

**AN ANALYSIS OF THE SELF-REGULATED LEARNING ABILITIES OF
STANDARD 10 BIOLOGY STUDENTS IN THE MANKWE REGION**

Gustav Moshanti Mahuma

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**Gustav Moshanti Mahuma
B.A., B.ED.**

**Mini-dissertation submitted in partial fulfilment of the requirements for the
degree Magister Educationis in Educational Psychology at the Potchefstroomse
Universiteit vir Christelike Hoër Onderwys.**

Supervisor : Prof. Dr. J. L. de K. Monteith

**Potchefstroom
1996**

ACKNOWLEDGEMENTS

I wish to express my most sincere gratitude to:

- * Professor Dr. J.L. de K. Monteith, my supervisor, for his guidance, motivation, support, constructive criticism and selfless assistance;
- * Dr. M. Scott, for her motivation;
- * Mr. J.W. Breytenbach, Mr. J.P. Engelbrecht and Mrs. E. Mentz for statistical analyses.
- * Mrs. E. Mentz and Mr. J.P. Engelbrecht, for statistical analyses;
- * Mrs. C. Postma and Mrs. J.P. Joseph for help with the typing of the dissertation;
- * Prof. A.L. Combrink, for language editing;
- * Mrs. Van der Walt, for checking the bibliography;
- * Mrs. Daphne Masipa, Mrs. Olga Mogodiri and Mrs. Tebogo Modisane, for sorting and packing the research questionnaires;
- * Mr. A.N. Monau, for his constant motivation and interest in my studies;
- * Mankwe High Schools' principals, for allowing me to administer the research questionnaires in their schools;
- * Mr. A.I. Tsomokae for his sacrifices and support as Acting Principal, especially during my study leave days;
- * My parents, Jethro and Evelyn, for their support and motivation;
- * My wife, Monica, and children, Kenosi, Boikanyo, Olefile and Ikitse, for their constant support and sacrifice;
- * Almighty God, for spiritual empowerment, which allowed me to complete the project.

In gratitude I wish to give recognition to:

- * The SAS computer-programmes which were used in the statistical research data. Information of the programmes can be found in:

SAS Institute Inc., 1985. SAS user's guide. 5th ed. Cary, N.C.

SAS Institute Inc., 1988. SAS/SAT user's guide. 6th ed. Cary, N.C.

- * The *Health Science Computing Facility (HSCF)*, University of California, Los Angeles (UCLA) sponsored by *NIH Special Research Resources Grant RR-3* for the use of the BMDP-Programme. Information concerning this programme can be obtained from:

DIXON, W.J. & BROWN, M.B. ed. 1979. *Biomedical Computer Programs P-series*. Berkeley: University of California Press.

SUMMARY

AN ANALYSIS OF SELF-REGULATED LEARNING ABILITIES OF STANDARD 10 BIOLOGY STUDENTS.

The aim of this research was to determine by means of the review of the literature and an empirical investigation whether metacognition, self-efficacy, goal-setting and learning strategies have an influence on the academic achievement of Standard 10 Biology students.

It was concluded from the literature review that metacognition, self-efficacy, goal-setting and learning strategies influence academic achievement. Students who appraise, manage, evaluate, regulate and monitor their learning tasks achieve academically better than their counterparts.

High efficacy students choose challenging tasks and are task-persistent, unlike low efficacy students who avoid difficult tasks and choose easy tasks in order to preserve their self-esteem.

Goal-setting enhances self-efficacy because efficacious students will pursue their set goals and work much harder in order to achieve their set goals.

Students who use learning strategies achieve better than those who don't use learning strategies. Learning strategies such as note-taking enable students to recall information.

The above variables, viz: metacognition, self-efficacy, goal-setting and learning strategies enhance self-regulated learning because students who use these variables become engrossed in the learning task on their own.

By means of an empirical investigation, though, it could not be concluded that self-efficacy influence students' academic achievement. Metacognition influenced academic

achievement with reference to self-testing, while learning strategies influenced academic achievement through the use of study aids. It was accepted that goal-setting influenced academic achievement of the Standard 10 Biology students.

Goal-setting enhances motivation, and as a result students are self-driven to work hard.

OPSOMMING

'N ONTLEDING VAN SELF-GEREGULEERDE LEERVERMOËNS VAN STANDERD 10 BIOLOGIELEERLINGE

Die doel van hierdie navorsing was om, deur middel van 'n literatuuroorsig en 'n empiriese ondersoek vas te stel of metakognisie, selfdoeltreffendheid, doelwitstelling en leerstrategieë 'n invloed het op die akademiese prestasie van standerd 10 Biologieleerlinge.

Uit die literatuuroorsig het dit geblyk dat metakognisie, selfdoeltreffendheid, doelwitstelling en leerstrategieë akademiese prestasie beïnvloed. Leerlinge wat hulle leertake evalueer, bestuur, reguleer en moniteer doen akademies beter as hulle eweknieë.

Hoë-selfdoeltreffendheidleerlinge kies uitdagende take en is taak-deurvoerend, in teenstelling met lae-selfdoeltreffendheidleerlinge wat moeilike take vermy en makliker kies om hulle selfbeeld te bewaar.

Doelwitstelling verhoog self-doeltreffendheid want effektiewe leerlinge sal hulle gestelde doelwitte nastreef en veel harder werk om hulle doelwitte te bereik.

Leerlinge wat leerstrategieë gebruik vaar beter as diegene wat dit nie doen nie. Leerstrategieë soos notas afneem maak dit vir studente moontlik om inligting te herroep.

Die veranderlikes hierbo, naamlik metakognisie, self-doeltreffendheid, doelwitstelling en leerstrategieë versterk self-gereguleerde leer omdat studente wat van hierdie veranderlikes gebruik maak op hulle eie in hulle leertake verdiep raak.

Deur middel van 'n empiriese ondersoek kon dit egter nie vasgestel word dat self-doeltreffendheid studente se akademiese prestasie beïnvloed nie. Metakognisie

beïnvloed akademiese prestasie met verwysing na selftoetsing, terwyl leerstrategieë akademiese prestasie beïnvloed deur die gebruik van studiehulpmiddels. Dit word aanvaar dat doelwitstelling akademiese prestasie van Standaard 10 Biologieleerlinge beïnvloed.

Doelwitstelling verhoog motivering, en as gevolg daarvan word leerlinge aangemoedig om hard te werk.

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APPENDICES

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CHAPTER 1

1 THE PROBLEM AND ITS OVERVIEW

1.1 Introduction and statement of the problem

One of the highest educational ideals a teacher should strive for, is to teach his students to become self-regulated learners. Zimmerman (1989:329) describes self-regulated learners as learners who are metacognitively, motivationally and behaviourally active participants in their own learning, while Pintrich (1989:118) describes them as critical thinkers. The social cognitive view of self-regulated learning (SRL) assumes the reciprocal causation among three influence processes i.e. personal, environmental and behavioural determinants which render the following variables that the teacher must address when a student is to be helped to be more self-regulated:

Personal variables: Declarative and self-regulative knowledge, metacognition, self-efficacy and goalsetting.

Environmental variables: The physical context of learning, and the social environment.

Behavioural influence: Self-observation, self-judgement and self-reaction (Zimmerman, 1988:11).

These behavioural influences can also be defined as learning strategies.

This study proposes to analyse the following of the above-mentioned variables as they pertain to Standard 10 Biology students: metacognition, learning strategies and self-efficacy. It is assumed that if a teacher can improve the metacognitive abilities of his

students, teach them learning strategies and improve their self-efficacy beliefs, they will become self-regulated learners. They will then not only be able to be more autonomous and less reliant on the teacher when studying, but will allow the teacher to spend more time with less self-regulated learners.

According to Cross and Paris (1988:131) and Jacobs and Paris (1987:258) metacognition is understood to embrace self-appraised knowledge and self-managed thinking. As an example a metacognitive learner assesses his knowledge of the task, i.e. he self-appraises by checking his subject-knowledge through self-testing. This metacognitive behaviour influences the learner's academic achievement because if in his self-appraisal he realises that he has not reached subject-mastery, he finds other ways that can help improve his knowledge (self-management), so that he can enter the examination room fully prepared for a good grade.

Self-efficacy refers to personal judgements of one's capability to organize and implement actions necessary to attain higher levels of performance in specific situations (Shunk, 1984:43). Norwich (1987:384) maintains that self-judgements have motivational effects and are considered to be relevant to children's academic achievement. An efficacious learner may compare his own performance with the performance of others because people can learn something about their own capabilities from observing others (Bandura, 1981 quoted by Shunk, 1985:218).

A learning strategy is a sequence of procedures for accomplishing learning (Schmeck, 1988:5). Learning strategies include among others, note-taking, monitoring, rehearsing, paraphrasing, summarising etc.

A self-efficacious student engages in strategy selections and enactments, i.e. a student selects the strategies he deems relevant and employs them (Zimmerman, 1989:336). In this way it is assumed that the learning strategies that students use correlate with

students achievement and optimize students' learning. (Zimmerman, 1989 336-337). Wade and Trathen (1989:40-41) maintain that taking notes while reading increases the retention of prose, because noted text elements are learned better than unnoted elements.

1.2 Aim of the research

The aim of the research was to seek answers to the following four research questions:

- 1.2.1 What is the relationship between metacognition and the academic achievement of Standard 10 Biology students?
- 1.2.2 What is the relationship between self-efficacy beliefs and the academic achievement of Standard 10 Biology students?
- 1.2.3 What is the relationship between learning strategies and the academic achievement of Standard 10 Biology students?
- 1.2.4 What is the relationship between goal-setting and the academic achievement of Standard 10 Biology students?

1.3 Research hypotheses

To achieve the above-mentioned aims, the following research hypotheses were tested:

- 1.3.1 There is a relationship between self-efficacy and the academic achievement of Standard 10 Biology students.

- 1.3.2 There is a relationship between metacognition and the academic achievement of Standard 10 Biology students.
- 1.3.3 There is a relationship between learning strategies and the academic achievement of Standard 10 Biology students.
- 1.3.4 There is a relationship between goal-setting and the academic achievement of Standard 10 Biology students.

1.4 Method of research

The method of research consisted of a review of the literature and an experimental study.

Literature on self-regulated learning, self-efficacy, metacognition, learning strategies and academic achievement was reviewed. A DIALOG-search was done with the above-mentioned variables as key words.

1.5 Experimental design

An *ex post facto* design was used to determine the relationship between self-efficacy, metacognition, learning strategies, goal-setting and academic achievement.

1.6 Procedure and overview of the study

The aim of the study (see par. 1.2) was to determine the influence of self-efficacy (see par. 5.2), metacognition (see par. 4.1), learning strategies (see par. 3.2) and goal-

setting (see par.5.4.1) on academic achievement of Standard 10 Biology students. Chapter 1 was confined to the statement of the problem. Chapter 2 dealt with self-regulated learning. In Chapter 3 the relationship between learning strategies and academic achievement was discussed. The relationship between metacognition and academic achievement was discussed in Chapter 4. The relationship between self-efficacy and academic achievement was discussed in Chapter 5. The method of research was explained in Chapter 6. The statistical analysis and interpretation of results were outlined in Chapter 7, while Chapter 8 dealt with the summary, limitations, recommendations and a concluding paragraph.

CHAPTER 2

2 SELF-REGULATED LEARNING

2.1 Introduction

The purpose of this chapter on self-regulated learning is to explain the concept, self-regulated learning. The goal of this chapter will be attained by discussing self-regulated learning from a social cognitive point of view. A description of self-regulated learning (see par.2.2) will first be given, followed by a discussion of the assumptions underlying self-regulated learning (see par.2.4).

2.2 Description of self-regulated learning

Self-regulated learners are learners who are metacognitively, motivationally and behaviourally active participants in their own learning process (Zimmerman, 1989:329). Metacognitively, self-regulated learners organize and plan their learning, motivationally they have an intrinsic interest in learning a task and behaviourally they create and structure the learning environment to ensure optimal learning (Zimmerman, 1990:4-5). Self-regulated learners are independent learners in that they personally initiate and direct their own efforts to acquire knowledge and skills rather than to rely on other people like teachers and parents to persuade them to do their schoolwork (Zimmerman, 1989:329; Tuckman, 1990:292).

A self-regulated learner is capable of choosing a particular strategy for optimal learning (Zimmerman, 1990:4). For example when a self-regulated learner encounters obstacles such as either poor study conditions or a confusing teacher he finds a way to succeed in

learning by employing appropriate learning strategies to study effectively (Zimmerman, 1990:4). As a result self-regulated learning can be defined in terms of how students choose to use a particular strategy to attain a set of goals (Paris & Newman, 1990:88).

A self-regulated learner does not easily give up on a task because of its difficulty, but tries various learning strategies, until he finds an appropriate one for the task in question (Zimmerman, 1989:329). Pintrich and De Groot (1990:33) maintain that self-regulated learners persist at a task despite its difficulty, because they are able to maintain their cognitive engagement in the task for better performance.

Self-regulated learning reveals planfulness, i.e. the self-regulated student structures his work by devising a plan to work on (Paris & Newman, 1990:87). If he finds that his plan is deficit he restructures it until he finds a working plan (Paris & Newman, 1990:87). When a self-regulated learner becomes planful, it means that his work will not be obstructed by debilitating factors that are indicative of work not well-thought of.

Paris and Newman (1990:87) believe that self-regulated learning reveals control. The self-regulated learner exercises strategic control over his work in the form of self-monitoring (see par.2.2.4.6.1.), self-evaluation (see par.2.2.4.6.2.) and self-reaction or self-regulation. Since the self-regulated learner is characterised by self-initiative and self-direction, he monitors his work to make sure that he is on the right track to attain his goal. Self-regulation also reveals reflection, as the self-regulated learner is able to account for the steps that he has taken in carrying out a learning task (Paris & Newman, 1990:87).

A self-regulated learner knows when and how to use cognitive learning strategies to complete a task (Zimmerman, 1989:333). Cognitive strategies foster active cognitive engagement in learning and result in higher levels of achievement (Pintrich & De Groot,

1990:33). The student who uses cognitive learning strategies effectively may be engrossed in his work for many hours on end because he is self-regulated unlike the one who is ineffective in as far as cognitive learning strategies are concerned (Pintrich, 1989:118).

Self-regulated learners are not only distinguished by their knowledge of cognitive learning strategies as mentioned above but also by their self-motivative capabilities (Zimmerman, Bandura & Martinez-Pons, 1992:664). Self-regulated learners set challenging goals for themselves, and are motivated to achieve their goals, particularly when these goals are attainable (Zimmerman *et al.*, 1992:664). For instance a Biology student may aim to improve his subject-mastery skills by studying related chapters to make the subject more meaningful. A student can be motivated especially if there is progress and improvement in his subject-knowledge (Zimmerman *et al.*, 1992:664; Pintrich, 1989:125).

2.3 Assumptions underlying self-regulated learning

There are three assumptions underlying self-regulated learning, namely, triadic reciprocity (see par.2.3.1), self-efficacy (see par.2.3.2) and the sub-processes of self-observation, self-reaction and self-judgement (see par.2.3.3) (Bandura, 1985:267; Zimmerman, 1989:330). Assumptions are the cornerstones of self-regulated learning, i.e. learning cannot be assumed to be self-regulated if the student is not persistent and does not expend greater effort in his work on the basis of his self-efficacy perceptions (Zimmerman, 1989:330). Self-regulated learning can only be assumed if learning is determined by the triadic reciprocity between personal, environmental and behavioural processes, for instance a student may monitor his own work and may create a suitable study environment by removing distractors in order to learn effectively (Zimmerman, 1989:330).

Sub-processes such as self-observation, self-judgement and self-reaction are assumed to be basic to self-regulated learning because the student evaluates, assesses and judges his work for optimal learning (Schunk, 1991:88-91; Zimmerman *et al.*, 1992:187-188).

2.3.1 *Triadic reciprocity*

Triadic reciprocity suggests a multiple interactive influence of environmental, behavioural and personal processes on learning (Bandura, 1985:267; Zimmerman, 1989:330). It is assumed that none of these processes is more influential than the others, as self-regulated learning is not only determined by personal processes but also by environmental and behavioural determinants in a reciprocal fashion (Zimmerman, 1989:330). A student may for example create an environment conducive to learning by switching off her radio while studying (an environmental process). She can also jot down what she has learnt (a behavioural process of self-checking progress) to ensure that she knows her work (self-checking is also a personal process of self-evaluation) (Zimmerman, 1989:330).

In some contexts, though, personal factors may be stronger than either behavioural or environmental influences during self-regulated learning (Zimmerman, 1989:330). For instance, in over-crowded classrooms, a student may be so distracted by classroom distractors from checking his understanding of his work that he has to move out to find a quiet area to study - an environmental process (Zimmerman, 1989:330).

2.3.2 *Self-efficacy*

Self-efficacy (see par.5 for a more detailed discussion of self-efficacy) refers to the confidence that a student has in his ability to perform certain behaviour in order to achieve designated achievement levels (Bandura,1985:275; Zimmerman, 1989:331; Schunk, 1990:74; 1991:93). A student may either have low or high self-efficacy beliefs (Schunk, 1990:74; 1991:93). Students who hold low self-efficacy beliefs for learning may avoid learning tasks and those who are highly efficacious may expend or apply greater effort and can persist longer than those whose self-efficacy beliefs are low (Schunk, 1990:74; 1991:93; Schunk & Swartz, 1993:225).

2.3.3 *Sub-processes in self-regulated learning*

It is assumed by social cognitive theorists that self-regulation involves three classes of sub-processes viz. self-observation, self-judgement and self-reaction (Zimmerman *et al.*, 1992:187-188; Schunk, 1990:72-73; 1991:88-91).

Self-observation (also see par.2.4.2.1) refers to personal efforts to monitor one's behaviour (Schunk, 1991:89; 1990:72). Self-observation informs the student about goal progress (Schunk, 1990:72). For example a student who keeps a record of his subject-performance in weekly tests knows what the nature of his performance is, whether he or she is achieving at an acceptable level or not and whether a set goal will be attained or not (Schunk, 1990:72).

Self-judgement involves comparing one's present performance with a standard (Schunk, 1991:89, 1990:73). Without standards against which to measure performance, students have no basis for judging how they are doing. Positive judgements by students that they

are working towards self-set standards enhance self-efficacy and motivation (Schunk, 1994:2). Self-judgement is largely determined by the importance of goal accomplishment because if students care very little about how they perform, they may not evaluate what they do and may not study hard (Schunk, 1991:90).

Self-reaction (also see par.2.4.2.3) follows on the heels of self-judgement. Self-judgement occurs when a student judges that a learning strategy that is being used is not going to enable him to attain a set goal and decides to use another learning strategy that may be more suitable for goal attainment (Zimmerman et al.,1992:188; Zimmerman,1989:334; Schunk, 1991:90).

These sub-processes are assumed to interact reciprocally with one another (Zimmerman, 1989:331). A student may observe his performance record in tests. If he maintains a record of good grades, he judges himself to be capable and (self)-efficacious. This positive self-judgement motivates him to work even harder. If he judges that he will not make it he may try other learning strategies so that he may become successful (Zimmerman, 1989:331, Zimmerman *et al.*, 1992:188).

2.4 Determinants of self-regulated learning

Self-regulated learning is influenced by three sets of determinants, i.e. personal, environmental and behavioural determinants (Zimmerman, 1989:332). Each of these determinants may individually have an impact on self-regulated learning (Zimmerman, 1989:332).

2.4.1 *Personal determinants*

The personal determinants of self-regulated learning refers to the student's declarative and self-regulative knowledge, metacognitive processes, goal setting, self-efficacy and affect (Zimmerman, 1989:332).

2.4.1.1 Declarative or propositional knowledge.

Declarative or propositional knowledge (also see par.3.3.1.1) refers to knowing "that" or "what" (Paris, Cross & Lipson, 1984:1241; Zimmerman, 1989:332). Declarative knowledge refers to what the learner knows, that is, the contents of his knowledge which includes his understanding of the variables that influence learning (Cross & Paris, 1988:131). For example, the self-regulated learner may know that there is a learning strategy like self-questioning that may help him understand a learning task (Bondy, 1984:237).

2.4.1.2 Self-regulative knowledge

Self-regulative knowledge is assumed to include conditional and procedural knowledge (Schunk, 1990:73; Paris *et al.*, 1984:1241; Zimmerman, 1989:332).

2.4.1.2.1 Procedural knowledge

Procedural knowledge (see par.3.3.2.1) refers to the "how" of learning, for instance, how to skim, how to summarize or how to question oneself when studying (Paris *et al.*, 1984:1241; Cross & Paris, 1988:131; Billingsley & Wildman, 1990:19; Paris & Oka, 1986:30). A student has to observe how he acquires knowledge of a subject in such a way

that he can say that this is "how" he arrived at such knowledge or this is "how" he solved a problem. The student's learning may improve because procedural knowledge enables him to check for the steps that lead to his understanding of a concept (Paris & Oka, 1986:30).

