CHAPTER TWO

LITERATURE REVIEW ON COOPERATIVE LEARNING AND SCIENCE PROCESS SKILLS

2.1 INTRODUCTION

The aim of this chapter is to give a general review of the literature on cooperative learning and science process skills. Cooperative learning has many methods that, due to the limited scope of this study, cannot be dealt with all in this chapter. As such this study will focus on the Group Investigation and the Jigsaw methods of cooperative learning.

Similarly, there are numerous science process skills that cannot all be thoroughly investigated in this research. Consequently, only four process skills will be investigated, namely observation, controlling variables, graphing and experimenting.

2.2 BACKGROUND TO COOPERATIVE LEARNING

Constantopoulos (1994:251) and Northern Province Department of Education (2001:18) define cooperative learning as a concept based on group work in which the learners are responsible for others' learning as well as their own learning. A major feature of cooperative learning is that it involves learner-to-learner interaction in the process of fostering successful learning.

2.2.1 ***Cooperative learning methods***

Since its inception, many cooperative methods have been developed. These methods have been implemented and researched within the science classroom. Many methods of cooperative learning have been developed, including the

- Jigsaw method founded by Aronson, Stephan, Sikes Blaney in 1978;
- Group Investigation method founded by Sharan and Hertz-Lazarowitz in 1980;

- Learning Together method founded by Johnson in 1975;

- Student Teams Achievement Division (STAD) method founded by De Vries and Slavin in 1978; and

- Teams Games Tournaments (TGT) method founded by Slavin and Lazarowitz.

Initially the main goals of cooperative methods were to facilitate positive ethnic relation and increase academic achievement in heterogeneous classrooms.

2.2.2 Current Status of use in South Africa

There has been an increased reference to cooperative learning in both the literature and government documents since the implementation of Curriculum 2005 in South Africa. One of the major underlying philosophies of Curriculum 2005 is Outcomes-Based Education (OBE). Teaching in the new curriculum therefore places a great emphasis on the achievement of learning outcomes. Almost in all references to cooperative learning in official education documents, cooperative learning is believed to help in the acquisition of learning outcomes.

Since the implementation of Curriculum 2005 in 1998 (Northern Province Department of Education 2001:5), several schools were selected by the department of education for intense support in the testing of the implementation of the curriculum. These schools are often referred to as “pilot schools”. Teachers in pilot schools are given in-service training (INSET) which focus, among others, on the use of cooperative learning in the classroom. It is expected therefore that at a minimum, all pilot schools in South Africa should be capable of teaching using cooperative learning as one of the teaching strategies.

*2.2.3 **Importance of Cooperative Learning**.*

According to Roth and Roychoudhury (1993:143), cooperative learning is the convenient way to support the construction of individual knowledge of the members in a variety of ways. When learners are required to explain, elaborate, or defend their position, they construct a deep understanding because they have to evaluate, integrate, and elaborate upon their existing knowledge. Learning through cooperative problem solving gives rise to insights and solutions that would not come about without them.

This view is supported by Hertz-Lazarowitz, Baird and Lazarowitz (1994:70) and Wise (1996:338), when they indicate that cooperative learning creates a classroom learning environment which contributes to the positive perception pupils have towards social and cognitive aspects of the learning process, since learners are able to make more friends and practice more helping behaviour. They hold that cooperative learning creates a classroom environment in which learners listen to each other, develop love for peers, exchange ideas and be on task most of the time. Learners learn to cooperate and cooperate to learn. They also come to feel for their classmates. Communication abilities of listening and questioning as well as the learner's polite interaction are improved. Since cooperative learning requires learners to be both physically and mentally engaged, it makes them to construct knowledge.

2.2.4 Principles of cooperative learning

Principles of cooperative learning as outlined by the Northern Province Department of Education (2001:20) includes the classroom organization and the learner skills. Classroom organisation is the conditions that the educator must create like positive interdependence, face-to-face interactions, individual and group accountability. Learner skills refer to the participation skills for effective contribution to the cooperative learning environment. They include small group social interaction and group processing which involves careful listening, initiating, gatekeeping and evaluating.

Since learning occurs in the social context, knowledge is co-constructed with others. The following condition, which should be considered during cooperative learning are, summarized by the Northern Province Department of Education (2001:18).

- No member should dominate by doing all or most of the talking and work.
- Each member should contribute a fair share to the workload.
- The group should stick to the given task.

- The group should keep the task moving.

According to Mashile (2002: 73), the diverse methods found in cooperative learning imply that each method will have characteristics peculiar to the method. However, the following elements are essential for the successful implementation of cooperative learning.

