do it curly through the doors like that......you see, so that you get through every door, but you go through only once!

Susie: You have to do it curly!

Can I start here?

Jean: You can start wherever you’d like to start.

Susie: Oh, through the doors

Jean: No, you must.............Do you see what you’ve done here? What have you done here.....you went in here, then you went back out again!

Susie: Yes.

Jean: But you’re not allowed to go back out again.............just in one way and straight through!

Susie: Should I go that way?

Jean: No just start from here again

Susie: (begins to draw again)

Jean: Remember, you can’t go in the door again.

Susie: Woops.
Jean: Woops.....why don’t you take it out that way!
Susie: Should I go back?
Jean: Go back
Susie: There?
Jean: OK. Just go through the next door perhaps.
Susie: Should I go up?
Jean: Mmmmm....You can go inside and you can go outside......OK?
Susie: Now I can go down......can I?
Jean: Yes, if you want to......
Susie: Woops......can I go down?
Jean: Yes you can......
Appendix Q

Examples of field notes jotted on score sheets
Appendix Q

Examples of field notes jotted on score sheets
## Appendix R

### Strategy Rating Matrix

<table>
<thead>
<tr>
<th>LABEL</th>
<th>CODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategy 1</strong>&lt;br&gt;Identifies Prob</td>
<td>V</td>
<td>N</td>
</tr>
<tr>
<td>Questions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarifies</td>
<td></td>
<td></td>
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<tr>
<td>Confirms</td>
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<tr>
<td>Concentrates</td>
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<tr>
<td><strong>Strategy 2</strong>&lt;br&gt;Plans Task</td>
<td></td>
<td></td>
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<tr>
<td>Points</td>
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<tr>
<td>Plans</td>
<td></td>
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<tr>
<td>Alternatives</td>
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<tr>
<td>Goal</td>
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<td></td>
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<tr>
<td><strong>Strategy 3</strong>&lt;br&gt;Self-Monitors</td>
<td></td>
<td></td>
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<tr>
<td>Thinks</td>
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<td>Attends</td>
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<tr>
<td>Self-Questions</td>
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<td></td>
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<tr>
<td>Discuss</td>
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<td></td>
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<tr>
<td>Concentrates</td>
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<tr>
<td>Change</td>
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<tr>
<td>Checks</td>
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<tr>
<td>Retrace</td>
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<tr>
<td><strong>Strategy 4</strong>&lt;br&gt;Reflection</td>
<td></td>
<td></td>
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<tr>
<td>Review</td>
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<td></td>
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<tr>
<td>Challenge</td>
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### Appendix R

#### Strategy Rating Matrix

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<tr>
<th>LABEL</th>
<th>CODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategy 1</strong>&lt;br&gt;Identifies Prob</td>
<td>V</td>
<td>Child questions teacher about task</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Questions or comments to clarify objective</td>
</tr>
<tr>
<td></td>
<td>V</td>
<td>Child questions, comments to confirm understanding</td>
</tr>
<tr>
<td>Concentrates</td>
<td></td>
<td>Child attends with concentration when task explained</td>
</tr>
<tr>
<td><strong>Strategy 2</strong>&lt;br&gt;Plans Task</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Points</td>
<td></td>
<td>Child points or moves finger when planning moves</td>
</tr>
<tr>
<td>Plans</td>
<td></td>
<td>Child verbally outlines plan (if I go there... perhaps I should...</td>
</tr>
<tr>
<td>Alternatives</td>
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<td>Child verbally or non verbally considers alternatives</td>
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<tr>
<td>Goal</td>
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<td>Questions, states, confirms or indicates non-verbally final goal</td>
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<tr>
<td><strong>Strategy 3</strong>&lt;br&gt;Self-Monitors</td>
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<tr>
<td>Thinks</td>
<td></td>
<td>Child obviously thinking about task</td>
</tr>
<tr>
<td>Attends</td>
<td></td>
<td>Child attends to task</td>
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<tr>
<td>Self-Questions</td>
<td></td>
<td>Child uses self-quest techniques (should I do that? Where should I go now?)</td>
</tr>
<tr>
<td>Discuss</td>
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<td>Child discusses task with teacher - Yes!</td>
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<tr>
<td>Concentrates</td>
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<td>Obvious concentration to meet task demands</td>
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<tr>
<td>Change</td>
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<td>Changes strategy if necessary</td>
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<td>Checks</td>
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<td>Checks previous moves and assesses next</td>
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<td>Retrace</td>
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<td>Retrace to error</td>
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<td><strong>Strategy 4</strong>&lt;br&gt;Reflection</td>
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<tr>
<td>Review</td>
<td></td>
<td>Child reviews either verbally or non-verbally elements of task had to recreate</td>
</tr>
<tr>
<td>Challenge</td>
<td></td>
<td>Child challenged to consider performance may review strategy</td>
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Appendix R

Strategy Rating Matrix


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<td>Very internal concentration level of questioning</td>
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<td>Child questions teacher about task</td>
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<td>Clarifies</td>
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<td>Questions or comments to clarify objective</td>
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<td>Confirms</td>
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<td>Child questions, comments to confirm understanding</td>
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<td>Child attends with concentration when task</td>
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<td>Child points or moves finger when planning</td>
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<td>Plans</td>
<td>✓</td>
<td>Child verbally outlines plan (if I go there....)</td>
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<td></td>
<td></td>
<td>perhaps I should.....</td>
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<td>Goal</td>
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<td>Questions, states, confirms or indicates non-</td>
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<td>Self-Questions</td>
<td></td>
<td>Child uses self-quest techniques (should I do</td>
</tr>
<tr>
<td></td>
<td></td>
<td>that? Where should I go now?)</td>
</tr>
<tr>
<td>Discuss</td>
<td></td>
<td>Child discusses task with teacher</td>
</tr>
<tr>
<td>Concentrates</td>
<td></td>
<td>Obvious concentration to meet task demands</td>
</tr>
<tr>
<td>Change</td>
<td></td>
<td>Changes strategy if necessary</td>
</tr>
<tr>
<td>Checks</td>
<td></td>
<td>Checks previous moves and assesses next</td>
</tr>
<tr>
<td>Retrace</td>
<td></td>
<td>Retrace to error</td>
</tr>
<tr>
<td>Strategy 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reflection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review</td>
<td></td>
<td>Child reviews either verbally or non-verbally</td>
</tr>
<tr>
<td></td>
<td></td>
<td>elements of task</td>
</tr>
<tr>
<td>Challenge</td>
<td></td>
<td>Child challenged to consider performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>may review strategy</td>
</tr>
</tbody>
</table>

**Notes:**
- Child questions teacher about task
- Questions or comments to clarify objective
- Child questions, comments to confirm understanding
- Child attends with concentration when task explained
- Child points or moves finger when planning moves
- Child verbally outlines plan (if I go there.... perhaps I should.....)
- Child verbally or non verbally considers alternatives
- Questions, states, confirms or indicates non-verbally final goal
- Child obviously thinking about task
- Child attends to task
- Child uses self-quest techniques (should I do that? Where should I go now?)
- Child discusses task with teacher
- Obvious concentration to meet task demands
- Changes strategy if necessary
- Checks previous moves and assesses next
- Retrace to error
- Child reviews either verbally or non-verbally elements of task
- Child challenged to consider performance