2.4.1.2.2 Conditional knowledge

Knowing "what" and "how" may not be sufficient guarantee that the student's understanding can improve, he also needs to know "when" and "why" particular learning strategies should be used. Conditional knowledge (see par. 4.3.1.3) refers to "when" and "why" certain procedures should be applied and not others (Billingsley & Wildman, 1990:19; Paris & Cross, 1984:24). The "when" of conditional knowledge literally refers to when a student should employ self-questioning for effective learning and when not. The "why" of conditional knowledge gives the reason why a certain learning strategy has to be used and not another one. A student may find it difficult to understand a concept such as "protein-synthesis" by mere reading but when he starts to make a schematic representation of it (see par. 4.3.1.3) he may come to understand it clearly. A student may ascribe his improved understanding of protein-synthesis to the condition of employing organizational learning strategies (i.e. schematic representation) and not mere rehearsal strategies such as repetition until he can recite a passage on protein-synthesis (Dembo, 1991:158).

2.4.1.3 Goals

A student may set goals for himself or goals may be set by a teacher that control and direct his behaviour (Schunk, 1984:30; 1990:74). Goal-setting oils the machinery for commitment on the part of the student (Zimmerman *et al.*, 1992:6640). By the above statement it is meant that once the student has set goals for self-directedness he will be

committed at all times to do the work and this commitment will increase his progress (Bandura, 1986:354). Goals may influence the student's behaviour depending on whether they are specific or proximal as well as their difficulty level (Schunk, 1984:30).

A specific goal refers to a particular aim or goal that is not general, but easy to gauge, such as simplifying a learning task by studying individual chapters one at a time, instead of tackling all the chapters of a textbook as a whole (Schunk, 1984:30; 1990:73).

Proximal goals are goals that are close at hand and may sharpen the student's intrinsic task interest and result in higher performance because proximal goals are easier to attain than goals more distant in future (Schunk, 1984:30; Zimmerman, 1989:333). Specific and proximal goals promote self-efficacy because the learner is able to gauge his progress easily (Schunk, 1990:74). An example of a proximal goal may be to pass Biology monthly tests, whereas becoming a medical practitioner may exemplify a distant goal.

According to Schunk (1985:217) goal difficulty refers to the level of task proficiency required against a standard. When difficult goals are attained the student becomes efficacious because these goals offer information about how capable the student is in accomplishing difficult goals (Zimmerman, 1989:333).

2.4.1.4 Affect

The affective state of a student may affect self-regulated learning (Schunk, 1985:209). Affective state refers to the emotional state that a student experiences when he thinks of a test or examinations (Schunk, 1985:209). Affective states such as test-anxiety or fear of failure may impede self-regulation when a student feels that he is insufficiently prepared for the examinations (Zimmerman, 1989:333).

2.4.2 Behavioural determinants of self-regulated learning

Some behavioural influences are of particular relevance to the analysis of self-regulated learning viz., self-observation, self-judgement and self-reaction. These behavioural influences are interactive and are equally important (Zimmerman, 1989:333).

2.4.2.1 Self-observation.

Self-observation (see par.2.3.3) is informative of the progress that a self-regulated learner is making towards his goal (Zimmerman, 1989:333). It is maintained that self-observation can be influenced by such personal processes such as self-efficacy, goal-setting and metacognitive planning (Zimmerman, 1989:333). Self-efficacy may influence self-observation when the student believes that he has the ability for greater academic achievement (Schunk, 1990:72). The student may realise from his self-observation that he is not progressing well, but feels that he is efficacious enough to improve his progress. So the belief (self-efficacy) in himself develops confidence that he can improve his performance.

Similarly self-observation may influence goal-setting. The student sets challenging goals for himself. When the student observes that he fails to fulfil the goals, he employs other learning strategies in order to accomplish his goals (Zimmerman *et al.*, 1992:664).

Self-observation may influence metacognitive planning as well. A student who engages metacognitive planning monitors, plans, regulates and evaluates his work (Wenden, 1989:581; Jacobs & Paris, 1987:259). A student self-judges his progress by employing a learning strategy to improve his understanding and also to see whether he has enough

knowledge for performing a task (Bandura, 1986:352; Wenden, 1989:581; Pressley & Ghatala, 1990:21).

2.4.2.2 Self-judgement

A self-regulated learner gauges his progress towards his learning goal through self-judgement (see par.2.3.3) (Bandura, 1986:352; Schunk, 1990:73). Self-judgement informs the student of his progress so that in case of no or poor progress the student has to do something to increase his progress.

According to Zimmerman (1989:334) the student's self-judgement has a bearing on self-efficacy. Students who are highly efficacious display better self-judgement during problem solving whereas those with low self-efficacy will not display the same self-judgement. Highly efficacious students will judge themselves to be capable of problem solving whereas their counterparts will judge themselves incapable (Schunk, 1990:73).

2.4.2.3 Self-reaction

Self-reaction (see par.2.3.3) is when the student changes to another learning strategy on the basis of his self-observation and self-judgement that he would not succeed with the strategy he is using (Zimmerman *et al.*, 1992:188; 1989:334; Schunk, 1991:90). Three classes of self-reactions can be distinguished, viz., behavioural self-reactions (such as learning strategies) which are used by students to optimize learning, personal self-reactions (such as metacognitive strategies) by which students seek to enhance their personal processes (such as understanding the course work being studied) during learning and environmental self-reactions, which involve students' arrangement of a conducive

study area free of distractions (Zimmerman, 1989:334; Zimmerman & Martinez-Pons, 1990:188).

2.4.3 *Environmental determinants of self-regulated learning*

The environmental determinants of self-regulated learning include modeling, social support and the academic setting (Corno, 1987:334; Paris & Newman, 1990:90; Zimmerman, 1989:335-336; Duffy, Roehler & Herrman, 1988:762).

2.4.3.1 Modeling

Modeling is a physical and mental demonstration by the teacher to show students how to do something that they do not know how to do (Duffy *et al.*, 1988:762).

The modeling of effective self-regulated strategies can improve the self-efficacy of even poor learners (Zimmerman, 1989:335). For example, if a teacher is modeling paraphrasing as a sort of a self-regulative strategy, he teaches the students to express text ideas in their own words for better understanding (Zimmerman, 1989:335; Weinstein, Meyer & Van Mater Stone, 1993:11). Modeling can boost self-efficacy and help students increase their understanding of the text information that they paraphrased especially if modeling allows students to express themselves so that knowledge gaps can be identified (Zimmerman, 1989:335; Duffy *et al.*, 1988:766).

2.4.3.2 Social support

For self-regulated learning to occur a student needs the assistance and support of teachers, parents and peers for persistent learning, enhanced efficacy, motivation and task clarification (Zimmerman, 1989:336; Paris & Newman, 1990:900).

According to Paris and Newman (1990:98) social support is important for student's learning, because when students receive encouragement from their parents, teachers and peers their learning is enhanced. Students therefore become cautious and work hard on their own in order to avoid disappointing those who encourage them to study (Zimmerman, 1989:336).

2.4.3.3 Academic setting

The academic setting refers to, for example, the place of study such as the student's study area which may be the kitchen or bedroom (Zimmerman, 1989:336). For example a student will be able to concentrate on learning for many hours on end if the academic setting is good although his/her concentration span will also depend on the difficulty of the task especially if the student comprehends (Zimmerman, 1989:336). It is possible sometimes that capable students may persist at a difficult task even if there are distractors (Pintrich & De Groot, 1990:33).

2.5 Metacognitive learning strategies

Metacognitive learning strategies (see par.3.2.4 and 3.4.2) such as monitoring, predicting, evaluating and regulating may be resorted to in order to maintain concentration in the face of boredom and concentration failure (Corno, 1987:337; Zimmerman, 1989:338).

2.5.1 *Monitoring*

The self-regulated learner monitors his work to determine how well he knows his work. Monitoring is similar to self-observation because what a student does in monitoring is actually self-observation (see par.2.4.2.1) of his progress towards goal attainment. This monitoring can be done by posing his own questions or by attempting the questions at the end of a chapter (Wenden, 1989:581; Pressley & Ghatala, 1990:21). Monitoring helps the learner to check for understanding and knowledge retention, so that if there is little progress he should resort to a more applicable learning strategy that will enable him to master his task.

2.5.2 *Predicting*

Predicting (see par.4.4.1.2) occurs when a student compares his predicted ideas, i.e. predicted outcomes which he had before he started learning a chapter, to be the same as what he will find at the end of the chapter i.e. the outcomes of his learning (Meyers & Paris, 1978:681; Engelbrecht, 1990:57). Predicting helps the student to improve his understanding because at the end of the chapter he compares his predicted thoughts with the learned ideas (Jacobs & Paris, 1987:286).

2.5.3 *Evaluating*

Evaluating or self-judgement (see 2.4.2.2) implies a comparison of present performance with a standard (Paris et al., 1984:1241). The self-regulated learner evaluates his work by checking for outcomes (Jacobs & Paris, 1987:259). If the results are not good he has to do something to improve.

2.5.4 *Regulating*

Regulating occurs when a student monitors his progress and reacts by adopting the effective learning strategies (self-reaction see 2.4.2.3) (Jacobs & Paris, 1987:259).

2.5.5 *Self-regulated learning strategies*

Self-regulated learning strategies (see par. 4.3.2.2 for a detailed discussion) are self-controlled activities because they help a learner in correcting and checking his behaviour during task involvement (Pintrich, 1989:133; Bondy, 1984:236; Billingsley & Wildman, 1990:18).

2.6 **Conclusion**

Self-regulated learning promotes independence not only in high achievers but also with low-achieving students (Zimmerman, 1990:4; Zimmerman *et al.*, 1992:664). When students have reached this independent stage, the work does not become easier for the teachers only, but for the students as well (Zimmerman, 1990:4).

Self-regulated learning teaches students to set challenging goals. In striving to achieve such goals they apply appropriate learning strategies (Zimmerman *et al.*, 1992:664). Students are motivated for greater task persistence if their set goals are achievable (Zimmerman *et al.*, 1992:664).

Self-regulated learning serves as an eye-opener to students with a poor academic history showing them that much of their study time is wasted on non-academic activities (Schunk, 1990:72).

CHAPTER 3

THE RELATIONSHIP BETWEEN LEARNING STRATEGIES AND ACADEMIC ACHIEVEMENT

3.1 Introduction

In the past, under influence of behaviourism with its strong accent on conditioning learning was viewed as an almost mechanical response to incoming stimuli in that the learner was greatly limited in what he could do to improve comprehension and memory (Weinstein & Underwood, 1985:242). According to the behaviourist view students' learning difficulties could not be resolved because students could not take recourse to learning strategies as a way of accepting more responsibility for their own learning (Weinstein, 1987:590). Acceptance of more responsibility for students' learning is characteristic of autonomous and self-regulated learning (Weinstein, 1987:590; Weinstein & Underwood, 1985:242; Paris, Lipson & Wixson, 1983:293). When students minimize their learning difficulties by making use of learning strategies they may also develop an enduring interest in and continued motivation for learning (Paris *et al.*, 1983:293).

This chapter includes a brief discussion of learning as information processing (see par.3.2.), a definition of learning strategies (see par.3.3.), and a discussion of the different types of learning strategies (see par.3.4.).

3.2 Learning as information-processing

Information processing theorists condemn the idea that all learning involves the formation of associations between stimuli and responses as the behaviourists assume or propose (Schunk, 1991:139). The information processing theorists put emphasis on internal processes of information processing and view learners as active seekers and processors of information (Schunk, 1991:139). The internal processes of information processing include the learner's selection, rehearsal of information, transformation of and relating new information to old information (or prior knowledge) for effective learning (Weinstein & Underwood, 1985:241; Schunk, 1991:139; Weinstein & MacDonald, 1988:305-2).

Information can be processed on a surface level (requiring rehearsal of information) or on a deep level (requiring elaboration and organization of information) (Schunk, 1991:139; Dembo, 1991:271). Surface processing of information leads to rote learning while meaningful learning is enhanced by deep processing (Schunk, 1991:139).

Each of these levels of information processing plays a role in improving and increasing students' understanding of text information (Pintrich, 1989:130; Weinstein & Mayer, 1986:317; Dembo, 1991:271; Schunk, 1991:143). Rehearsal of information is important if the goal of learning is to recall items or words whereas elaboration and organization of information enable students to understand the structure of information such as the process of implanting of the blastocyst in the uterus. The levels at which

information is processed thus imply that greater understanding occurs when material is processed at deeper levels (Schunk, 1991:143; Weinstein, 1987:592; Weinstein & Underwood, 1985:243).

Information processing starts in the sensory register which is a structure that receives all the stimuli from the environment (Gagné, 1985:71; Dembo, 1991:268). The sensory register keeps this information for a brief period of time.(Gagné, 1985:71). Through a process of selective attention information in the sensory register not relevant for the learning goal is filtered out while relevant information is transferred to the short term or working memory to be processed (Weinstein, Goetz & Alexander, 1988:220; Dembo, 1991:268).

The short-term memory is limited in both capacity and duration. If the information is not acted upon quickly the information in the short-term memory decays rapidly (Schunk, 1991:152; Gagné,1985:72). To keep information longer in the short term memory it has to be rehearsed until it is integrated with knowledge from the long term memory or encoded for permanent storage in the long term memory (Dembo, 1991:270; Schunk, 1991:152).

Encoding of information is the process of transforming information into a form that is semantic or meaningful (Gagné,1985:81; Dembo, 1991:271; Schunk, 1991:156; Mayer, 1988:14).

Information in the long-term memory is said to be stored in either the episodic or semantic memory (Dembo, 1991:271). The episodic memory stores events in our lives for the episodic memory allows us to recall images of what happened and or was said during those events (Schunk, 1991:156). The semantic memory refers to memory of meaningfully organised information which is not stored as sounds or shapes, but as concepts whose meaning is known and can be correctly referenced to the learner's environment (Dembo, 1991:271; Gagné, 1985:72).

The semantic memory contains knowledge about things (declarative knowledge) (see par.2.4.1.1) such as dates and information in text-books, procedural knowledge (see par.2.4.1.2.) or knowledge about how to perform a task such as solving a math problem and conditional knowledge (see par.2.4.1.2.) or knowledge of when and why to rehearse information for knowledge retention and when and why another learning strategy is more suitable (Dembo, 1991:271; Cross & Paris, 1988:131; Jacobs & Paris, 1987:259).

Factors that influence encoding are rehearsal (see par. 3.4.1.1.), organization (see par.3.4.1.3.) and elaboration (see par. 3.4.1.2) (Dembo, 1991:156; Weinstein & Mayer, 1986:319). These factors are called control processes or learning strategies which influence the level of processing.

3.3 Defining learning strategies

Weinstein and Mayer (1986:315) define learning strategies as thoughts and behaviours that a student engages in during learning that are intended to influence the encoding process. Learning strategies are procedures tailored for specific purposes of information processing and may include summarizing, paraphrasing, imaging, creating analogies, note-taking and outlining (Pressley, 1988:140; Weinstein, 1987:590). Each of these procedures serves a different purpose (see par.3.4) (Weinstein, 1987:590).

Learning strategies should not be confused with learning styles in that the latter refers to a predisposition to adopt a particular learning strategy (Weinstein & MacDonald, 1988:305-1; Schmeck, 1988:100). Learning strategies are active, dynamic and teachable methods of processing information whereas learning styles are confined to the adoption of only one class of learning strategies (Schmeck, 1988:85; Weinstein & Mayer, 1986: 315; Weinstein *et al.*, 1988:175).

Another fundamental difference between learning strategies and learning styles is in terms of their deficits (Weinstein & MacDonald, 1988:305-1). For example students' learning difficulties can be overcome by teaching them new methods (learning strategies) of acquiring knowledge such as paraphrasing and highlighting. With learning styles, the students' learning difficulties are not easy to overcome because only one class of strategies is employed despite its deficiencies (Schmeck, 1988:278).

3.4 Types of learning strategies

Pintrich (1989:130) classifies learning strategies into three main groups, viz., cognitive, metacognitive and resource management strategies while Weinstein and Mayer (1986:316) differentiate between cognitive, comprehension monitoring and affective strategies.

3.4.1 *Cognitive strategies.*

Cognitive strategies or knowledge acquisition strategies include strategies that are relevant to the students' learning or encoding of material as well as strategies that influence retrieval of information (Weinstein & MacDonald, 1988:305-2; Pintrich, 1989:130).

Examples of these strategies include rehearsal, elaboration and organizational strategies. With relation to each of these strategies Weinstein and Mayer (1986:317) distinguish between strategies for basic and complex tasks.

3.4.1.1 Rehearsal strategies

Rehearsal strategies refer to the learner actively reciting or naming items during learning (Weinstein & Mayer, 1986:317; Weinstein, 1987:592; Pintrich, 1989:130).

3.4.1.1.1 Rehearsal strategies for basic tasks

Rehearsal strategies for basic learning tasks include such strategies as repeating the names of items in an ordered list (Weinstein & Mayer, 1986:316). For example in Biology a learner may repeat the various physiological processes in the life-cycle of the amoeba species until these processes are memorized and the student can recite them. Students will not fail to recall these physiological processes of the amoeba species if they have rehearsed them well, because rehearsal is designed to facilitate word for word recall (Weinstein & Mayer, 1986:592).

3.4.1.1.2 Rehearsal strategies for complex tasks

Complex rehearsal strategies include shadowing, note-taking, underlining or highlighting (Pintrich, 1989:130; Weinstein & Mayer, 1986:318; Wade & Trathen, 1989:40). These rehearsal strategies motivate students to pay more attention during learning.

By shadowing is meant saying the material aloud when the student learns (Pintrich, 1989:130) Note-taking may be done by jotting down facts because of their perceived importance (Wade & Trathen, 1989:40).

Highlighting information during learning is when the learner marks important aspects of what he learns with a conspicuous pen for immediate attention and recall (Pintrich, 1989:130).

Complex rehearsal strategies are assumed to influence attention and encoding processes, but do not help the student to integrate information with prior knowledge (Pintrich, 1989:130). They only increase the students' attention to learn better because the noted text elements are learnt better than unnoted elements (Wade & Trathen, 1989:40).

3.4.1.2 Elaboration strategies

Elaboration strategies help students add new information to their knowledge base in an organized fashion so that information becomes easier to understand and to remember (Weinstein & Underwood, 1985:243).

3.4.1.2.1 Elaboration strategies for basic learning tasks

Elaboration strategies for basic learning tasks include paired associate learning (such as learning foreign language vocabulary) serial list learning (such as learning to recite the alphabet) and free recall list learning (such as learning to name all the parts of the brain in random order) (Weinstein & Mayer, 1986:319).

The most effective elaboration strategies for paired-associate learning involve using mental images to help relate and represent items in a pair (Weinstein & Mayer,

1986:319) For example, in order to remember a word pair such as "cat-fish", a learner could form an image of a cat biting a fish.

3.4.1.2.2 Elaboration strategies for complex learning tasks

Elaboration strategies for complex learning tasks involve the addition of new knowledge to existing knowledge.

Paraphrasing, summarization, creating analogies, generative note-taking and question-answering are examples of such elaboration strategies (Weinstein & MacDonald, 1988:305-2; Weinstein & Mayer, 1986:319; Weinstein & Underwood, 1985:243). The goals of these strategies include integration of presented information with prior knowledge, i.e. transferring knowledge from long-term memory to working memory and integrating the incoming information with this knowledge (Weinstein & Mayer, 1986:320).

When a learner adds new knowledge to what he already knows, he elaborates the information to make it more meaningful (Weinstein & MacDonald, 1988:243). Weinstein and Underwood (1985:243) refer to this phenomenon as "active" or "generative learning" because the learner must generate relationships between what he already knows and the new information to be learned.

When this relationship has been established, understanding is promoted.

Elaboration can be exemplified in Biology by relating the heart and the circulatory system to a water pipe system. Learning is aided by relating new information like the circulatory system to the prior knowledge of a water pipe system to add meaningful information to the already existing information (Weinstein & MacDonald, 1988:305-2).

Paraphrasing refers to the expressing of ideas in one's own words (Weinstein, Mayer & Van Mater Stone, 1993:9). Paraphrasing helps the student to identify gaps or errors in his understanding and leads to better understanding (Weinstein *et al.*, 1993:11).

Making summaries (see par.4.4.2.1) of text is indicative of synthesizing information from many sources in a concise manner in which learners can understand the information better (Garner, 1987:110; Van der Westerhuizen, 1989:566). Text summarization is also a tool for making cognitive progress and for monitoring cognitive progress (Garner, 1987:110; Bondy, 1984:236).

Note-taking is an elaboration strategy if students do not take notes verbatim, but take notes using their own words (Pintrich, 1989:130). This type of note-taking differs from note-taking in rehearsal strategies because it results in better storage and retrieval of information.

Analogy can be used as an elaboration strategy by adding symbolic information to what the student is trying to learn in an attempt to make information more meaningful (Weinstein, 1987:592). For an example the "turgor" pressure in plant cells can be

equated to the pressure in the inflated bicycle tube. The student knows the behaviour of the inflated bicycle tube, so he creates a bridge between what he knows (i.e. prior knowledge) and what he is trying to understand in order to make the new information easier to understand (Weinstein & MacDonald, 1988:305-2; Weinstein, 1987:592).

3.4.1.3 Organizational strategies

Organizational strategies help to organize and transform information into another format for quicker and deeper understanding (Weinstein, 1987:592; Pintrich, 1989:130).

3.4.1.3.1 Organizational strategies for basic learning tasks

Organizational strategies for basic tasks include sorting a list of items into a larger organizational framework (Weinstein & Mayer, 1986:321). Items can be organized into groups on the basis of their shared or common characteristics or features (Weinstein & Mayer, 1986:321).

For example a list may appear in the following order, "garden snail, frog, moss, milt, tentacles, spores, hydra, fish, fern, a student may organize the list by grouping them in this way,"garden snail, hydra, tentacles,- frog, fish, milt,-moss, fern, spores." The use of this kind of organizational strategies requires a learner to be actively involved in the task.

3.4.1.3.2 Organizational strategies for complex learning tasks

Organizational strategies for complex tasks include the selection of appropriate information by the student, identification of the main ideas and linkage of this information with relevant prior knowledge (Weinstein & Mayer, 1986:322; Pintrich, 1989:131).

Learning strategies such as rehearsal, elaboration and organization influence or determine the level on which information is processed (Dembo, 1991:282; Gagn, 1985:72-73; Weinstein & Mayer, 1986:318; Wade & Trathen, 1989:40). Rehearsal strategies enhance processing of information on a surface level (see par. 3.4.1.1.) while elaboration and organization enable deep level processing of information (Pintrich, 1989:130; Weinstein & Underwood, 1985:243; Weinstein & MacDonald, 1986:243).

3.4.2 *Metacognitive strategies*

Metacognitive strategies (see par.2.5 and 4.4 for a more complete discussion) involve the control or regulation aspects of metacognition, and include planning, monitoring and self-regulation (Pintrich, 1989:130). Students ought to actively and constantly check (i.e. monitor) their progress so that they do not fall victim to what has been called "illusion of knowing" (Weinstein, Mayer & Van Mater Stone, 1993:10). Illusion of knowing occurs when students think that they know something when actually they

do not know anything and only realize that holes exist in the understanding when writing a test (Weinstein *et al.*, 1993:10).

3.4.2.1 Planning strategies

Planning strategies include setting goals for studying, and deciding on what has to be done to reach such goals (Pintrich, 1989:189). Planning strategies include skimming (see par.4.4.1.1) and predicting (see par.4.4.1.2.) (Jacobs & Paris, 1987:259).

3.4.2.2 Monitoring strategies

Monitoring strategies (see par.2.5.1. and 4.4.2) are metacognitive strategies that are used to assess whether goal-specific strategies are accomplishing their purposes and to identify learning failures with the aim of correcting such learning failures (Weinstein & MacDonald, 1988:305-3; Pressley, 1986:141; Pintrich, 1989:133).

Monitoring strategies enable a learner to take action when he does not understand something (Dembo, 1991:278).

3.4.2.3 Self-regulation strategies

Self-regulation strategies (see par.2.5.5 and 4.3.2.2.) are related to monitoring strategies because they are self-controlled activities (Pintrich, 1989:133). They include re-reading in order to repair comprehension (Bondy, 1984:236; Billingsley & Wildman, 1990:18).

Self-regulating strategies are assumed to improve performance by assisting learners in checking and correcting their behaviour as they proceed on a task (Pintrich, 1989:133).

3.4.3 Resource management strategies

Resource management strategies include a variety of strategies that assist students in managing the learning environment and the resources available to complete their learning tasks (Weinstein, 1987:593; Pintrich, 1989:133). These strategies help students to create and maintain a conducive climate for learning (Weinstein, Mayer & Van Mater Stone, 1993:4; Weinstein, 1987:593). Examples of resource management strategies are, management of the study environment, time management and social support strategies (Pintrich, 1989:133; Weinstein, 1987:593).

3.4.3.1 Management of the study environment

The study environment must be arranged in such a manner that it becomes relatively free of distractors, both visual and auditory (Zimmerman, 1989:333; Pintrich, 1989:134; Weinstein, 1987:593). A properly arranged study environment is an environment without distractors that may divert students' concentration from what he learns. For example students may study either in a library, study-hall or in the dormitory where it is quiet. An environment of this nature helps the student to focus attention on his academic tasks and also helps eliminate internal and external distractions that can adversely affect concentration which is required for effective learning (Weinstein, 1987:593; Pintrich, 1989:134).

3.4.3.2 Time management strategies

Time management is an important self-management activity in studying (Pintrich, 1989:133; Weinstein, Mayer and Van Mater Stone, 1993:4). Students must schedule time for task accomplishment, for instance if they have set aside certain hours every evening for studying they must strictly and efficiently keep to this schedule (Pintrich, 1989:1340).

Students' time-schedules, though, must be flexible enough to allow for adaptation when necessary, for example, study time must be increased during tests and examinations (Pintrich, 1989:143).

According to Weinstein *et al.* (1993:4) students' self-awareness may influence their time-management skills. Self-awareness refers to a student's knowledge about himself as a learner which is used to manage his learning activities (Weinstein *et al.*, 1993:4). Students may know what times of the day are best for them to concentrate on intellectual tasks, for instance some students prefer to study subjects like Biology in the morning while others may prefer to study the same subject in the evening. Students should concentrate their study sessions on their most productive working hours.

3.4.3.3 Support strategies

Students need to know when and how to seek and obtain help (Zimmerman, 1989:333; Pintrich, 1989:134). The sources of this help can be either a teacher, other adults, peers or the library. Good students know when they do not know something and are able to identify someone to provide some assistance (Pintrich, 1989:134).

3.4.3.4 Effort management strategies

Effort management strategies may be of the most important learning strategies (Pintrich, 1989:134). A good student knows when to increase effort and persist at a task as well as when maximal effort is not required (Pintrich, 1989:134). An effective student may also know that effort alone may not result in success but effort together

with various learning strategies may be needed depending on the task (Pintrich, 1989:134).

3.5 Conclusion

Learning strategies can take many forms ranging from simple paraphrasing to complex content analysis, but the common factor underlying each of these forms is the active involvement of the student (Weinstein *et al.*, 1993:8; Weinstein & Underwood, 1985:242-243). Active cognitive involvement is important for meaningful learning, because passive students cannot expect to reach their learning goals (Weinstein *et al.*, 1993:9).

CHAPTER 4

THE RELATIONSHIP BETWEEN METACOGNITION AND ACADEMIC ACHIEVEMENT

4.1 Introduction

Self-regulated learning requires that the learner or student takes responsibility for managing his own learning in order to reach his learning goal (Zimmerman, 1989:333). A student should therefore not only know what to do in order to reach his learning goals and how to reach his learning goals, but should also monitor and regulate his effort or actions to reach his goals (Paris & Winograd, 1989:2; Jacobs & Paris, 1987:256). Monitoring and regulating one's learning activities is referred to as metacognition (Bondy, 1984:234-235).

Possessing the cognitive skills, i.e. learning strategies to reach one's goals are not sufficient to attain one's goals (Dembo, 1991:236). The execution of such skills should also be planned, monitored and regulated (Paris & Winograd, 1989:4). Effective learning is thus not possible without metacognition (Babbs & Moe, 1983:423).

Metacognition is not only the main ingredient of the cognitive approach to learning but is also seen as an essential component of the cognitive approach to learning whereby a student embarks on the executive control of learning and apply planning, monitoring and regulating to improve his understanding (Paris & Winograd, 1989:4).

Metacognition will first be defined (par. 4.2), followed by a discussion of the components of metacognition (par.4.3), metacognitive strategies (par.4.4.), and the value of metacognition (par.4.5). The relation between metacognition and academic achievement will receive attention in (par.4.6.).

4.2 Defining metacognition

Metacognition is a broad concept that cannot be defined in a few words or sentences. In order to bring about a clear definition of metacognition it is necessary to distinguish between metacognition and cognition. Cognition refers to using the knowledge or skills that an individual has in doing an assigned task, whereas metacognition on the other hand goes further than the possession of skills because metacognition includes awareness (also see par.4.3.1) and control (also see par. 4.3.2) of such skills (Stewart & Tei, 1983:36; Babbs & Moe, 1983:423; Bondy, 1984:234-235).

Some researchers hold the view that metacognition means conscious awareness of thinking (Jacobs & Paris, 1987:259; Paris & Winograd, 1989:9). For example, a learner who paraphrases a paragraph to make sure that he understands it illustrates the conscious character of metacognition. Other researchers argue that metacognition is unconscious (Jacobs & Paris, 1987:258; Wenden, 1989:576). For example when the student pauses to re-read an unknown word in order to find contextual meaning illustrates the unconscious nature of metacognition. Jacobs and Paris (1987:258), though, consider metacognition as conscious awareness about the cognitive awareness

of one's thinking as they define metacognition "as any knowledge about cognitive states or processes that can be shared between individuals. Flavell (1979:906) explains the awareness aspect of metacognition according to the interactions among four classes of phenomena, viz, metacognitive knowledge, metacognitive experiences, goals or tasks as well as actions or strategies. Metacognitive knowledge consists of knowledge or beliefs about variables that influence learning such as person, task and strategy variables that interact to affect the course and outcome of cognitive activities. The person variable includes the learner's knowledge of himself as a learner and the belief in his own nature in as far as cognitive information processing is concerned (Flavell, 1979:907). The person variable can further be sub-categorized into beliefs about intraindividual and interindividual differences as well as the universals of cognition (Flavell, 1979:907). Intraindividual differences refer to the student's knowledge that he learns text information better by mere listening than by reading. There are some students who grasp information more readily by just listening to a lesson given in class than by reading the same information. Interindividual differences refer to the way people react to the same social situation, viz. that some students are shy to answer questions in class while others are not (Flavell, 1979:907). The student's social anxiety may have an adverse effect on learning, for instance a shy student may not prefer to study in the library because of the presence of other students.

With regard to the universals of cognition it refers to what learners know about the permanent attributes of humans as learners. Flavell (1979:907) lists various ways in which a learner may conceptualize understanding, viz., that there are various degrees or levels of understanding, that there are various reasons for not understanding

someone and that the way someone understands something at a certain time may not guarantee his understanding of the same matter at another time.

The task variable concerns information available about the learning task (Flavell, 1979:907). This information can be that the task is either easy or difficult, well structured or not. If the task is too difficult it can either challenge or discourage the learner.

The strategy variable (see par.3.3.) concerns the selection, application and employment of effective strategies in order to achieve task objectives (Flavell, 1979:907). For example a student may skim (see par.4.4.1.1.) through the exam paper to check whether it is what he expected the paper to be about.

Metacognitive experiences are any affective experiences that pertain to an intellectual enterprise, e.g. one's feeling that one is not ready for ensuing examinations, so one studies once again employing metacognitive strategies (see par.4.4.) like self-questioning in order to improve or repair comprehension (Jacobs & Paris, 1987:256). Metacognitive goals are achieved through metacognitive experiences that give one the feeling that one is not ready for ensuing examinations and that when one employs metacognitive strategies one improves one's metacognitive knowledge and one's metacognitive goals are achieved in this way (Brown, 1984:214).

4.3 Components of metacognition

According to Cross and Paris (1988:131), Paris and Winograd (1989:6) and Jacobs and Paris (1987:258) metacognition includes two broad categories of mental activities namely, self-appraisal or knowledge of cognition and self-management or the management of one's knowledge of cognition.

4.3.1 *Self-appraisal*

Self-appraisal refers to the student's awareness of his thinking processes (par.4.2.) or his assessment of his task knowledge (Paris & Winograd, 1989:2; Jacobs & Paris, 1987:258). For example a student may appraise cognitive strategies he intends using to test their effectiveness in the given task, or he may appraise his knowledge before sitting for a test.

Self-appraisal appears to fall into sub-categories such as declarative, procedural and conditional knowledge (Cross & Paris, 1988:131; Billingsley & Wildman, 1990,19; Jacobs & Paris, 1987:258-259).

4.3.1.1 Declarative knowledge

Declarative knowledge (see par.2.4.1.1) refers to what the learner knows, that is the contents of his knowledge (Cross & Paris, 1988:131; Jacobs & Paris, 1987:259). For

example, a student may know that topic familiarity and prior knowledge influence reading speed and comprehension.

According to Cross and Paris (1988:131) declarative knowledge includes the understanding of what variables influence learning. Once the learner knows what learning strategies to use in order to learn effectively, he will employ these learning strategies. For example the student may employ self-questioning (see par.4.4.2.2) to find out whether he understands what he is learning. There is a relationship between declarative knowledge and Flavell's views on metacognition (see par.4.2) (Paris & Winograd, 1989:5; Flavell, 1979:907). Declarative knowledge encompasses what the student knows which relates to Flavell's metacognitive knowledge, metacognitive experiences and students' knowledge of the learning tasks (Paris & Winograd, 1989:5).

4.3.1.2 Procedural knowledge

Procedural knowledge (see par.2.4.2.1) refers to an awareness of the processes of thinking and relates to cognitive learning strategies (see par.3.4.1; (Paris & Oka, 1986:30). For example, a student may know how to skim, how to use context, how to underline, how to summarize and also how to find the main ideas in a passage when studying or learning (Cross & Paris, 1988:131; Billingsley & Wildman, 1990:19; Paris & Oka, 1986:30). The student has to observe how he acquired knowledge of a subject in such a way that he can say this is "how" he arrived at this knowledge or this is "how" he solved the problem. Procedural knowledge can also be illustrated as a means whereby essential information in a textbook chapter is identified (Jacobs &

Paris, 1987:259). If the learner knows how to use the various steps or procedures, it aids comprehension which leads to effective learning. Procedural knowledge also enables the learner to check for understanding by going through the steps that lead to the correct response (Paris & Oka, 1986:30).

4.3.1.3 Conditional knowledge

Conditional knowledge (see par.2.4.1.2) on the other hand refers to an awareness of the conditions that influence learning such as "why" certain strategies are effective and "when" they should be applied and "when" or "why" they are appropriate and "when" or "why" not (Jacobs & Paris, 1987:259). If a student has to write a test which he knows will require only the recall of memorized names or facts without application, he should know that in his preparation for the test he merely has to concentrate on rehearsal or memorization and that elaboration or organization is not necessary, although the latter may result in deep processing or meaningful learning (Weinstein & Underwood, 1985:241; Weinstein & MacDonald, 1989:305-2).

If a learner is aware of the declarative, procedural and conditional aspects of knowledge, his learning will be facilitated because he can answer the "what", "how", "when", and "why" questions which if well answered are indicative of subject-mastery (Paris & Oka, 1986:30; Paris & Winograd, 1989:5; Jacobs & Paris, 1987:259). The use of these aspects of knowledge enables effective learning (Cross & Paris, 1988:132).

4.3.2 *Self-management*

According to Jacobs and Paris (1987:259) self-management refers to the dynamic aspects of translating knowledge into action by planning (see par.4.3.2.1.) evaluating (see par. 2.5.3.) and regulating (see par.2.5.4.) the process of learning. A learner who manages his learning behaviour knows how to control and direct his behaviour towards better academic achievement (Jacobs & Paris, 1987:259).

Self-management transfers, for example, the learning-checking responsibility from the parents and teachers to the students themselves (Paris & Winograd, 1989:6). The student who monitors his work without persuasion from adults is self-managing (or self-regulating) his learning and is learning effectively without parent or teacher intervention.

4.3.2.1 Planning

Planning (see par.3.4.2.1.) in the context of self-management refers to the selection of particular strategies for goal attainment and to optimize task completion (Jacobs & Paris, 1987:259; Cross & Paris, 1988:131; Paris, *et al.*, 1984:1241). For example, a student may plan a learning task before he tackles it, i.e. he may jot down all the important points he has to cover to guide him in the course of completing the task. A student may evaluate (see par.2.5.3.) his work by assessing the effectiveness of his strategies, i.e. by checking which learning strategies are helpful and should be

continued and which learning strategies are not helpful and should be discarded (Paris *et al.*, 1984:1241; Cross & Paris, 1988:131). For example, a student may realise that self-questioning strategies may not help him understand a poem better as would be the case if he used paraphrasing.

4.3.2.2 Regulating

Regulating (see par.2.5.4) refers to the ability to follow the designed plan and to gauge its effectiveness because the self-managed student has to revise his plans to see whether they are effective or not (Cross & Paris, 1988:131; Jacobs & Paris, 1987:259). For example, a student may self-regulate his work by employing learning strategies such as answering self-set questions to check whether he can respond correctly. If he gives the correct responses it means his learning strategy is working well.

Self-management skills such as planning, evaluating and regulating enable the student to acquire a more explicit understanding of the subject-material if exhaustively engaged by the learner (Reeves & Brown, 1984:6).

4.4 Metacognitive strategies

Metacognitive strategies (see par.2.5. and 3.4.2.) do not differ from planning strategies (see par.3.4.2.1. and 4.4.1.), which may include skimming and predicting (see par. 4.4.1.2.), monitoring strategies (see par.2.5.1. and 3.4.2.3.) which include re-reading,

summarising and self-questioning. Re-reading may also be used as a regulating strategy, depending on its purpose (see par. 2.5.4) (Babbs & Moe, 1983:422; Bondy, 1984:234; Reeves & Brown, 1984:15). Students who engage in these strategies improve their abilities to answer comprehension questions and develop an enduring interest in learning (Babbs & Moe, 1983:422).

Metacognitive strategies may be used at all school levels, although the pupils at lower levels may not engage all the procedures, because they are still not yet mentally matured, but they can be taught to think about a topic before reading about it (Bondy, 1984:234).

4.4.1 Planning strategies

Skimming and predicting are planning strategies (Jacobs & Paris, 1987:259; Cross & Paris, 1988:131).

4.4.1.1 Skimming

Skimming is a method of reading according to which the reader reads as fast as possible to identify main ideas and key terms, without actually reading the complete text (Longman & Atkinson, 1988:77; Flavell, 1979:909). Longman and Atkinson (1988:77) maintain that the difficulty of the material and the learner's familiarity with the topic determine how effectively he can skim. Skimming helps the learner to find

out whether what he thought of a topic before studying it, is true after studying it or not.

Skimming can be classified as a cognitive or a metacognitive strategy (Cross & Paris, 1988:131). The goal of skimming as a metacognitive strategy is to monitor comprehension before actually learning the material as a whole, whereas the goal of skimming as a cognitive strategy is to increase and improve one's knowledge of the text information (Jacobs & Paris, 1987:259; Flavell, 1979:909; Longman & Atkinson, 1988:77; Cross & Paris, 1988:131).

4.4.1.2 Predicting

Predicting as a planning strategy refers to when a student tells or predicts ahead of learning a chapter how much will be remembered at the end of the study session or what information is likely to be encountered during a study session (Meyers & Paris, 1978:681; Engelbrecht, 1990:57; Shuell, 1986:416). Predicting helps a student by looking forward as he studies in order to compare his predicted thoughts and questions during the course of completing the task (Jacobs & Paris, 1987:286; Wong, 1986:14). The goal of predicting is to aid comprehension by scanning ahead, that is, checking subsequent text in order to find clues to problem solving (Bondy, 1984:237; Wong, 1986:14; Jacobs & Paris, 1987:256).

4.4.2 *Monitoring strategies*

Summarizing, self-questioning and re-reading are monitoring strategies (see par 2.5.1. and 3.4.2.3.) (Bondy, 1984:234; Mangano & Goetz, 1972:373; Paris, Winograd, 1989:13).

4.4.2.1 Summarizing

Good (1959:537) defines summarizing as the act of condensing material read or studied, orally or in writing. When a student summarizes text information as a means of obtaining feedback on his understanding of text material, he engages a metacognitive strategy (Bondy, 1984:234).

Students check their understanding of the material they are studying through summarizing what they are studying in a concise manner in which they can understand the material best (Van der Westhuizen, 1989:566).

Summarizing is thus a type of self-testing procedure that reveals the status of one's understanding and suggests that something must be done if satisfactory comprehension of the text is not reached (Bondy, 1984:236). Summarizing can be used, for instance, when one prepares for a test or an examination so that one may go into the exam room with confidence (Paris & Winograd, 1989:13; Bondy, 1984:236).

4.4.2.2 Self-questioning

Self-questioning is a monitoring strategy that a student may engage in by setting his own questions that he answers as he learns a chapter or at the end of a chapter in order to improve his understanding of the work he is studying (Bondy, 1984:237). Self-questioning may be used when a student starts an assignment by identifying the purposes and reasons for doing it with the aim of clarifying the assignment (Bondy, 1984:237; Flavell, 1979:909; Wong, 1986:14).

Students should pose questions that may be answered during the course of completing the task. The questions that a student poses for himself, reflect the student's purpose for doing the task and serve to focus the student's attention on important aspects of the task or text. During self-questioning, the students' attention is endured and they are able to approach the text in a deep meaningful way (Mangano & Goetz, 1982:373).

4.4.2.3 Re-reading

Re-reading is a metacognitive strategy that is resorted to when the student is unable to answer his own questions, when he clarifies an assignment and when the meaning of what he reads or studies is not clear (Babbs & Moe, 1983:425).

The goal of re-reading is to help a learner to repair his comprehension because it is a corrective procedure (Bondy, 1984:236; Billingsley & Wildman, 1990:18). When the

student employs the re-reading strategy he stays actively involved in his studies, thus increasing his understanding of what he learns or studies (Bondy, 1984:236).

Re-reading may be a regulating strategy as well because a student can employ re-reading in order to check whether he is following his designed plan of action (Jacobs & Paris, 1987:259; Cross & Paris, 1988:131). For example, he may re-read his work to see whether the learning strategy that he is employing is effective or he should find an alternative learning strategy.

4.5 The value of metacognition

Metacognition develops in students a positive self-perception (Paris & Winograd, 1989:2). Once the student perceives himself positively, he will work much harder because he wants to maintain a high self-perception of himself. A positive self-perception will enable the student to regard obstacles in problem solving as a challenge that can be overcome by, among others, changing his learning strategies (Paris & Winograd, 1989:2).

Metacognition helps to focus the student's attention on the role of awareness and active management of his thinking (Paris & Winograd, 1990:9). A student can then monitor his work with this awareness of his thinking (Stewart & Tei, 1983:36).

Metacognition promotes self-appraisal and self-management skills (see par.3.3) (Paris & Winograd, 1990:9). As a student engages these skills he becomes an active participant in learning instead of remaining a passive recipient of instruction (Jacobs & Paris, 1987:259; Paris & Winograd, 1990:9).

4.6 The relation between metacognition and academic achievement

Metacognition encourages independent learning (Paris & Winograd, 1989:2; Cross & Paris, 1988:131). Independent learning influences academic achievement, because if a learner or a student does the work on his own it means he is committed to the learning task. Independent learning relates to endured task interest and task persistence (Cross & Paris, 1988:132; Paris *et al.*, 1983:293). For example if a student learns independently it means he is motivated and will refer to various sources for task clarification and mastery which will enhance his academic achievement. Metacognition implies that various ways and approaches must be tried in problem solving instead of using only one strategy, because when the student relies on only one learning strategy and if this strategy fails, he may experience learned helplessness (Babbs & Moe, 1983:423; Reeves & Brown, 1984:15; Bondy, 1984:234; Paris & Winograd, 1989:8). Learned helplessness refers to a situation wherein a student believes that he is unable to master a task and that further effort is futile (Paris & Winograd, 1989:22).

Metacognitive strategies help students to avoid learned helplessness because these strategies empower the students to control and direct their learning and thinking (Paris

& Winograd, 1989:24). For example, students may control and direct their learning and thinking by judging their level of comprehension while reading or preparedness for a test while studying for a test. Students may metacognitively engage executive actions like planning, regulating and evaluating in order to have positive expectations for their performance (Paris *et al.*, 1984:241). Such students are referred to as trouble-shooters because they are resourceful at repairing their own problem solving (Paris & Winograd, 1990:8).

4.7 Conclusion

Metacognition promotes positive self-perception and motivation because when students encounter problems they may take recourse to metacognitive strategies such as monitoring their performance (Paris & Winograd, 1989:13).

When these students are able to solve their problems, they acquire new knowledge and achieve subject mastery. The appropriate use of metacognitive strategies distinguishes skilled learners from less skilled learners. The use of these metacognitive strategies informs less skilled learners on how to improve their learning skills for optimal performance (Jacobs & Paris, 1987:256).

With metacognition students tend to view themselves as intentional, self-directed and self-critical learners because they come to understand why, how, when and where metacognitive strategies may be used in order to facilitate understanding (Paris & Oka, 1984:124; Billingsley & Wildman, 1990:19; Paris & Winograd, 1989:24).

CHAPTER 5

THE RELATIONSHIP BETWEEN SELF-EFFICACY AND ACADEMIC ACHIEVEMENT

5.1 Introduction

This chapter on self-efficacy includes defining self-efficacy (see par.5.2.), sources of self-efficacy (see par.5.3.), the influence of self-efficacy on academic achievement (see par.5.5) and conclusion (see par. 5.6). The above paragraphs help in reviewing self-efficacy as a variable that determines self-regulated learning.

5.2 Defining self-efficacy

Defining

Self-efficacy (see par.2.3.2) refers to a student's expectations that he or she is capable of performing behaviour that will produce desired outcomes in a particular situation (Bandura, 1985:275; Schunk, 1982:89; 1984:29). A self-efficacious student believes that he possesses the capabilities to do well in either a test or an examination. This belief motivates him for more skillful performances (Bandura, 1985:275).

According to Wilhite (1990:696) self-efficacy is the best (single predictor of academic achievement because self-efficacy guarantees students' confidence) in their ability to improve their academic achievement.

Self-efficacy is a variable that boosts self-performance because a strong sense of efficacy for being able to perform cognitive tasks sustains task involvement and promote achievement (Schunk, 1982:90; Schunk, 1991:93).

Students may hold either high or low self-efficacy beliefs for learning (Schunk, 1990:74). Students with high self-efficacy beliefs participate actively in learning even when facing difficult tasks, expend or apply greater effort and can persist longer than those whose self-efficacy is low (Schunk, 1990:74; Bandura, 1985:275). Students who have a low sense of efficacy for learning may attempt to avoid learning tasks, whereas those who judge themselves more efficacious participate more eagerly in learning tasks (Schunk, 1990:74).

Self-efficacy is assumed to influence students' choice of activities, effort expended, perseverance when difficulties are encountered as well as skillful performance (Schunk, 1982,89; Schunk, 1984:29).

5.3 Sources of self-efficacy

It is maintained that people acquire information about their level of self-efficacy through self-performance, vicarious or observational means, verbal persuasion and inferences from their physiological states (Bandura, 1985:276). Information acquired from these sources does not automatically influence self-efficacy (Schunk, 1985:209; 1994:2). Such information has to be cognitively appraised (Schunk, 1994:2).

Efficacy appraisal is an inferential process in which students weigh and combine the contributions of such personal and situational factors as their perceived ability, the difficulty of the task, amount of effort expended, amount of external assistance received, task outcomes and patterns of successes and failures (Schunk, 1994:2). The outcome of such appraisals will, if positive, contribute to the development of a sense of self-efficacy in the learner which will motivate him to work even harder in future.

5.3.1 Self-performance

Self-performance or enactive learning refers to learning from the results of one's own actions and experiences (Schunk, 1991:87). Actions that result in successful performance are retained, while those that lead to failures are discarded (Schunk, 1991:87).

Self-performance is hypothesized to offer the most valid information for assessing self-efficacy (Schunk, 1985:209).

Students who perceive themselves as capable of performing well expect and usually receive positive reactions from their teachers commending them for their good work. The positive feedback received from their teachers enhance achievement motivation and self-efficacy (Schunk, 1985:209; Schunk & Swartz, 1993:225).

Students who perform successfully believe that they are capable of doing well (Schunk, 1991:93). Such students develop high self-efficacy as successful performance raises

efficacy expectancies (Bandura, 1985:276). On the other hand, students who doubt their ability for task-mastery and successful performance work half-heartedly on a task, because they have low self-efficacy (Schunk, 1985:211; Bandura, 1990:276).

According to Schunk (1985:211) performance outcomes have an important influence on students' learning and self-efficacy because students' good results may raise self-efficacy in proportion to the difficulty of the task. The student who performs well on a difficult task feels motivated to challenge all the subsequent difficult tasks.

5.3.2 *Vicarious learning*

According to Schunk (1991:87) much human learning occurs vicariously by observing others. Observation accelerates learning and saves the students the trouble of personally experiencing negative results. When a student observes others (peers) successfully performing a task, he may get the impression that he is also capable of accomplishing similar tasks (Schunk, 1991:93; 1994:2). Observation of other's successful performance therefore informs and motivates students to attempt similar performance.

5.3.3 *Physiological states*

Physiological states (see par.2.3.2.) refer to some emotional arousal that a student experiences when he thinks of frightening moments like preparing or sitting for examinations (Schunk, 1985:209; Bandura, 1985:277).

Emotional experiences like trembling or sweating before writing a test have debilitating effects and may greatly lower one's performance (Schunk, 1985:209; Bandura, 1985:278). Some students though may interpret these emotional symptoms to mean that they are not ready for the examinations and that more preparation is implied and will therefore put in more effort which may ensure success.

5.3.4 Verbal persuasion

Verbal persuasion refers to the encouragement from teachers, parents and friends that they possess the capabilities to do well in their school work (Schunk, 1984:48; Bandura, 1985:48). Although verbal persuasion may have limited effects, under proper conditions verbal persuasion may either raise or lower self-efficacy (Schunk, 1985:218; Bandura, 1985:277). For instance a student must have confidence in the persuader so that he can believe him because encouragement from a credible source has more motivating effect than those from an incredible person (Bandura, 1985:277). Another important condition of verbal persuasion is that it can only be effective if it is combined with successful performance (Bandura, 1985:277; Schunk, 1984:48).

5.4 Variables that influence self-efficacy

5.4.1 Goal setting

Goal setting involves establishing a standard or objective to serve as the aim of one's actions and modifying an objective as necessary (Schunk, 1984:30; Schunk, 1990:72). When students pursue a goal, they may experience heightened self-efficacy for attaining a goal as they realise goal progress, which enhances task motivation (Schunk, 1984:30; Schunk, 1990:73; Schunk & Swartz, 1993:225).

The effects of goals on behaviour depend primarily on their properties of specificity, proximity and difficulty level (Schunk, 1984:30).

5.4.2 Goal specificity

Goal specificity refers to a particular goal that is not general but specific and therefore easy to gauge (Schunk, 1984:30; 1990:73). For example, a student may specifically aim at making weekly summaries of a chapter with an aim of mastering subject matter. A specific goal may promote self-efficacy because the student can tell whether there is progress or not in what he learns (Schunk, 1990:73)

When a student realises that he or she is making progress, he becomes intrinsically motivated, which then raises self-efficacy. Specific goals boost task performance and raise efficacy more than general goals (Schunk, 1985: 217).

A general goal may be exemplified by a student learning to pass Std 10 Biology.

5.4.3 *Goal proximity*

Proximal goals are goals that are close at hand. Proximal goals sharpen the students' intrinsic motivation and result in higher performance (Schunk, 1984:30). Proximal goals may be set by the student himself or by someone else such as a parent or teacher. For example a student may decide to make summaries of the work taught for easy revision. Goal proximity can reduce the learning difficulties of a low achieving student because if such a student is taught to set proximal goals for himself he can raise his cognitive efficacy and his intrinsic interest in the subject matter because goal progress is easy to gauge (Bandura, 1985:276). When a teacher can achieve this with low-achieving students, he should know that his work is simplified, not only for himself but for the student as well because proximal goals promote self-efficacy, motivation and may bring satisfying results to the students (Schunk, 1990:73).

5.4.4 *Goal difficulty*

According to Schunk (1985:217) goal difficulty refers to the level of task proficiency required as assessed against a standard. The effort that the student applies in order to attain a goal depends on the level at which it is set (Tuckman, 1990:29). When students are working towards difficult goals, which are attainable, they feel highly efficacious because the difficult goals offer information about how capable the students

are in attaining them. Students therefore become engrossed in their tasks because they are motivated and will presumably achieve better.

Students feel motivated and efficacious when difficult goals are attainable (Schunk, 1985:217). When students observe progress as they pursue their goals they sustain task motivation and experience a heightened feeling of learning self-efficacy.

5.4.5 Goal progress feedback

Goal progress feedback is a persuasive form of self-efficacy information to students that the goals that they are pursuing are achievable (Schunk & Swartz, 1993:335; Schunk, 1984:54). Goal progress feedback substantiates self-efficacy because it conveys efficacy information to students that they are becoming skillful (Schunk & Swartz, 1993:335; Schunk, 1994:1).

Positive goal progress feedback raises self-efficacy by suggesting to students that they are competent and they can continue to learn (Schunk & Swartz, 1993:339).

5.4.6 Rewards

Rewards given to students for work well done instil in students a sense of efficacy (Schunk, 1984:30). Rewards inform students that they are capable (efficacious) of doing work and motivate students for task persistence (Schunk, 1984:29; 1984:54). Students will work much harder if they know that their efforts will be rewarded. In

this way self-efficacy will be enhanced, especially if rewards are tied to actual accomplishments (Schunk, 1984:29).

Telling students that they can earn rewards based on their level of achievement can promote task motivation and instil a sense of efficacy for performing well (Schunk,1984:30;1994:1).

Receiving of rewards also validates self-efficacy because it symbolizes progress.

5.4.7 *Strategy value feedback*

Students' perceptions of strategy value feedback promote self-efficacy and skill acquisition because it tells students that the learning strategy that they are adopting is valuable (Schunk & Swartz, 1993:340). Strategy value feedback leads students to believe that they are learning a useful strategy, which raises self-eflicacy and motivates them to continue using it (Schunk & Swartz, 1993:340; 1993:225).

5.5 **The influence of self-efficacy on academic achievement**

Self-efficacy beliefs influence effort expenditure and persistence (Schunk, 1991:93; Zimmerman *et al.*,1992:664). Positive judgements of efficacy determine how much effort students will expend and how long they will persist in the face of difficulties. Putting in more effort and persisting will improve students' learning and academic achievement.

Self-efficacy influences the level of goal challenge that students set for themselves (Zimmerman *et al.*, 1992:664; Schunk, 1994:6). Self-efficacious students set difficult but attainable goals (Schunk, 1994:1). The positive judgments that result from the attainment of their goals enhance self-efficacy and motivation for continued learning because they indicate to students that they are skillful (Schunk & Swartz, 1993:225; Schunk, 1994:1).

Students who feel efficacious about learning choose to engage in tasks and select effective learning strategies (see par.3.3) (Schunk, 1994:1). By engaging in tasks on their own indicates that self-efficacy is an important variable that determines self-regulated learning and self-efficacy beliefs influence choice of learning strategies. Selection of learning strategies by students enable them to persist in the task even in the face of difficulties, because when students realise that the strategies that they selected are useful, self-efficacy and motivation are raised and they continue applying them (Schunk & Swartz, 1993:340).

5.6 Conclusion

Self-efficacy influences the level of goal challenge students set for themselves and the effort that they apply in difficult tasks (Zimmerman *et al.*, 1992:664).

The goals that students set become the driving force towards performance accomplishments (Schunk, 1991:99). Self-efficacy develops in students confidence and strength to tackle learning problems (Zimmerman *et al.*, 1992:664).

CHAPTER 6

METHOD OF RESEARCH

6.1 Introduction

The method of research is discussed in this chapter. The aim of the research was stated in paragraph 6.2, paragraph 6.3 has the population and the sample as focus. The questionnaires used in this study are described in paragraph 6.4. The variables used are in paragraph 6.5, followed by the experimental design (see par 6.6), the statistical technique in paragraph 6.7 and procedure in paragraph 6.8.

6.2 The aim of the research

The aim of the research (see par.1.3) was to determine the influence of metacognition, self-efficacy, learning strategies and goal-setting on the academic achievement of Standard 10 Biology students.

6.3 Population and sample

The population for this study embraced all the Standard 10 students offering Biology in the Mankwe Circuit (N=2699) (see table 6.1). Through random sampling a sample of eight Std 10 classes which gave 347 students or subjects was drawn (see table 6.2.).

The ages of the subjects ranged from 16-29 years and they came from urban and rural areas.

Table 6.1: Number of schools, classes in each school and the total number of students comprising the study population.

School number	Std 10 classes							Total
	A	B	C	D	E	F	G	
(01)	45	45	37	-	-	-	-	127
(02)	48	48	52	-	-	-	-	148
{03}	47	47	47	49	-	-	-	190
(04)	45	45	43	-	-	-	-	133
{05}	50	50	50	50	48	45	45	338
(06)	33	32	36	-	-	-	-	101
{07}	45	40	50	55	55	-	-	245
(08)	48	48	40	30	29	-	-	195
{09}	45	45	45	45	45	48	-	228
(10)	59	59	59	57	59	58	61	412
(11)	27	27	-	-	-	-	-	54
(12)	45	45	45	45	-	-	-	180
{13}	45	45	45	45	-	-	-	266
(14)	41	41	-	-	-	-	-	82
The total number of Std 10 Biology students								2699

NB () indicates the schools included in the sample for this study.

{ } indicates the reserve schools to replace a school that did not wish to participate in the study.

Table 6.2. Classes and number of students per class included in the sample

Original number	Classes	Students per class
(4)	D	28
(1)	A	45
(10)	A & B	70
(2)	A	40
(4)	A	43
(8)	C	34
(6)	A	28
Total number of Standard 10 students		342

The questionnaires for this study were administered just after the downfall of the erstwhile Bophuthatswana. Some schools were busy with the half-yearly examinations while others boycotted the lessons as well as half-yearly examinations. There was confusion in all the schools.

Because of this problem there were sample as well as reserve schools so that in case of boycotts and other reasons the researcher could take recourse to reserve schools. The total number of questionnaires were correctly completed. The column for age in months was incorrectly completed in about five questionnaires, e.g. 30 months, 33 months (see table 6.2)

6.4 Instrumentation

The following tests or questionnaires were administered in the study, viz. a biographical questionnaire, the Learning and Study Strategies Inventory-High School Version, the Motivated Strategies for Learning Questionnaire and the Children's Multidimensional Self-efficacy scales.

6.4.1 *The biographical questionnaire*

The purpose of the biographical questionnaire (see appendix A) was to identify variables such as parents' support in school work, homework monitoring, parents' places of work, family size, etc. that influenced the academic achievement of the Standard 10 Biology students.

The biographical questionnaire consisted of 49 items which were designed to obtain information about students' socio-economic status and their academic achievement in Biology.

Table 6.3. provides a biographical analysis of the 347 subjects. Their ages ranged from 16 years to 29 years.

The subjects consisted of more females (204 or 58,2%) than males (143 or 41,8%). The educational qualification level of the fathers fluctuated between Standard 5 or lower (114 or 32,8%) to (40 or 11,5%) who had a post-matric.

Seventy three or 21,1% of the subjects' mother had a Std. 5 or lower while 37 or 10,7% had a post matric. It is clear that most of the subjects lived with either the father or mother (177 or 51%) while (170) subjects (49%) lived with both parents. A good number of subjects had both parents working (210 or 60,5%), while 137 subjects' (39,5%) parents were not working. About (197 or 56,8%) of the subjects' fathers work places were not in the neighbourhood. The family sizes ranged from 2-3 members (44 or 12,7%), 4-5 members (107 or 30,9%), 6-7 members (108 or 31,2%), 8-9 members (59 or 17,2%), 10 or more members (29 or 8,4%).

Many respondents had either none or a few brothers and sisters in the high school (0) (275) (79,3%), (1) (54) (15,6%), (2) (12) (3,5%), (3+) (6) (1,8%). A greater number of subjects came from places which were not electrified (276 or 79,5%) and only (71 subjects or 20,5%) came from electrified places.

The majority of subjects had parents who encouraged them to study (339 members or 97,7%). The subjects had friends who were serious with their studies (313 or 90,2%) and only 34 or (9,8%) had friends who were not serious with their studies. Sibsize differed from (1-3 members 244 or 70,3%), (4-6 members 86 or 24,7%), (7 and more members 17 or 5%). Some subjects' responses were uncertain like where they were to indicate the person with whom they lived, a parent who is employed and number of parents whose work places were in the neighbourhood, etc. They left the spaces blank because some were living in the boarding schools and others did not know what to say

Table 6.3. Biographical analysis of the subjects ¹

Variable	N=347	Frequency	%
1. Age	16	35	10,1
	17	93	26,8
	18	70	20,2
	19	51	14,7
	20	39	11,2
	21	25	7,2
	22 ¹	34	9,2
2. Sex	male	143	41,8
	female	204	58,2
3. Father's level of education	Std 5 or lower	114	32,8
	6	75	21,6
	7	36	10,4
	8	30	8,6
	9	10	2,9
	10	42	12,1
	Post matric	40	11,5
4. Mother's level of education	Std 5 or lower	73	21,1
	6	109	31,4
	7	28	8,1
	8	39	11,2
	9	15	4,3
	10	37	10,7
	Post matric	46	13,3
5. Number of subjects who lived with mother and father	Yes	170	49
	No	177	51
6. Number of subjects whose both parents	Yes	210	60,5
	No	137	39,5

are employed			
7. The actual subjects' parent who were employed	mother	86	24,8
	father	96	27,7
	uncertain	165	47,6
8. Number of subjects whose fathers' places of work were in the neighbourhood	Yes	89	25,6
	No	197	56,8
	uncertain	61	17,6
9. Number of subjects whose mothers' places of work were in the neighbourhood	Yes	119	34,3
	No	135	38,9
	uncertain	93	26,8
10. The time the parents or the people the subjects stayed with arrive home from work	Before sunset	153	44,1
	After sunset	122	35,2
	uncertain	72	20,7
11. Family size	2-3	44	12,7
	4-5	107	30,9
	6-7	108	31,2
	8-9	59	17,0
	10+	29	8,4
12. Sibsize	1-3	244	70,3
	4-6	86	24,7
	7+	17	5,0
13. Birthorder	1-2	249	71,7
	3-4	66	19,0
	5-6	25	7,2
	7+	7	2,1
14. Number of subjects'	0	275	79,3

brothers and sisters who were in the high school	1	54	15,6
	2	12	3,5
	3+	6	1,8
15. The place where the subjects stayed	farm	1	0,3
	town	30	8,6
	village	313	90,2
	other place	3	0,9
16. Number of subjects in homes with electricity	Yes	71	20,5
	No	276	19,5
17. Number of parents encouraging the subjects to study	Yes	339	97,7
	No	8	2,3
18. Number of parents who expected the subjects to do homework after school	Yes	324	93,4
	No	23	6,7
19. Number of parents providing a quiet study area	Yes	272	78,4
	No	75	21,6
20. Number of subjects who were helped to do homework.	Yes	128	36,9
	No	219	63,1
21. Number of hours the subjects spent in doing homework	1-3	302	87,0
	4-5	41	11,9
	6+	4	1,2
22. Number of subjects' friends who	Yes	313	90,2

were serious			
with their studies	No	34	9,8

6.4.2 *The Learning and Study Strategies Inventory High School Version (LASSI-HS)*

The Learning and Study Strategies Inventory-High School Version (LASSI-HS) (see appendix B) is an assessment tool designed to measure students' use of learning and study strategies and methods at the secondary school level (Weinstein & Palmer, 1990:3).

The LASSI-HS can be used in the following manner:

- as a diagnostic measure to help identify areas in which students could benefit most from educational interventions.
- as a counselling tool for advising students on academic remediation, enrichment, student learning assistance and college preparation programmes.
- as a basis for planning individual prescriptions for both remediation and enrichment.
- as a pre-post achievement measure for students participating in programmes or courses focussing on learning strategies and study skills.
- as an evaluation tool to assess the degree of success of intervention programmes or courses.

The LASSI-HS consists of ten subscales. Each subscale is described and its alpha is indicated as given in LASSI-HS users manual (Weinstein & Palmer, 1990:3). Item numbers appeared in brackets.

Attitude

The attitude subscale contains items addressing attitude and interest in education and school (Weinstein & Palmer, 1990:13). Students' general attitudes towards school and their general motivation for successful performance have a great impact on their learning especially if they have to learn on their own. If students' disposition and attitude towards school work are not good then it is difficult to concentrate in school and its related tasks.

Students' scores on this scale measure their general attitude and motivation for successful performance in school (Weinstein & Palmer, 1990:13). If students don't find the school being important to their lives then it is going to be difficult to adopt the positive attitude needed to manage their own learning.

Coefficient Alpha =0,74

I work hard to get a good grade, even when I don't like a class. (28)

I dislike most of the work in my classes. (50)

Motivation

This subscale addresses students' diligence, self-discipline, sense of responsibility and willingness to work hard (Weinstein & Palmer, 1990:13). Motivation is indicative of the degree to which students accept responsibility for studying and for their

performance which is reflected in the everyday behaviours they exhibit in their learning tasks. These behaviours may be manifested in reading textbooks, preparing for class, finishing their assignments on time and being able and eager to tackle even boring topics (Weinstein & Palmer, 1990:13).

Students' high scores on this motivation scale measure the degree of success in the learning tasks while students who score low on this measure need to set realistic and achievable goals. Students' acceptance of more responsibility for their work results in more effective studying and school performance.

Coefficient Alpha =0,78

When I begin a test, I feel pretty sure that I will do well. (35)

I set high standards or goals for myself in school. (40)

Time management

This subscale examines students use of time management principles for academic work (Weinstein & Palmer, 1990:14). Managing time is an important support strategy for learning. Students ought to create and use time schedules that encourage them to take more responsibility for their own learning by sticking to them.

Students should know which subjects to tackle at which times, for example they should know where to place their difficult subjects according to their time schedules. These workable schedules help to create motivation to use them.

Students' scores on this scale measure the degree to which they create and use schedules. Students who score low on this measure may not be capable of creating time schedules and may be wasting time on non-academic activities.

Coefficient Alpha =0,77

I put off schoolwork more than I should. (65)

I have a hard time knowing how to study for different types of subjects. (70).

Anxiety

This subscale addresses the degree to which students worry about schoolwork and their performance (Weinstein & Palmer, 1990:14). If a student is worried that he will not have time to finish a test, then he is just making matters worse by taking more time away to worry about his performance. A tense, an anxious and a student who is fearful about studying or sitting for a test may not apply himself accordingly to academic tasks.

Students' scores on this scale measure how tense or anxious they are when approaching academic tasks. Students who indicate high anxiety need to learn

techniques for coping with anxiety and reducing worry so that they can focus on the task and not on their anxiety.

Coefficient Alpha =0,82

I worry that I will fail my tests or exams (1)

I am very tense when I study . (25)

Concentration

Concentration is a subscale that helps to focus on students' attention on school related activities, such as studying and paying attention in class rather than on situations that distract their attention (Weinstein & Palmer, 1990:14). Distracting students' attention from classroom activities debilitates their focus on the task at hand and interferes with their concentration in school-related tasks.

Students' scores on this scale measure their abilities to concentrate and direct their attention to the learning tasks. Students who score high on this measure are effective at focussing their attention and maintaining a high level of concentration. Students who score low on this measure are less successful at focussing their attention on the learning task by eliminating interfering thoughts, feelings and situations. They need to learn ways and means of enhancing concentration. Learning techniques for focusing attention and maintaining concentration helps students to implement effective learning strategies and can make learning effective.

Coefficient Alpha =0,82

I find it difficult to stick to a study schedule/time table (3)

My mind wanders a lot when I do school work (67).

Information processing

This scale contains items addressing several subscales. These include the use of mental imagery, verbal elaboration, comprehension monitoring and reasoning (Weinstein & Palmer, 1990:15). Meaningful learning is enhanced by the use of elaboration and organization strategies that help to bridge what a student knows and what he is trying to learn and remember. Students succeed at the learning tasks mainly because of the way they elaborate and organize knowledge.

Students' scores on this scale measure how well they can create imaginal and verbal elaborations and organizations to foster understanding and recall. Students who score low on this measure need to learn methods that they can use to help add meaning and organizations to what they are learning.

These methods range from paraphrasing, summarising, outlining, inferential and analytical skills. A student who does not have knowledge of these skills finds it difficult to add new meaning to what he already knows. The use of information processing facilitates effective classroom learning.

Coefficient Alpha =0,80

I stop often while reading and think over or review what has been said. (30)

I try to find connections between what I am learning and what I already know. (39)

Selecting main ideas

This scale addresses students' ability to pick out important information for further study (Weinstein & Palmer, 1990:15). Most lessons, discussions and textbooks contain redundant material, extra examples and many supporting details that help to explain what is being taught or presented. Effective studying requires that the student be able to select main ideas from these extra details for in-depth attention.

If a student cannot select the main ideas the learning task becomes difficult because he has to acquire huge amount of material. Lack of this skill means that the student will not have enough time to study everything that he must cover.

Students' scores on this scale measure their skills at selecting important information to concentrate on classroom lesson. Students who score low on this measure need to learn more about how to identify important information so that they can focus their attention on appropriate material.

Coefficient Alpha =0,71

I use chapter headings as a guide to find important ideas in my reading. (61)

I can tell the difference between more important and less important information. (2)

Study aids

This subscale examines the degree to which students create or use support techniques or materials to help them learn and remember new information (Weinstein & Palmer, 1990:16). Textbooks authors use headings, special type, special markings and summaries in order to help students learn from these materials. If students cannot recognize and use these hints and aids they will not benefit from them. It is also important for students to know how to generate their own aids by creating their own diagrams, text marking and underlining.

Students' scores on this scale measure their ability to use or create study aids that support and increase meaningful learning and retention. Students who score low on this measure may need to learn more about the types of study aids provided in educational material and how they create their own aids. Using and creating study aids improve efficiency in autonomous learning.

Coefficient Alpha =0,68

I use special study aids, such as italics and headings, that are in my textbook to help me understand and remember.(7)

I make drawings or sketches to help me understand what I am studying. (49)

Self-testing

This subscale focuses on reviewing and preparing for classes and tests (Weinstein & Palmer, 1990:16). Reviewing and testing one's level of understanding are important for knowledge acquisition and comprehension monitoring. These strategies support and contribute to meaningful learning and effective performance. Without these strategies learning could be incomplete or errors might persist undetected.

Using mental reviews, going over class notes and text, thinking up potential questions to guide reading are all important methods of checking understanding and identifying if additional studying must be done.

Students' scores on this scale measure their awareness of the importance of self-testing and reviewing and the degree to which they must use these methods. Students who score low on this measure need to learn more about the importance of self-testing and need to learn specific methods to review school material and to monitor comprehension. These methods include structure review of large amounts of material, asking questions before, during and after reading.

Coefficient Alpha =0,74

When I study a topic I try to make the ideas fit together and make sense. (32)

When studying for an exam, I try to think which questions might be in the paper. (17).

Test strategies

This last subscale focuses on students' approaches to preparing for and taking quizzes and tests (Weinstein & Palmer, 1990:17). Effective test performance depends on both preparation strategies and test taking strategies.

A student needs to know how to prepare for the type of performance that will be required and how to maximise that performance. Test preparation includes knowing about the type and duration of a test, for example, is it going to be short-answer or a multiple-choice test. Test-taking strategies include knowing about the characteristics of tests and test items and how to create an effective test- taking plan.

Students' scores on this scale measure their use of test-taking and preparation strategies. Students who score low on this measure may need to learn about how to prepare for tests, how to create a plan of attack for taking a test, characteristics of different types of tests and test items (Weinstein & Palmer, 1990:17). Test-taking and preparation strategies and how to use them help students target their study activities, set up study goals and implement effective study plan for learning effectively.

Coefficient Alpha=0,81

I end up "cramming" (learning a lot of work in a very short period) for almost every test. (41)

I go over homework assignments when reviewing class materials.(69).

6.4.3 The Motivated Strategies for Learning Questionnaire MSLQ (High School)

The Motivated Strategies for Learning Questionnaire (MSLQ) (see appendix C) comprises of 44 items. The questionnaire asks the respondents about study habits, learning skills and motivation for learning or studying. Students were instructed to respond to the items on a 7-point Likert scale (not at all like" to 7="very much like me". The MSLQ consists of two parts, viz. Part A - Motivated beliefs and Part B - Self-regulated learning strategies.

The items of the MSLQ were adapted from various instruments used to assess student motivation, cognitive strategy use and metacognition (Pintrich & De Groot, 1990:34). Factor analysis was used to guide scale construction, resulting in the exclusion of some of the items from the scales because of lack of correlation (Pintrich & De Groot, 1990:34).

An analysis of the motivational items revealed three distinct motivational factors such as self-efficacy, intrinsic value and test anxiety (Pintrich & De Groot, 1990:35). The Self-efficacy Scale (Alpha=0,89) consisted of nine items regarding perceived confidence in class work (for example, "I expect to do very well in this class" (8)"I am

sure that I can do an excellent job on the problems and tasks assigned for this class" (11) "I know that I will be able to learn material for this class"(19).

The Intrinsic Value Scale ($\text{Alpha}=0,87$) was constructed by taking the mean score of the students' response to nine items concerning intrinsic interest for example, "It is important for me to learn what is being taught in this Biology class"(4) and perceived importance of course work ,e.g. "I think that what I am learning in this Biology class is useful for me to know"(15). The preference for challenge and mastery goals include items such as "I prefer class work that is challenging so that I can learn new things"(1).

About four items concerning worry about and cognitive interference on tests were used in the Test Anxiety Scale ($\text{Alpha}=0,75$) and include "I am so nervous during a test that I cannot remember facts I have learnt"(3)"When I take a test I think about how poorly I am doing" (22) "I have an uneasy, upset feeling when I take a test" (20).

On the basis of the results of the factor analysis, two cognitive scales were constructed, such as cognitive strategy use and self-regulation. The Cognitive Strategy Use Scale ($\text{Alpha}=0,83$) consisted of 13 items pertaining to the use of rehearsal strategies e.g. "When I read material for science class I say the words over and over to myself to help me remember"(41). Elaboration strategies such as summarising and paraphrasing e.g. "When I study for this Biology class, I put important ideas into my own words" (28)

Organizational strategies, e.g. "I outline the important chapters in my book to help me study" (42) and when reading I try to connect the things I am reading about with what I already know"(44) (Pintrich & De Groot, 1990:35).

The Self-Regulation Scale (Alpha=0,74) was constructed from metacognitive and effort management items (Pintrich & De Groot,1990:35). The items on metacognitive strategies, such as planning, skimming and comprehension monitoring, e.g "I ask myself questions to make sure I know the material I have studying"(25) " I find that when the teacher is talking I think of other things and don't really listen to what is being said" (38) "I often find that I have been reading for class but don't know what it is about"(37) (Pintrich & De Groot, 1990:35).

The Effort Management Strategies included students' persistence at difficult or boring tasks and working diligently, e.g. "Even when study materials are dull and uninteresting, I keep working until I finish" and "When it is hard I either give up or study only the easy parts"(27) (Pintrich & De Groot, 1990:35).

6.4.4 Children's Multidimensional Self-efficacy Scales

The Children's Multidimensional Self-efficacy (see appendix D) scales were designed by Bandura to help the students understand better the learning task that appears difficult to them.

Students were requested to circle the number indicating their opinions about each of the items. These scales comprise 40 items that instructed the students to respond to a 7 point Likert scale (1="not well at all", to 7 = very well).

A discussion of each of the seven subscale follows:

6.4.4.1 Self-efficacy for enlisting social resources

Self-efficacy for enlisting social resources is when a student is capable of using guidance, assistance and motivation from parents, teachers, peers, adults, sisters, brothers and friends in his school work (Zimmerman, 1989:23-335). The guidance that students use help them improve their academic achievement.

Self-efficacy for enlisting social resources consists of the following items, (items numbers are in brackets) viz.: "How well can you get teachers to help you when you get stuck on schoolwork?" (9) "How well can you get your brother (s) and sister (s) to help you stuck on schoolwork?" (19) "How well can you get adults to help you when you have social problems?" (27) "How well can you get a friend to help you have social problems?" (35).

6.4.4.2 Self-efficacy for academic achievement

Self-efficacy for academic achievement is when a student believes that he can successfully complete academic tasks and that he can obtain marks that he can be

satisfied with in a particular subject (Schunk, 1990:72). Students of low self-efficacy beliefs for academic achievement may avoid working hard, whereas those of high self-efficacy beliefs for academic achievement may work much harder (Bandura, 1985:275).

Self-efficacy for academic achievement include the following items such as "How well can you work in a group?" (3) "How well can you learn biology?" (5) "How well can you learn general mathematics?" (14) "How well can you plan your school work?"(15) "How well can you learn social studies?" (20).

6.4.4.3 Self-efficacy for self-regulated learning.

Self-efficacy for self-regulated learning indicates that students are self-driven to do the learning task (Zimmerman, 1990:4; Zimmerman & Martinez Pons, 1992:664).

Self-efficacy for self-regulated learning includes students' beliefs that they perform successfully on academic tasks and may embrace the following items such as "How well can you concentrate on school subjects?" (1) "How well can you participate in class discussions?" (2) "How well can you take class notes of class instruction?" (8) "How well can you learn reading and writing language skills?" (10) "How well can you use the library to get information for class assignments?" (11) "How well can you arrange a place to study without distractions?" (33).

6.4.4.4 Self-efficacy to meet others' expectations

Self-efficacy to meet others' expectations entails students' preparedness to live up to what their parents, teachers, peers as well as what they expect of themselves on academic achievement.

Self-efficacy to meet others' expectations embraces the following such as "How well can you live up to what your parents expect of you?" (7) "How well can you live to what your teachers expect of you?" (12) "How well can you live up to what your peers expect of yourself?" (16) "How well can you live up to what you expect of yourself?" (34).

6.4.4.5 Social self-efficacy

Social self-efficacy involves students' associations, i.e. how students make friends, work or live with other people. Social self-efficacy consists of some items indicating students' socialization such as "How well can you work in a group?" (3) "How well can you carry on conversation with others?" (17).

6.4.4.6 Self-assertive self-efficacy

Self-assertive efficacy indicates that a student is capable of applying himself in doing schoolwork despite discouragements from friends and how he can resist peer pressure (Zimmerman, 1989:335). The following are some of the self-assertive efficacy items,

viz: "How well can express your opinions when other classmates disagree with you?" (8) "How well can you stand firm to someone who is asking you to do something unreasonable or inconvenient?" (13) "How well can you stand up for yourself when you feel you are being treated unfairly?" (25) "How well can you deal with situations where others are annoying you or hurting your feelings?" (30).

6.4.4.7 Self-efficacy for enlisting parental and community support

Self-efficacy for enlisting parental and community support refers to when students can utilise support from their parents, members of their community and from their community institutions for academic achievement (Paris & Newman, 1990:90).

Self-efficacy for enlisting parents and community support embraces the following items such as "How well can get people outside the school to take an interest in your school (for example, community groups, churches)?" (4) "How well can you get your brother (s) and sister (s) to help you with a problem?" (18).

6.5 Variables used

(See table 7.1.)

Independent variables

Age

Sex

Socio economic status

Family size

Sibsize

Birth order

Time spent on homework

Highest mark aimed at in Biology

Lowest mark satisfied with in Biology

Self-efficacy for enlisting social resources

Self-efficacy for academic achievement

Self-efficacy for self-regulated learning

Self-efficacy to meet others' expectations

Social self-efficacy

Self-assertive efficacy

Self-efficacy for enlisting parental and community support

Attitude

Motivation

Time management

Anxiety

Concentration

Information processing

Selecting main ideas

Study aids

Self-testing

Test strategies

Metacognition

Effort management strategies

Dependent variable

Academic achievement in Biology

6.6 Experimental design

An ex-post facto design was used to determine the relationship between self-efficacy, metacognition, goal-setting, learning strategies and academic achievement in Biology.

6.7 Statistical procedures and techniques

The data were processed with a mainframe computer of the PU for CHE.

Correlation coefficients were calculated with the CORR Procedure of SAS Program (SAS INSTITUTE INC, 1985) to determine the relationship between the independent variables (paragraph 6.5) and the dependent variable.

To determine the collective and individual influence of the independent variables on the dependent variable, a multiple regression analysis was performed. The BMDP-9R computer programme (Dixon & Brown, 1979) was used for the calculation of the multiple regression analysis.

Multiple regression analysis is a method for analysing the collective and separate contributions of two or more independent variables, X_1, X_2, X_3, \dots to the variation of a dependent variable, Y (Kerlinger and Pedhazur, 1973:3 and Kerlinger, 1966:360; 1975:659; 1969:187). This method was appropriate in this research in which the collective and the separate contributions of self-efficacy, metacognition, learning strategies and goal-setting on academic achievement in Biology, are to be determined.

Multiple regression analysis also helps "explain" the variance of a dependent variable and also to study the influence of several independent variables on academic achievement (Kerlinger *et al.*, 1973:4).

One-way analysis of variance (ANOVAs) were performed by means of PROC GLM procedure of SAS.

The means, standard deviations, smallest and largest values of each variable were taken from the multiple regression printout.

The practical or educational significance (effect size) was calculated by using two equations. To determine the educational significance of the difference between two groups means as with t-tests, the following equation was used:

$$d = \frac{\bar{X}E - \bar{X}K}{S_{\max}}$$

Where,

d = effect size;

$\bar{X}E$ = mean of group E;

$\bar{X}K$ = mean of group K;

S_{\max} = highest standard deviation of either E or group K

(Steyn, 1990:10-12).

To determine the educational significance of the contribution of a single variable to R^2 , the following equation was used:

$$f^2 = \frac{\text{contribution to } R^2}{1 - R^2}$$

(Steyn, 1990:13-23).

6.8 Procedure

The researcher visited all the schools of the Mankwe Circuit of Education in the North-West Province. The aim of the visit was to get details regarding the number of students in the various classes where the research was to be conducted.

There were about 2699 subjects who were doing Biology as a Std. 10 subject (see par 6.3).

The schools concerned were tested during May in 1994 when there were problems in the former Bophuthatswana schools (as was explained in table 6.1).

The subjects were instructed on what was to happen as the tester feared that they may boycott these tests. When they realised that they would benefit from these tests they became eager to take these tests. They started with the biographical questionnaire which appeared to interest them most. They then completed LASSI-HS, then moved to the MSLQ and the Self-efficacy Questionnaire. They were given a 10-minute break after every questionnaire.

The tester tried to minimize mistakes by explaining all the questions before the subjects tackled them. After the subjects were sure that they responded correctly the tester collected the questionnaires.

6.9 Conclusion

The method of research was described in this chapter. The main aim of the empirical research was to gather data to be used to determine the influence of self-efficacy, metacognition, learning strategies and goal-setting on academic achievement of Standard 10 Biology students.

The procedure followed was described in paragraph 6.8.

CHAPTER 7

7 STATISTICAL ANALYSIS AND INTERPRETATION OF RESULTS.

7.1 Introduction

As was indicated in paragraph 1.3, the aim of this research as to determine whether there is a relationship between learning strategies, metacognition, goal-setting, self efficacy and academic achievement of Standard 10 Biology students. The aim of the research formed the basis of the hypotheses which were tested. The hypotheses are listed in paragraph 7.2. The procedure followed to test the hypotheses is given in paragraph 7.3. Summary statistics and correlation co-efficients are given in paragraph 7.4, while the variables are grouped in 7.5. The relationship between goal-setting, learning strategies and academic achievement are discussed in paragraph 7.6. while the conclusions regarding the hypotheses are given in paragraph 7.8.

7.2 Hypotheses

The following four hypotheses were tested in order to achieve the aims of the research.

Hypothesis 1

There is a relationship between self-efficacy and the academic achievement of Standard 10 Biology students.

Hypothesis 2

There is a relationship between metacognition and the academic achievement of Standard 10 Biology students.

Hypothesis 3

There is a relationship between learning strategies and the academic achievement of Standard 10 Biology students.

Hypothesis 4

There is a relationship between goal-setting and the academic achievement of Standard 10 Biology students.

7.3 Procedure followed to test the hypotheses

- 1 The summary statistics and correlation coefficients between these variables and Biology were first calculated (see table 7.1).
- 2 The independent variables were then grouped together on the basis of common characteristics (see par. 7.5).
- 3 All possible subsets regression analysis were used to identify those variables that contribute most to explain the variance in academic achievement.

- 4 After identifying those variables that made the biggest/largest contribution to the variance in academic achievement in Biology a further multiple regression analysis was performed on the individual variables that constituted those variables to determine the individual contribution of these individual variables to the variance in academic achievement.
- 5 After identifying these independent variables a number of ANOVAs were performed to determine the differences in academic achievement in relation to different levels of these individual variables.
- 6 After following the above mentioned procedure it was possible to draw conclusions concerning the hypotheses (see par. 7.8).

7.4 Summary of statistics and correlation coefficients

Table 7.1. Summary statistics and correlation coefficients

Variable	Value obtained or possible to obtain		Mean	Standard deviation	Correlation coefficients with Biology
	Min	Max			
1. Age	16	29	18,7	2,4	0,05*
2. Sex					0,05*
3. Socio economic status	1	18	8,8	4,3	-0,06*
4. Family size	2	13	6,1	2,3	-0,06*
5. Sibsize	1	9	3,1	1,8	-0,13*
6. Birth order	1	9	2,6	1,8	-0,10*
7. Time spent on homework in hours	1	6	2,5	1,0	0,04
8. Highest mark aimed at in Biology	62	400	282,7	65,3	0,45**
9. Lowest mark satisfied with in Biology	65	370	215,8	58,7	0,50***
10. Self-efficacy for enlisting social resources	4	28	20,9	4,2	0,06*
11. Self-efficacy for academic achievement	9	63	41,1	9,3	0,22*
12. Self-efficacy for self-regulated learning	11	77	57,9	9,1	0,16*
13. Self-efficacy to meet others' expectations	4	28	20,5	4,3	0,05*
14. Social self-efficacy	4	28	20,0	4,1	-0,01
15. Self-assertive efficacy	4	28	16,6	4,7	0,03
16. Self-efficacy for enlisting parental and community support	4	28	18,6	5,1	0,01
17. Attitude	8	40	30,1	5,3	0,04
18. Motivation	8	40	29,5	4,9	0,16*
19. Time management	7	35	25,6	4,5	0,08*

20. Anxiety	8	40	23,6	4,9	-0,02
21. Concentration	8	40	30,2	5,5	0,04
22. Information processing	8	40	28,9	5,2	0,19*
23. Selecting main ideas	5	25	17,4	3,5	0,08*
24. Study aids	8	40	28,9	5,3	0,21*
25. Self-testing	8	40	29,5	5,3	0,23*
26. Test strategies	8	40	27,3	5,4	0,07*
27. Metacognition	5	35	26,9	5,4	0,09*
28. Effort management	4	28	19,9	4,9	0,09*
29. Academic achievement in Biology	68	400	236,9	71,8	-

All correlation coefficients $\geq 0,14 < p0,05$

Effect size : *Small effect $f^2 = 0,10$

**Medium effect $f^2 = 0,30$

***Large effect $f^2 = 0,50$

From table 7.1 it can be concluded that there are reasonable correlations of large educational significance between goal-setting, defined as the highest mark aimed at in Biology ($r=0,45$), and the lowest mark a student is satisfied with in Biology ($r=0,50$) and academic achievement in Biology. Though the correlation coefficients between self-efficacy for academic achievement ($r=0,22$), study aids ($r=0,21$), self-testing ($r=0,23$) and academic achievement in Biology are small, these correlation coefficients approach average educational or practical significance. The relation between all the other variables and academic achievement in Biology is very low and of little educational or practical significance.

On the basis of the correlation coefficients it can therefore be concluded that there is a strong relationship of large educational or practical significance between goal-setting and academic achievement in Biology.

7.5 Grouping of variables

Before the relationship between the independent variables and the academic achievement in Biology was determined the variables were first grouped together on the basis of common features or characteristics (see table 7.2).

SES was compiled by summing variables of the biographical questionnaire such as your "father's highest level of education"(4), "mother's level of education"(5), "whether the father and mother were employed or not" (8) and "the availability of electricity at home" (18).

The family variable was composed of family size, sibsize and birth order.

Goal-setting was defined by summing the highest mark a student would like to obtain in Biology and the lowest mark a student would be satisfied with in Biology.

Learning strategies include the ten subscales of the LASSI-HS, i.e. motivation, time management, anxiety, concentration, information processing, selecting main ideas, study aids, self-testing strategies and test strategies.

Self-regulated learning strategies were defined by summing metacognitive strategies and effort management strategies.

Self-efficacy was compiled by totalling all the self-efficacy subscales.

The following independent variables were then subjected to a multiple regression analysis with academic achievement in Biology as dependent variable: Age, sex, SES, family variable, time spent on homework, goal-setting, self-efficacy, learning strategies and self-regulated learning strategies.

7.6 The relationship between goal-setting, learning strategies and academic achievement

Table 7.2. Contribution of the independent variables to R^2 . Criterion : Biology ($R^2=0,2928$)

Variable	Contribution to R^2	F-value	Effect size (f^2)
1. Age	0,0001	0,04	0
2. Sex	0,002	0,87	0,003
3. Socio economic status	0,0007	0,30	0
4. Family variables	0,0018	0,78	0
5. Time spent on homework	0,0001	0,43	0
6. Goal-setting	0,2439	106,04**	0,34
7. Self-efficacy	0,0004	0,13	0
8. Learning strategies	0,0114	4,96*	0,02
9. Self-regulated learning	0,0046	2,0	0,01

* $p < 0,05$ Small effect $f^2 = 0,02$

** $p < 0,01$ Medium effect $f^2 = 0,15$

Large effect $f^2 = 0,35$

An analysis of table 7.2 reveals that the independent variables collectively explain 29,3 percent ($R^2 = 0,2928$) of the variance in academic achievement in Biology. Of the independent variables it seems that goalsetting is the single most important variable that influences academic achievement in Biology. Goal-setting explains 24,4 percent

(contribution to $R^2=0,2439$ of the variance in Biology achievement). This contribution is not only of statistical significance but also of high educational significance ($f^2=0,34$). The contribution of learning strategies is significant at the 5% level. Learning strategies explain 1,14 percent (contribution to $R^2=0,0114$) of the variance in academic achievement in Biology. This contribution is of statistical significance, but of little educational significance because of the small effect size ($f^2=0,02$).

It can therefore be concluded that goal-setting and to a lesser extent learning strategies are variables that have an important influence on students' academic achievement in Biology.

7.7 The relationship between the individual variables and academic achievement in Biology

As both goal-setting and learning strategies were compiled by a number of individual variables and as there was an interest in the relationship between metacognition and Biology (i.e. hypothesis 2), the variables that constituted goal-setting, learning strategies and self-regulated learning were subjected to a further multiple regression analysis to determine the relative influence of these individual variables on academic achievement in Biology (see table 7.3).

Table 7.3. Contribution of the individual variables to R^2 . Criterion: Biology $R^2 = 0,3248$.

Variable	Contribution to R^2	F-value	Effect size f^2
Effort	0,0001	0,05	0
Anxiety	0,0001	0,05	0
Motivation	0,0004	0,18	0
Concentration	0,001	0,45	0,001
Information processing	0,0012	0,55	0,001
Selecting main ideas	0,0015	0,68	0,002
Metacognition	0,0016	0,73	0,002
Time management	0,0019	0,86	0,003
Test strategies	0,002	0,91	0,003
Attitude	0,0029	1,32	0,004
Self-testing	0,0066	3,0*	0,01
Study aids	0,0073	3,32*	0,01
The highest mark a student would aim at in Biology	0,0173	7,86**	0,03
The lowest mark a student would be satisfied with in Biology	0,0723	32,86**	0,11

* $p < 0,1$ Small effect (f^2)=0,02** $p < 0,01$ Medium effect (f^2)=0,15Large effect (f^2)=0,35

An analysis of table 7.3 reveals that the individual variables collectively explain 32,48 percent ($R^2=0,3248$ of the variance in Biology achievement). Of the individual variables the lowest mark a student would be satisfied with in Biology is the single most important variable that influences the academic achievement in Biology. The lowest mark a student is satisfied with explains 7,23 percent (contribution to $R^2=0,0723, f^2=0,11$) of the variance in R^2 . The contribution is of medium educational significance. The highest mark a student aims at in Biology explains 1,73 percent of the variance in Biology achievement. The relationship between self-testing strategies (contribution to $R^2=,0066; f^2=3,0$), using study aids (contribution to $R^2=,0073; f^2=0,01$) and academic achievement in Biology is also of statistical significance, though only on the 10 percent level of significance. The educational significance of using study aids and self-testing strategies is of little significance.

A number of one-way analyses of variance were then performed to determine the differences in academic achievement in Biology between different levels of these variables.

ANOVA revealed that there is a statistically significant difference in the academic achievement between students whose lowest mark they would be satisfied with in Biology is higher than the lowest mark of other students. [$F(4,324) = 30,2$; $p < 0,0001$]. Tukey's post hoc comparison revealed that students whose lowest mark they would be satisfied with in Biology is higher than that of other students who do better in Biology (see table 7.4). The levels in table 7.4. indicate the lowest mark students who do better would be satisfied with in Biology.

Table 7.4. Mean academic achievement in Biology per lowest mark students would be satisfied with.

Level	Mean academic achievement	Standard deviation	Comparison between levels	Difference between means
1 (low)	192,7	77,3	5-1	133,0 *
2	213,1	60,1	5-2	112,6 *
3	248,3	61,8	5-3	77,1 *
4	282,6	55,9	5-4	43,1 *
5 (high)	325,7	55,7	5-5	-

* $p < 0,05$

ANOVA revealed that there is a statistically significant difference in academic achievement between students who set high goals for academic achievement in Biology and students who set lower goals [$F(4,324) = 20,5; p < 0,0001$]. Tukey's post hoc comparison revealed that students who set high goals for academic achievement in Biology do better than students who set lower goals. The levels in table 7.5. represent the degree to which students set high goals for academic achievement in Biology.(see table 7.5.).

Table 7.5. Mean academic achievement in Biology by highest goal set per students'level.

Level	Mean academic achievement	Standard deviation	Comparison between levels	Difference between means
1 (low)	190,8	63,5	5-1	95,2 *
2	210,3	48,9	5-2	75,7 *
3	237,7	60,3	5-3	48,3 *
4	270,8	73,2	5-4	15,2 *
5 (high)	286,0	80,6	5-5	-

* $p < 0,05$

ANOVA revealed that there is a statistically significant difference in academic achievement between students who use self-testing strategies for academic achievement in Biology and students who do not use self-testing strategies - [$F (4,324 = 4,92; p < 0,0007)$]. Tukey's post hoc comparison revealed that students who use self-testing strategies extensively, obtain higher marks in Biology than students who use self-testing strategies less (see table 7.6). The levels in table 7.6. indicate the degree to which students use self-testing strategies. The higher the level the more self-testing strategies are used, i.e. students on level five use more self-testing strategies than students on level one (see table 7.6).

Table 7.6. Mean academic achievement in Biology per self-testing strategy level.

Level	Mean academic achievement	Standard deviation	Comparison between levels	Difference between means
1 (low)	202,9	57,7	5-1	62,23*
2	218,6	71,4	5-2	45,56*
3	228,7	63,1	5-3	36,42*
4	250,3	81,3	5-4	14,78*
5 (high)	265,1	67,8	5-5	-

* $p < 0,05$

ANOVA revealed that there is a statistically significant difference in academic achievement between students who use study aids extensively and students who use study aids less - [$F(4,324) = 4,0; p < 0,0037$]. Tukey's post hoc comparison revealed that students who use study aids achieve better in Biology than students who do not use study aids (see table 7.7.)

The levels in table 7.7. indicate the degree to which students use study aids. The highest level such as five represents students who use study aids more than students in the lower levels such as level one.(see table 7.7).

Table 7.7. Mean academic achievement in Biology per study aids level.

Level	Mean academic achievement	Standard deviation	Comparison between levels	Difference between means
1 (low)	208,6	66,0	5-1	62,1*
2	226,5	75,7	5-2	44,2*
3	228,8	68,2	5-3	41,9*
4	247,5	71,4	5-4	23,2*
5 (high)	270,7	66,4	5-5	-

*p < 0,05

It can be concluded that the lowest mark a student is satisfied with, the highest mark a student aims at, self-testing strategies, and study aids are important variables that influence students' academic achievement in Biology.

7.8 Conclusions regarding the hypotheses

7.8.1 Hypothesis 1, that there is a relationship between self-efficacy and the academic achievement, could not be accepted as no statistically significant relationship between self-efficacy and academic achievement in Biology was found (see table 7.2).

7.8.2 Hypothesis 2, that there is a relationship between metacognition and academic achievement, can only be accepted with reference to self-testing strategies, which is a metacognitive variable (see par. 4.4.2.2).

- 7.8.3 Hypothesis 3, that there is a relationship between learning strategies and academic achievement, can be accepted, with reference to the use of study aids (see par.3.4.1.2.2).
- 7.8.4 Hypothesis 4, that there is a relationship between goal-setting and academic achievement can be accepted (see par. 5.4.1).

CHAPTER 8

SUMMARY AND CONCLUSION

8.1 Introduction

A summary of the research is outlined in this chapter. The problem is stated in paragraph 8.2. The review of literature is summarized in paragraph 8.3, followed by an explanation of the method of research in paragraph 8.4. The results are summarized in paragraph 8.6. Some limitations and recommendations appear in paragraphs 8.7 and 8.8 respectively.

8.2 Statement of the problem

The Biology teacher is faced with the problem of teaching his students to become self-regulated learners in order to improve their academic achievement in the subject. The Biology teacher's problem is aggravated by students who regard Biology as a difficult subject. Some students espouse this view because they inherited it from their predecessors, while others regard the subject as difficult because they lack the self-efficacy beliefs and the knowledge of self-regulated learning strategies that ensure good academic performance (Pintrich, 1989:133). Students do not know how much effort to apply in order to achieve better (Pintrich, 1989:134).

In the same vein some Biology students cannot self-appraise (see par.4.3.1) their learning task before sitting for an exam and as a result they enter the examination room not fully prepared for the examination.



8.3 Review of the literature

8.3.1 The relationship between learning strategies and academic achievement

Learning strategies are defined by Weinstein and Mayer (1986:315) as thoughts and behaviours that a student engages in during learning that are intended to influence the encoding process. Learning strategies may include procedures such as rehearsal, elaboration and organization of information (Weinstein, 1987:592; Pintrich, 1989:130). Students who use learning strategies are able to simplify and recall information better than those who do not engage in these procedures (Weinstein & Mayer, 1986:319; Pintrich, 1989:130).

Learning strategies may be used by the learner to identify when learning goals have been met or not and when comprehension failures have occurred or not (Weinstein & McDonald, 1985:305-2; Pintrich, 1989:130). Students cannot succeed in identifying and correcting learning failures without the use of learning strategies (Weinstein & MacDonald, 1985:305-2).

Learning strategies train students to take over the responsibility for their own learning and to manage their own learning, i.e. they become self-regulated learners (see par.

4.3.2) (Klauer, 1988:360). When students have accepted responsibility for their own learning, they learn effectively and develop an enduring interest in learning (Paris *et al.*, 1983:293).

8.3.2 *The relationship between metacognition and academic achievement*

Metacognition (see par.4.2) means conscious awareness of thinking (Jacobs & Paris, 1987:259; Paris & Winograd, 1989:3). Metacognition includes self-appraisal (see par. 4.3.1), self-management (see par.4.3.2) and metacognitive strategies (see par.4.4) (Jacobs & Paris, 1987:259; Cross & Paris, 1988:131). A metacognitive learner is aware of his knowledge gaps and knows which learning strategies to use in order to close knowledge gaps with the aim of improving understanding and academic achievement (Paris & Oka, 1986:30; Billingsley & Wildman, 1990:19). In this way a student becomes self-regulated because he is capable of employing metacognitive strategies when facing difficult learning tasks such as planning strategies (see par.3.4.2.1 and 4.3.2.1 and monitoring strategies (see par. 3.4.2.2 and 4.4.2) (Cross & Paris, 1988:131).



8.3.3 *The relationship between self-efficacy and academic achievement*

Self-efficacy (see par.5.2) is defined as a student's expectation that he or she is capable of performing behaviours that will produce desired outcomes in a particular situation (Bandura, 1985:275; Schunk, 1982:89). Students with high self-efficacy beliefs participate actively in learning and those who have low self-efficacy beliefs may avoid

working hard (Schunk, 1990:74). Students with high self-efficacy beliefs do their schoolwork on their own and are task-persistent as compared with their counterparts who are not highly efficacious.

8.4 Method of research

8.4.1 Subjects

All the Standard 10 Biology students in the high schools in the Mankwe Circuit constituted the population for this research. Through random cluster sampling a sample of eight Std 10 classes, which gave 347 students or subjects, was drawn. The ages of the subjects ranged from 16-29 years and they came from urban and rural areas.

8.4.2 Instruments

The following instruments were used:

8.4.2.1 The Learning and Study Strategies Inventory - High School Version (LASSI-HS)

The Learning and Study Strategies Inventory High School Version (LASSI-HS) is an assessment tool made up of 76 items. It has been designed, among others, to measure students' use of learning and study strategies at high school level. The students

responded to the items on a 5 - point Likert scale (1 = "not at all like me" to 5 = "very much like me").

The Lassi-HIS encompasses the following ten subscales: attitude, motivation, time management, anxiety, concentration, information processing, selecting main ideas, study aids, self-testing and test strategies.

8.4.2.2. The Motivated Strategies for Learning Questionnaire (MSLQ) High School

The MSLQ is made up of two parts, viz: motivational beliefs and self-regulated learning strategies. It consists of 56 items. The subjects responded to the items on a 7 - point Likert scale (1 = "not at all true of me" to 7 = "very true of me").

8.4.2.3 The Children's Multidimensional Self-efficacy Scales.

The children's multidimensional self-efficacy scales were designed to find a better understanding of the kinds of the learning tasks that are difficult for students. It consists of 40 items to which students responded on a 7-point Likert scale (1-2 = "not well at all", 3-4 = "not too well", 5-6 = "pretty well", 7 = "very well").

8.5 Procedure

Through random cluster sampling, a sample of 347 subjects was selected from a population of 2699 Standard 10 Biology students in Mankwe Circuit. After completing the questionnaires, these were scored and analysed by means of the BMDP - 9R and PROC CORR statistical programmes.

8.6 Results

The following hypotheses were tested.

Hypothesis 1, that there is relationship between self-efficacy (see par.1.3.1) and the academic achievement of Standard 10 Biology students, could not be accepted on the basis of the statistical analysis (see table 7.1).

Hypothesis 2 (see par.1.3.2), that stated there is relationship between metacognition and academic achievement of Standard 10 Biology students, could only be accepted with specific reference to self-testing strategies which is a metacognitive variable (see par. 4.4.2.2).

Hypothesis 3 (see par.1.3.3), that there is a relationship between learning strategies and academic achievement of the Standard 10 Biology students, was accepted with reference to the use of study aids (see par.3.4.1.2.2).

Hypothesis 4 (see par.1.3.4), that there is a relationship between goal-setting and academic achievement in Standard 10 is wholly accepted. Goal-setting serves as the driving force towards achievement of goals set by students for academic achievement in Biology. Students who set high goals will work very hard in order to avoid under-achieving in Biology (see par. 5.4.1).

8.7 Limitations

The children's multidimensional self-efficacy scales questionnaire was not adequately done by the subjects as their responses indicated that they (subjects) lacked knowledge of themselves. This could be proved by the fact that the subjects responded mainly on the extreme poles of the scale, i.e. they responded with values of either 1 or 7 and disregarded the middle values. This may indicate that they could not assess themselves in as far as the middle values were concerned. The subjects could therefore not give their appropriate responses despite the fact that these scales were explained to the subjects by the researcher before the administering of questionnaires was started.

The subjects did not take the questionnaires seriously, especially when they were told that there were no right or wrong answers. Some indicated, in the age column of the biographical questionnaire, purposefully wrong information such as 30 months and 33 months (see par.6.3).

Another serious limitation was that the questionnaires were unfortunately administered during the period of a political change, i.e. at the beginning of 1994 which was actually a period of serious problems in Black schools.

The subjects may also have lacked knowledge of self-regulated learning strategies, metacognitive awareness, knowledge of how self-efficacy beliefs and goal-setting may influence their academic achievement.

8.8 Recommendations

It is recommended that students be taught to evaluate themselves by means of self-testing strategies in order to have sound knowledge of their strengths and weaknesses as students or learners and of the variables that influence their learning. Such knowledge is important to enable students to self-regulate their own learning (see par 8.7).

Students must also be taught that learning strategies (see par.3.4) such as test strategies, selecting main ideas and the use of study aids may help them to achieve better in Biology.

Students must be taught that they must set realistic goals that they will always strive to achieve. Realistic goals motivate students to engage in the learning tasks (see par. 5.4.1).

Self-regulated learning strategies must be explained to students to show how they may employ them for improving their achievement in Standard 10 Biology. These self-regulated learning strategies (see par.2.5.5) must be imparted to students especially by the school guidance officer and he must involve all the subject teachers to make a follow-up on how to employ or apply specific learning strategies in the different subjects as different tasks and subjects require different learning strategies.

8.9 Concluding remarks

An investigation into the variables that render a student self-regulated, such as metacognition, learning strategies, goal-setting and self-efficacy was done. It is recommended that all the Mankwe High Schools should study this research and implement it in their Circuit and see to what extent the recommendations made in this study may enhance their students' Biology academic achievement. It is hoped that when these variables are used, the poor attitude towards the subject will change and students will redouble their efforts in this subject.

BIBLIOGRAPHY

- BABBS, P.J. & MOE, A.J. 1983. Metacognition. A key for independent learning from test. *Reading teacher*, 36:422-436.
- BANDURA, A. 1985. Cognitive learning theory. (In Feist, J. Theories of personality. New York : Holt, Rinehart & Winston. p. 262-294.)
- BANDURA, A. 1986. Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ : Prentice-Hall.
- BILLINGSLEY, B.S. & WILDMAN, T.M. 1990. Facilitating reading comprehension in learning disabled students metacognitive goals and instructional strategies. *Remedial and special education*, 11(2):18-31.
- BONDY, E. 1984. Thinking about thinking. Encouraging children's use of metacognitive processes. *Childhood education*, 60(4):234-238.
- BORKOWSKI, J.G., CARR, M. & RELINGER, E. 1987. Self-regulated cognition: Interdependence of metacognition, attribution and self-esteem. (In Jones, B.K. & Idol, L., eds. Dimensions of thinking and cognitive instruction. Vol. 1. Hillsdale, NJ : Lawrence Erlbaum. p. 2-60.)
- BROWN, G. 1984. Metacognition: New insight into old problems? *British journal of educational studies*, 22(3):213-219.
- CORNO, L. 1987. The metacognitive components of self-regulated learning. *Contemporary educational psychology*, 11:333-346.
- CROSS, D.R. & PARIS, S.G. 1988. Developmental and instructional analysis of children's metacognition and reading comprehension. *Journal of educational psychology*, 80(2):131-142.
- DEMBO, M.H. 1991. Applying educational psychology in the classroom. New York : Longman.
- DUFFY, G.G., ROEHLER, L.R. & HERRMAN, B.N. 1988. Modeling mental process helps poor readers become strategic readers. *Reading teacher*, 41(8):762-767.
- ENGELBRECHT, P. 1990. Cognitive and metacognitive base for remediation. *Pedagogiejoernaal*, 11(1):55-64.

- FLAVELL, J.H. 1979. Metacognition and cognitive monitoring: A new area of cognitive developmental inquiry. *American psychologist*, 34(5):906-911.
- GAGNÉ, R.M. 1985. The conditions of learning and theory of instruction. New York : Holt, Rinehart & Winston.
- GARNER, R. 1987. Metacognition and reading comprehension. Norwood, NJ : Ablex.
- GOOD, C.V. 1959. Dictionary of education. New York : McGraw-Hill.
- JACOBS, J.E. & PARIS, S.G. 1987. Children's metacognition about reading: Issues in definition, measurement and instruction. *Educational psychologist*, 23(3&4):255-278.
- KERLINGER, F.N. 1966. Foundations of behavioural research. New York : Holt, Rinehart & Winston.
- KERLINGER, F.N. 1969. Foundations of behavioural research. Educational and psychological enquiry. New York : Holt, Rinehart & Winston.
- KERLINGER, F.N. 1975. Foundations of behavioural research. 2nd ed. New York : Holt, Rinehart & Winston.
- KERLINGER, F.N. & PEDHAZUR, E.J. 1973. Multiple regression in behavioural research. New York : Holt, Rinehart & Winston.
- KLAUER, K.J. 1988. Teaching for learning-to-learn: A Critical appraisal with some proposals. *Instructional science*, 17:351-367.
- LONGMAN, D.G. & ATKINSON, R.H. 1988. College learning and study skills. New York : West Publishing Company.
- MANGANO, N.G. & GOETTZ, E.T. 1982. Improving metacognition through metacognitive training. *Reading psychology*, 3(4):365-374.
- MAYER, R.E. 1988. Learning strategies: An overview. (In Weinstein, C.E., Goetz, E.T. & Alexander, P.A., eds. Learning and study strategies: Issues in assessment, instruction and evaluation. New York : Academic.)
- MEYERS, I.M. & PARIS, S.G. 1978. Children's metacognitive knowledge about reading. *Journal of educational psychology*, 70(5):680-690.
- NORWICH, B. 1987. Self-efficacy and Mathematics achievement: A study of their relation. *Journal of educational psychology*, 79(4):384-387.

- PARIS, S.G. & NEWMAN, R.S. 1990. Developmental aspects of self-regulated learning. *Educational psychologist*, 25(1):97-102.
- PARIS, S.G. & OKA, E.R. 1986. Children's reading strategies, metacognition and motivation. *Developmental review*, 8:25-58.
- PARIS, S.G. & WINOGRAD, P. 1989. How metacognition can promote academic learning and instruction. (In Jones, B.F. & Idol, L., eds. Dimensions of thinking and cognitive instruction. Vol. 1. Hillsdale, NJ : Lawrence Erlbaum. p. 2-51.)
- PARIS, S.G. & WINOGRAD, P. 1990. Promoting metacognition and motivation of exceptional children. *Remedial and special education*, 1:6-15.
- PARIS, S.G., CROSS, D.R. & LIPSON, M.Y. 1984. Informed strategies for learning a program to improve reading awareness and comprehension. *Journal of educational psychology*, 7(4):1239-1252.
- PARIS, S.G., LIPSON, M.Y. & WIXON, K.K. 1993. Becoming a strategic reader. *Contemporary educational psychology*, 8:293-316.
- PINTRICH, P.R. 1987. Motivated learning strategies in the college classroom. Paper presented in April 1987 at the Annual Meeting of the American Educational Research Association. (Washington D.C.).
- PINTRICH, P.R. 1989. The dynamic interplay of student motivation and cognition in the college classroom. (In Maehr, M & Ames, C. eds. Advances in motivation and achievement : Motivation enhancing environments. Greenwich, CT: JAI. 6: 117-160.
- PINTRICH, P.R. & DE GROOT, E.V. 1990. Motivational and self-regulated components of classroom academic performance. *Journal of educational psychology*, 12(1):33-40.
- PRESSLEY, M. 1986. The relevance of the good strategy user model to the teaching of mathematics. *Educational psychologist*, 21(1&2):139-161.
- PRESSLEY, M. & GHATALA, E.D. 1990. Self-regulating: monitoring learning from text. *Educational psychology*, 25(1):19-33.
- PRICHARD, K.M. & Mc LAVAN SAWYER, R. 1993. Handbook of college teaching: Theory and application. s.l.

- RABINOWITZ, M. 1988. On teaching cognitive strategies: The influence of accessibility of conceptual knowledge. *Contemporary educational psychology*, 13:229-235.
- REEVE, R.P. & BROWN, A.L. 1984. Metacognition reconsidered. Implications for intervention research. Technical Report, No. 328. University of Illinois at Urbana Champaign.
- REEVES, R.A. & BROWN, A.L. 1984. Metacognition reconsidered: Implications for intervention research. *Technical report*, 328:2-24.
- SCHIMECK, R.R. 1988. Learning strategies and learning styles. New York : Plenum Press.
- SCHUNK, D.H. 1982. Progress self-monitoring: Effects on children's self-efficacy and achievement. *Journal of experimental education*, 51(2):89-93.
- SCHUNK, D.H. 1984. Enhancing self-efficacy and achievement through rewards and goals: Motivational and informational effects. *Journal of educational research*, 78(1):29-34.
- SCHUNK, D.H. 1984. Self-efficacy perspective on achievement behaviour. *Educational psychologist*, 19(1):48-58.
- SCHUNK, D.H. 1985. Self-efficacy and classroom learning. *Psychology in the schools*, 22:208-223.
- SCHUNK, D.H. 1990. Goal setting and self-efficacy during self-regulated learning. *Educational psychologist*, 25(1):71-86.
- SCHUNK, D.H. 1991. Goal setting and self-evaluation. A social cognitive perspective on self-regulation. (In Mahr, M.L. & Pintrich, P.R., eds. *Advances in motivation and achievement*. Greenwich, CT : JAI Press. p. 85-113.)
- SCHUNK, D.H. 1991. Learning theories: An educational perspective. New York : Macmillan.
- SCHUNK, D.H. 1994. Goal and self-evaluation influences during children's mathematical skill acquisition. (Paper presented at the annual meeting of the American Educational Research Association, New Orleans, April 1994.)

- SCHUNK, D.H. 1994. Self-efficacy, motivation and performance. (Invited address presented at the annual meeting of the Association for the Advancement of Applied Sport Psychology.)
- SCHUNK, D.H. & RICE, J.M. 1991. Learning goals and progress feedback during reading comprehension instruction. *Journal of reading behaviour*, 23(3):351-364.
- SCHUNK, D.H. & SWARTZ, C.W. 1993. Goals and progress feedback: Effects on self-efficacy and writing achievement. *Contemporary educational psychology*, 18:337-354.
- SCHUNK, D.H. & SWARTZ, C.W. 1993. Writing strategy instruction with gifted students. Effects of goals and feedback on self-efficacy and skills. *Roepier review*, 15:225-230.
- SHUELL, T.J. 1986. Cognitive conceptions of learning. *Review of educational research*, 56(4):411-436.
- STEWART, O. & TEI, E. 1983. Some implications of metacognition for reading instruction. *Journal of reading*, 27:36-43.
- THOMAS, J.W. & ROHWER, W.D. 1986. Academic studying: The role of learning strategies. *Educational psychologist*, 21(1&2):19-41.
- TUCKMAN, B.W. 1990. Group versus goal-setting effects on the S.R. performance of students differing in self-efficacy. *Journal of experimental education*, 58(4):291-296.
- VAN DER WESTHUIZEN, G.J. 1989. Metakognisie en die maak van opsommings. *Suid-Afrikaanse tydskrif vir opvoedkunde*, 9(3):564-569.
- WADE, S.E. & TRATHEN, W. 1989. Effects of self-selected study methods on learning. *Journal of educational psychology*, 81(1):40-47.
- WEINSTEIN, C.E. 1987. Fostering learning autonomy through the use of learning strategies. *Journal of reading*, 32(7):590-595.
- WEINSTEIN, C.E. & MAYER, R.E. 1986. The teaching of learning strategies. (In Wittrock, M.C., ed. *Handbook of research on teaching*. 3rd ed. New York : MacMillan. p. 305-325.)
- WEINSTEIN, C.E. & McDONALD, J.D. 1988. Why does a school psychologist need to know about learning strategies? *Journal of school psychology*, 24:305-1-305-9.

- WEINSTEIN, C.E. & PALMER, D.R. 1990. LASSI-HS User's Manual. Austin, USA : University of Texas.
- WEINSTEIN, C.E. & UNDERWOOD, V.L. 1985. Learning strategies: The how of learning. (*In* Segal, J.W., Chipman, J.F. & Glaser, R., eds. Thinking and learning skills, Vol. 1. Hillsdale, NJ : Erlbaum. p. 241-258.)
- WEINSTEIN, C.E., MEYER, D.H. & VAN MATER STONE, G. 1993. Student learning strategies and the implications for college teaching. s.l.
- WENDEN, A.L. 1989. Review of metacognition: An expanded view on the cognitive abilities of L2 learners. *Applied linguistics*, 7(2):573-597.
- WILHITE, S.C. 1990. Self-efficacy, locus of control, self-assessment of memory ability and study activities as predictors of college course achievement. *Journal of educational psychology*, 82(4):696-700.
- WONG, B.Y.L. 1986. Metacognition and special education: A review of a view. *The journal of special education*, 20(1):9-29.
- ZIMMERMAN, B.J. 1988. A social cognitive view of self-regulated academic learning. (A paper presented as part of a symposium entitled "Self-regulated learning I: Theories and models of self-regulation" presented at the annual meeting of the American Educational Research Association. New Orleans, LA. April 1988.)
- ZIMMERMAN, B.J. 1989. A social cognitive view of self-regulated academic learning. *Journal of educational psychology*, 81(3):329-339.
- ZIMMERMAN, B.J. 1990. Self-regulated learning and academic achievement: An overview. *Educational psychologist*, 25(1):3-17.
- ZIMMERMAN, B.J., BANDURA, A. & MARTENEZ-PONS, M. 1992. Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American educational research journal*, 29(3):663-676.



APPENDIX A

THE BIOGRAPHICAL QUESTIONNAIRE

BIOGRAPHICAL QUESTIONNAIRE

Questionnaire number:

--	--	--

 (1-3)

Card number:

1

 (4)

1. Name of student: _____

2. Age:

--	--

 (5-6)

--	--

 (7-8)
Years Months

3. Sex:

1
2

 (9)
Male Female

4. Indicate with a cross your father's highest level of education.

Std 5 or lower	1	(10)
Std 6	2	
Std 7	3	
Std 8	4	
Std 9	5	
Std 10	6	
Post matric qualification	7	

5. Indicate with a cross your mother's highest level of education.

Std 5 or lower	1	(11)
Std 6	2	
Std 7	3	
Std 8	4	
4 Std 9	5	
5 Std 10	6	
Post matric qualification	7	

6. Are you living with both your father and mother?

Yes	1	(12)
No	2	

7. If not, indicate with a cross with whom you are living.

Mother	1	(13)
Father	2	
Relatives	3	
Friend	4	
Alone	5	

8. Are both your father and mother employed?

No	1	(14)
Yes	2	

9. If not, indicate with a cross which one is employed.

Mother	1	(15)
Father	2	

10. Is your father's place of work in your neighbourhood?

Yes	1	(16)
No	2	

11. Is your mother's place of work in your neighbourhood?

Yes	1	(17)
No	2	

12. When do your parents or the people you are living with arrive home from work?

Before sunset

1

After sunset

2

(18)

13. How many people (including yourself) live in your home?

02	03	04	05	06	07	08	09	10	11	12	13
----	----	----	----	----	----	----	----	----	----	----	----

(19-20)

14. How many blood brothers and/or sisters do you have?

0	1	2	3	4	5	6	7	8	9 or more
---	---	---	---	---	---	---	---	---	-----------

(21)

15. How many of your brothers and sisters are older than you?

0	1	2	3	4	5	6	7	8	9 or more
---	---	---	---	---	---	---	---	---	-----------

(22)

16. How many of your brothers and sisters are in high school?

0	1	2	3	4	5	6	7	8	9 or more
---	---	---	---	---	---	---	---	---	-----------

(23)

17. Where do you live?

Farm

1

Town

2

Village

3

Squatter camp

4

Other

5

(24)

If other, state where _____

18. Do you have electricity in your home?

Yes

1

No

2

(25)

19. Do your parents encourage you to study?

Yes	1	(26)
No	2	

20. Do your parents or the people with whom you live expect you to do homework (i.e. schoolwork) after school?

Yes	1	(27)
No	2	

21. If yes, do they provide a quiet area or place for you to study?

Yes	1	(28)
No	2	

22. Is there someone at home who helps you with your homework?

Yes	1	(29)
No	2	

23. How many hours do you spend doing homework every day?

1	2	3	4	5	6 or more	(30)
---	---	---	---	---	-----------	------

24. Are your friends serious with their studies?

Yes	1	(31)
No	2	

25. Is Mathematics one of your difficult subjects at school?

Yes	1	(32)
No	2	

26. Do you get extra tuition in Mathematics after school hours?

Yes

1

No

2

(33)

27. What is the mark you would like to obtain in Mathematics?

--	--	--

(34-36)

28. What is the lowest mark you would be happy with in Mathematics?

--	--	--

(37-39)

29. Are you satisfied with the mark you received for Mathematics in the last test or exams you wrote?

Yes

1

No

2

(40)

30. Is Physical Science one of your difficult subjects at school?

Yes

1

No

2

(41)

31. Do you get extra tuition in Physical Science after school hours?

Yes

1

No

2

(42)

32. What is the mark you would like to obtain in Physical Science?

--	--	--

(43-45)

33. What is the lowest mark you would be happy with in Physical Science?

--	--	--

(46-48)

34. Are you satisfied with the mark you recieved for Physical Science in the last test or exams you wrote

Yes	1
No	2

(49)

35. Is English one of your difficult subjects at school?

Yes	1	(50)
No	2	

36. Do you get extra tuition in English after school hours?

Yes	1	(51)
No	2	

37. What is the mark you would like to obtain in English?

--	--	--

(52-54)

38. What is the lowest mark you would be happy with in English?

--	--	--

(55-57)

39. Are you satisfied with the mark you recieved for English in the last test or exams you wrote?

Yes	1	(58)
No	2	

40. Is Biology one of your difficult subjects at school?

Yes	1	(59)
No	2	

41. Do you get extra tuition in Biology after school hours?

Yes	1	(60)
No	2	

42. What is the mark you would like to obtain in Biology?

--	--	--

(61-63)

43. What is the lowest mark you would be happy with in Biology?

--	--	--

(64-66)

44. Are you satisfied with the mark you received for Biology in the last test or exams you wrote?

Yes	1	(67)
No	2	

45. Academic achievement in English

--	--	--

(68-70)

46. Academic achievement in
Mathematics

--	--	--

(71-73)

47. Academic achievement in Physical
Science

--	--	--

(74-76)

48. Academic achievement in Biology

--	--	--

(77-79)

49. School

--

(80)

APPENDIX B

**LEARNING AND STUDY STRATEGIES INVENTORY - HIGH SCHOOL
VERSION
LASSI-HS**

LASSI-HS
LEARNING AND STUDY STRATEGIES INVENTORY - HIGH SCHOOL
VERSION

by

Claire E. Weinstein & David Palmer,
Department of Educational Psychology,
University of Texas at Austin.

Adapted for South African Students by J.L. de K. Monteith,
Potchefstroom University for CHE

DIRECTIONS

The Learning and Study Strategies Inventory - High School Version (LASSI-HS) is designed to find out how you learn, how you study, and how you feel about learning and studying. On these pages you will find 76 statements about learning and studying. Read each statement and then mark one of these choices on the answer sheet:

1. NOT AT ALL LIKE ME
2. NOT VERY MUCH LIKE ME
3. FAIRLY MUCH LIKE ME
4. VERY MUCH LIKE ME

To help you decide which choice to mark, we will explain what is meant by each one.

By **NOT AT ALL LIKE ME**, we do not necessarily mean that the statement would never describe you, but that it would be true of you only rarely. Cross out number 1 for this choice.

By **NOT VERY MUCH LIKE ME**, we mean that the statement would generally not be true of you. Cross out number 2 for this choice.

By **FAIRLY MUCH LIKE ME**, we mean that the statement would generally be true of you. Cross out number 3 for this choice.

By **VERY MUCH LIKE ME**, we do not necessarily mean that the statement would always describe you, but that it would be true of you almost all the time. Cross out number 4 for this choice.

Try to answer according to how well the statement describes you, not how you think you should be or what others do. There are no right or wrong answers to these statements. Please work as quickly as you can without being careless and please answer all the items. Use a pencil or a ballpoint pen to cross out the numbers.

STATEMENTS

1. I worry that I will fail my tests or exams.
2. I can tell the difference between more important and less important information.
3. I find it difficult to stick to a study schedule/time table.

4. After a class, I look over the work we did to help me understand the information.
5. I don't care if I finish high school as long as I can get a job.
6. I find that when my teacher is teaching I think of other things and don't really listen to what is being said.
7. I use special study aids, such as italics and headings, that are in my textbook to help me understand and remember.
8. I try to identify the main ideas when I listen to my teacher teaching.
9. I get discouraged because of low grades or marks.
10. I am up-to-date in my class assignments.
11. Problems outside of school - conflict with parents, etc. - cause me to not do my school work.
12. I try to think through a topic and decide what I am supposed to learn from it rather than just read it over when doing schoolwork.
13. Even when study materials are dull and not interesting, I manage to keep working until I finish.
14. I feel confused and undecided as to what my educational goals should be.
15. I learn new words or ideas by imagining a situation in which they occur.
16. I come to class unprepared.
17. When studying for an exam, I try to think which questions might be in the paper.
18. I would rather not be in school.
19. The notes I take as I read my textbooks are helpful when I review the textbook material.
20. I do poorly on tests because I find it hard to plan my work within a short period of time.
21. I try to think of possible test questions when studying my class material.
22. I only study when there is the pressure of a test.
23. I change the material I am studying into my own words.
24. I compare class notes with other students to make sure my notes are correct.
25. I am very tense when I study.
26. I look over my work or notes before the next class.
27. I have trouble summarizing what I have just heard in class or read in a textbook.

28. I work hard to get a good grade, even when I don't like a class.
29. I often feel like I have little control over what happens to me in school.
30. I stop often while reading and think over or review what has been said.
31. Even when I am well prepared for a test, I feel very upset when writing it.
32. When I study a topic I try to make the ideas fit together and make sense.
33. I talk myself into believing some excuse for not doing a homework assignment.
34. When I study, I have trouble figuring out just what to do to learn the material.
35. When I begin a test, I feel pretty sure that I will do well.
36. I check to see if I understand what my teacher is saying during a class period.
37. I do not want to learn a lot of different things in school. I just want to learn what I need to get a good job.
38. I am sometimes unable to keep my mind on my schoolwork because I am restless or moody.
39. I try to find connections between what I am learning and what I already know.
40. I set high standards or goals for myself in school.
41. I end up "cramming" (learning a lot of work in a very short period) for almost every test.
42. I find it hard to pay attention during class.
43. I key in on the first or last sentences of most paragraphs when reading my textbooks.
44. I only study the subjects I like.
45. I am distracted from my studies very easily.
46. I try to find connections between what I am studying and my own experiences.
47. I make good use of study hours after school.
48. When work is difficult I either give up or study only the easy parts.
49. I make drawings or sketches to help me understand what I am studying.
50. I dislike most of the work in my classes.
51. I have trouble understanding just what a test question is asking.

52. I make simple charts, diagrams, or tables to pull together material in my classes.
53. While I am taking a test, worrying about doing poorly gets in the way of keeping my mind on the test.
54. I don't understand some class material because I do not listen carefully.
55. I read textbooks intended for my classes.
56. I feel very panicky when I take an important test.
57. When I decide to do schoolwork, I set aside a certain amount of time and stick with it.
58. When I write a test I realize I have studied the wrong material.
59. It is hard for me to know what is important to remember in a textbook.
60. I pay attention fully when studying.
61. I use the chapter headings as a guide to find important ideas in my reading.
62. I get so nervous and confused when taking a test that I don't answer questions to the best of my ability.
63. I memorize grammatical rules, technical terms, formulas, etc., without understanding them.
64. I test myself to be sure I know the material I have been studying.
65. I put off schoolwork more than I should.
66. I try to see how what I am studying would apply to my everyday living.
67. My mind wanders a lot when I do schoolwork.
68. In my opinion, what is taught in my classes is not worth learning.
69. I go over homework assignments when reviewing class materials.
70. I have a hard time knowing how to study for different types of subjects.
71. Often when doing schoolwork I seem to get lost in details and can't remember the main ideas.
72. When they are available, I go to study, or review sessions or extra classes.
73. I spend so much time with my friends that my schoolwork suffers.
74. In taking tests, writing themes, and other schoolwork, I find I have not understood what the teacher wants and lose marks because of it.
75. I try to make connections between various ideas in what I am studying.
76. I have a hard time finding the important ideas in my reading.

APPENDIX C

**MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE (HIGH
SCHOOL)**

MSLQ-HS

PART A. MOTIVATIONAL BELIEFS

The following questions ask about your motivation for and attitudes about this class. Remember there are no right or wrong answers, just answer as accurately as possible. Use the scale below to answer the questions.

Not at all true of me	1	2	3	4	5	6	7	Very true of me
-----------------------	---	---	---	---	---	---	---	-----------------

If you think the statement is very true of you, cross out 7; if a statement is not at all true of you, cross out 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you. Cross out this number.

- I prefer class work that is challenging so that I can learn new things.
- Compared with other students in this class I expect to do well.
- I am so nervous during a test that I cannot remember facts I have learned.
- It is important for me to learn what is being taught in this class.
- I like what I am learning in this class.
- I'm certain I can understand the ideas taught in this course.
- I think I will be able to use what I learn in this class in other classes.
- I expect to do very well in this class.
- Compared with others in this class, I think I'm a good student.
- I often choose paper topics I will learn something from even if they require more work.
- I am sure I can do an excellent job on the problems and tasks assigned for this class.
- I have an uneasy, upset feeling when I take a test.
- I think I will receive a good grade in this class.
- Even when I do poorly on a test I try to learn from my mistakes.
- I think that what I am learning in this class is useful for me to know.
- My study skills are excellent compared with others in this class.
- I think that what we are learning in this class is interesting.
- Compared with other students in this class I think I know a great deal about the subject.
- I know that I will be able to learn the material for this class.
- I worry a great deal about tests.
- Understanding this subject is important to me.
- When I take a test I think about how poorly I am doing.

PART B. SELF-REGULATED LEARNING STRATEGIES

The following questions ask about your learning strategies and study skills for this class. Again, there are no right or wrong answers. Answer the questions about how you study in this class as accurately as possible. Use the same scale to answer the remaining questions.

Not at all true of me	1	2	3	4	5	6	7	Very true of me
-----------------------	---	---	---	---	---	---	---	-----------------

If you think the statement is very true of you, cross out 7; if a statement is not at all true of you, cross out 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you. Cross out this number.

- When I study for a test, I try to put together the information from class and from the book.
- When I do homework, I try to remember what the teacher said in class so I can answer the questions correctly.
- I ask myself questions to make sure I know the material I have been studying.
- It is hard for me to decide what the main ideas are in what I read. (*R)
- When work is hard I either give up or study only the easy parts. (*R)
- When I study I put important ideas into my own words.
- I always try to understand what the teacher is saying even if it doesn't make sense.
- When I study for a test I try to remember as many facts as I can.
- When studying, I copy my notes over to help me remember material.
- I work on practice exercises and answer end of chapter questions even when I don't have to.
- Even when study materials are dull and uninteresting, I keep working until I finish.
- When I study for a test I practice saying the important facts over and over to myself.
- Before I begin studying I think about the things I will need to do to learn.
- I use what I have learned from old homework assignments and the textbook to do new assignments.
- I often find that I have been reading for class but don't know what it is all about. (*R)
- I find that when the teacher is talking I think of other things and don't really listen to what is being said. (*R)
- When I am studying a topic, I try to make everything fit together.
- When I'm reading I stop once in a while and go over what I have read.

41. When I read material for this class, I say the words over and over to myself to help me remember.
42. I outline the chapters in my book to help me study.
43. I work hard to get a good grade even when I don't like a class.
44. When reading I try to connect the things I am reading about with what I already know.

MOTIVATED STRATEGIES FOR LEARNING QUESTIONNAIRE

(HIGH SCHOOL)

National Center for Research to Improve Postsecondary Teaching
and Learning
(NCRIP TAL)

School of Education, The University of Michigan,
Ann Arbor, Michigan

Adapted by

J.L. de K. Monteith (Potchefstroom University for CHE)

*The questionnaire asks you about your study
habits, your learning skills, and your motivation
for learning or studying.*

**THERE ARE NO RIGHT OR WRONG
ANSWERS TO THE QUESTIONNAIRE. THIS
IS NOT A TEST.**

*We want you to respond to the questionnaire as
accurately as possible, reflecting your attitudes
and behaviors in this course.*

APPENDIX D

CHILDREN'S MULTIDIMENSIONAL SELF-EFFICACY SCALES

CHILDREN'S MULTIDIMENSIONAL SELF-EFFICACY SCALES

Developed by:

ALBERT BANDURA
Stanford University
Stanford, California

This questionnaire is designed to help us get a better understanding of the kinds of things that are difficult for students. Please indicate your opinions about each of the statements below by circling the appropriate number. Your answers will be kept strictly confidential and will not be identified by name. Please give your frank opinions.

1	2	3	4	5	6	7
Not well at all		Not too well		Pretty well		Very Well

1. How well can you concentrate on school subjects?
2. How well can you participate in class discussions?
3. How well can you work in a group?
4. How well can you get people outside the school to take an interest in your school (for example, community groups, churches)?
5. How well can you learn biology?
6. How well can you take class notes of class instruction?
7. How well can you live up to what your parents expect of you?
8. How well can you express your opinions when other classmates disagree with you?
9. How well can you get teachers to help you when you get stuck on schoolwork?
10. How well can you learn reading and writing language skills?
11. How well can you use the library to get information for class assignments?
12. How well can you live up to what your teachers expect of you?
13. How well can you stand firm to someone who is asking you to do something unreasonable or inconvenient?
14. How well can you learn general mathematics?
15. How well can you plan your school work?
16. How well can you live up to what your peers expect of you?
17. How well can you carry on conversations with others?

18. How well can you get your brother(s) and sister(s) to help you with a problem?
19. How well can you get another student to help you when you get stuck on schoolwork?
20. How well can you learn social studies?
21. How well can you finish homework assignments by deadlines?
22. How well can you get your parents to take part in school activities?
23. How well can you learn algebra?
24. How well can you make and keep friends of the opposite sex?
25. How well can you stand up for yourself when you feel you are being treated unfairly?
26. How well can you organize your school work?
27. How well can you get adults to help you when you have social problems?
28. How well can you learn to use computers?
29. How much can you get your parent(s) to help you with a problem?
30. How well can you deal with situations where others are annoying you or hurting your feelings?
31. How well can you study when there are other interesting things to do?
32. How well can you learn a foreign language?
33. How well can you arrange a place to study without distractions?
34. How well can you live up to what you expect of yourself?
35. How well can you get a friend to help you when you have social problems?
36. How well can you learn science?
37. How well can you remember information presented in class and textbooks?
38. How well can you make and keep friends of the same sex?
39. How well can you learn English grammar?
40. How well can you motivate yourself to do school work?

APPENDIX E

ANSWER SHEETS

LASSI

CARD NUMBER

2

(1)

KEY

1	2	3	4	5
Not at all like me	Not very much like me	Fairly much like me	Much like me	Very much like me

1.	1	2	3	4	5	(2)	27.	1	2	3	4	5	(28)	53.	1	2	3	4	5	(54)
2.	1	2	3	4	5	(3)	28.	1	2	3	4	5	(29)	54.	1	2	3	4	5	(55)
3.	1	2	3	4	5	(4)	29.	1	2	3	4	5	(30)	55.	1	2	3	4	5	(56)
4.	1	2	3	4	5	(5)	30.	1	2	3	4	5	(31)	56.	1	2	3	4	5	(57)
5.	1	2	3	4	5	(6)	31.	1	2	3	4	5	(32)	57.	1	2	3	4	5	(58)
6.	1	2	3	4	5	(7)	32.	1	2	3	4	5	(33)	58.	1	2	3	4	5	(59)
7.	1	2	3	4	5	(8)	33.	1	2	3	4	5	(34)	59.	1	2	3	4	5	(60)
8.	1	2	3	4	5	(9)	34.	1	2	3	4	5	(35)	60.	1	2	3	4	5	(61)
9.	1	2	3	4	5	(10)	35.	1	2	3	4	5	(36)	61.	1	2	3	4	5	(62)
10.	1	2	3	4	5	(11)	36.	1	2	3	4	5	(37)	62.	1	2	3	4	5	(63)
11.	1	2	3	4	5	(12)	37.	1	2	3	4	5	(38)	63.	1	2	3	4	5	(64)
12.	1	2	3	4	5	(13)	38.	1	2	3	4	5	(39)	64.	1	2	3	4	5	(65)
13.	1	2	3	4	5	(14)	39.	1	2	3	4	5	(40)	65.	1	2	3	4	5	(66)
14.	1	2	3	4	5	(15)	40.	1	2	3	4	5	(41)	66.	1	2	3	4	5	(67)
15.	1	2	3	4	5	(16)	41.	1	2	3	4	5	(42)	67.	1	2	3	4	5	(68)
16.	1	2	3	4	5	(17)	42.	1	2	3	4	5	(43)	68.	1	2	3	4	5	(69)
17.	1	2	3	4	5	(18)	43.	1	2	3	4	5	(44)	69.	1	2	3	4	5	(70)
18.	1	2	3	4	5	(19)	44.	1	2	3	4	5	(45)	70.	1	2	3	4	5	(71)
19.	1	2	3	4	5	(20)	45.	1	2	3	4	5	(46)	71.	1	2	3	4	5	(72)
20.	1	2	3	4	5	(21)	46.	1	2	3	4	5	(47)	72.	1	2	3	4	5	(73)
21.	1	2	3	4	5	(22)	47.	1	2	3	4	5	(48)	73.	1	2	3	4	5	(74)
22.	1	2	3	4	5	(23)	48.	1	2	3	4	5	(49)	74.	1	2	3	4	5	(75)
23.	1	2	3	4	5	(24)	49.	1	2	3	4	5	(50)	75.	1	2	3	4	5	(76)
24.	1	2	3	4	5	(25)	50.	1	2	3	4	5	(51)	76.	1	2	3	4	5	(77)
25.	1	2	3	4	5	(26)	51.	1	2	3	4	5	(52)							
26.	1	2	3	4	5	(27)	52.	1	2	3	4	5	(53)							

Card number (1)

Part A: MOTIVATION

1	1	2	3	4	5	6	7	(2)	23
2	1	2	3	4	5	6	7	(3)	24
3	1	2	3	4	5	6	7	(4)	25
4	1	2	3	4	5	6	7	(5)	26
5	1	2	3	4	5	6	7	(6)	27
6	1	2	3	4	5	6	7	(7)	28
7	1	2	3	4	5	6	7	(8)	29
8	1	2	3	4	5	6	7	(9)	30
9	1	2	3	4	5	6	7	(10)	31
10	1	2	3	4	5	6	7	(11)	32
11	1	2	3	4	5	6	7	(12)	33
12	1	2	3	4	5	6	7	(13)	34
13	1	2	3	4	5	6	7	(14)	35
14	1	2	3	4	5	6	7	(15)	36
15	1	2	3	4	5	6	7	(16)	37
16	1	2	3	4	5	6	7	(17)	38
17	1	2	3	4	5	6	7	(18)	39
18	1	2	3	4	5	6	7	(19)	40
19	1	2	3	4	5	6	7	(20)	41
20	1	2	3	4	5	6	7	(21)	42
21	1	2	3	4	5	6	7	(22)	43
22	1	2	3	4	5	6	7	(23)	44

Part B: LEARNING STRATEGIES

1	1	2	3	4	5	6	7	(24)	23
	1	2	3	4	5	6	7	(25)	24
	1	2	3	4	5	6	7	(26)	25
	1	2	3	4	5	6	7	(27)	26
	1	2	3	4	5	6	7	(28)	27
	1	2	3	4	5	6	7	(29)	28
	1	2	3	4	5	6	7	(30)	29
	1	2	3	4	5	6	7	(31)	30
	1	2	3	4	5	6	7	(32)	31
	1	2	3	4	5	6	7	(33)	32
	1	2	3	4	5	6	7	(34)	33
	1	2	3	4	5	6	7	(35)	34
	1	2	3	4	5	6	7	(36)	35
	1	2	3	4	5	6	7	(37)	36
	1	2	3	4	5	6	7	(38)	37
	1	2	3	4	5	6	7	(39)	38
	1	2	3	4	5	6	7	(40)	39
	1	2	3	4	5	6	7	(41)	40
	1	2	3	4	5	6	7	(42)	41
	1	2	3	4	5	6	7	(43)	42
	1	2	3	4	5	6	7	(44)	43
	1	2	3	4	5	6	7	(45)	44

School (46)

CHILDREN'S MULTIDIMENSIONAL SELF-EFFICACY SCALES

1	2	3	4	5	6	7
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Not well at all

Not too well

Pretty well

Very Well

1	1	2	3	4	5	6	7	(2)	21	1	2	3	4	5	6	7	(22)
2	1	2	3	4	5	6	7	(3)	22	1	2	3	4	5	6	7	(23)
3	1	2	3	4	5	6	7	(4)	23	1	2	3	4	5	6	7	(24)
4	1	2	3	4	5	6	7	(5)	24	1	2	3	4	5	6	7	(25)
5	1	2	3	4	5	6	7	(6)	25	1	2	3	4	5	6	7	(26)
6	1	2	3	4	5	6	7	(7)	26	1	2	3	4	5	6	7	(27)
7	1	2	3	4	5	6	7	(8)	27	1	2	3	4	5	6	7	(28)
8	1	2	3	4	5	6	7	(9)	28	1	2	3	4	5	6	7	(29)
9	1	2	3	4	5	6	7	(10)	29	1	2	3	4	5	6	7	(30)
10	1	2	3	4	5	6	7	(11)	30	1	2	3	4	5	6	7	(31)
11	1	2	3	4	5	6	7	(12)	31	1	2	3	4	5	6	7	(32)
12	1	2	3	4	5	6	7	(13)	32	1	2	3	4	5	6	7	(33)
13	1	2	3	4	5	6	7	(14)	33	1	2	3	4	5	6	7	(34)
14	1	2	3	4	5	6	7	(15)	34	1	2	3	4	5	6	7	(35)
15	1	2	3	4	5	6	7	(16)	35	1	2	3	4	5	6	7	(36)
16	1	2	3	4	5	6	7	(17)	36	1	2	3	4	5	6	7	(37)
17	1	2	3	4	5	6	7	(18)	37	1	2	3	4	5	6	7	(38)
18	1	2	3	4	5	6	7	(19)	38	1	2	3	4	5	6	7	(39)
19	1	2	3	4	5	6	7	(20)	39	1	2	3	4	5	6	7	(40)
20	1	2	3	4	5	6	7	(21)	40	1	2	3	4	5	6	7	(41)