1. Teachers must have a clear set of specific learning outcome objectives.

2. Students must, in turn, *accept such objectives* as their own.

3. *Positive interdependence*: a feeling of "sink or swim together" must be created, so that each pupil learns the assigned content and abilities and makes sure that all of his or her group mates also master the same content and abilities. There are several ways of achieving positive interdependence. You can establish mutual goals for the group; a division of labour for a mutual task; dividing materials, resources, or information so group members will have to cooperate to achieve their task; assign students different roles such as recorder, researcher, organiser, et cetera; or joint rewards for the group can be given.

4. *Face to face interaction* is required so that students discuss what they are studying; clarify and explain the content and procedures they are to learn; critique one another's ideas and performances and provide appropriate feedback, support, assistance and encouragement.

5. Each student is held *individually accountable* for doing his or her own share of the work and for knowing what the outcome of the learning activity is. Cooperative learning is not having one person do a report for two or three people. The aim is for all students to learn the material. In order to accomplish this, it is necessary to determine the level of mastery of students and then assign groups to maximise achievement.

6. *Public recognition and rewards for group academic success*. If group effort is not rewarded, students will not collaborate in the group. They will continue to work independently and thus lose the benefits of social learning.

7. Teachers should organise the three-, four-, or five-member small groups so that as much as possible *students are mixed heterogeneously* according to academic abilities, ethnic backgrounds, race, socioeconomic levels and gender.

8. In their groups, students need to engage in interaction abilities such as leadership, compromise, negotiation and clarifying to complete their tasks. To achieve this, they must use *behaviour and attitudes* like leadership; trust building, communication, conflict management, constructive criticism and encouragement. Note that these activities are not innate within students and thus need to be taught.

9. *Post group reflection (debriefing) about group processes*. Students must spend time discussing group maintenance, social and group processing behaviour and particular behaviour and attitudes that promoted or prevented the group's and individual member's success.

10. *Sufficient time for learning* is required; otherwise the benefits of cooperative learning will be limited.

The following sections will concentrate on the Jigsaw method of cooperative learning and the Group Investigation method of cooperative learning since they are the focus of this research.

2.3 THE JIGSAW METHOD OF COOPERATIVE LEARNING

According to Constantopoulos (1994:261) and Hertz-Lazarowitz et al. (1994:67), Elliot Aronson and his colleagues first developed the Jigsaw method of cooperative learning in 1978. In this method each learner becomes a specialist of a particular topic or activity that he teaches others in a group. The facilitator explains what will be done, structures the groups and facilitates the process.

The procedure and sequence followed during the Jigsaw method of cooperative learning is outlined by the Northern Province Department of Education (2001:19) as follows:

Task Division

Divide the section to be learned into component parts.

Home Groups

Divide learners into groups of 4 to 6 and give each person a number.

Expert Group

Participants with the same number from each of the groups meet in one group, the ‘expert’ group. Each expert group receives a separate section of the learning task and studies it within the group until they become ‘expert’ on the content and how to teach it.

Home groups

Experts go back to home groups and each member teaches the rest of the group the component he/she is an “expert” in. Some content will require to be dealt with in a specified order according to the facilitator’s instructions.

Assessment

The teacher continually assesses whether the learning outcomes are being achieved and if not, provides the necessary support.

Group Review

Group members review their effectiveness and discuss how to improve the process next time.

The above procedure supports the description by Constantopoulos (1994:261) that in the Jigsaw method, the classroom is organized in groups of four to six members (the jigsaw groups). The topics to be learned are divided into four to six sub-units so that every group member receives a part of the topic. The learning activity starts in the jigsaw group where the four to six members receive their sub-units and everyone informs the group members about the sub-unit he/she received. The learners who received the same sub-unit form the expect group. It is in this group that they study, learn, or perform an experiment.

They check each other for the mastery of the learning material, since they know that first they will teach their part to the members of the jigsaw group and everyone will be tested on the entire four to six sub-units (Hertz-Lazarowitz et al. 1994:71).

After the expert group learning, every learner moves back to his/her jigsaw group and tutors the rest of the group. After the presentation of each sub-unit, learners are encouraged to ask questions and receive answers. Learners check each other’s work and verify that everyone masters the four to six sub-units.

The importance of the Jigsaw method of cooperative learning as indicated by Constantopoulos (1994:261) is that it makes the science classroom a positive learning environment, thereby fostering participation, motivation and enthusiasm. Teaching other learners reinforces what each learner has learned. The other importance of cooperative learning as indicated by Hertz-Lazarowitz et al. (1994:71) includes that in the jigsaw learning, learners master not only cognitive outcomes but social and affective outcomes too. Learners listen to each other and learn to respect each other. They develop interdependence and mutual responsibility, since everyone contributes his/her part, but depend on the other four to five members regarding the mastery of the other four to five sub-unit.

2.4 THE GROUP INVESTIGATION METHOD OF COOPERATIVE LEARNING

The Group Investigation method as described by Hertz-Lazarowitz et al. (1994:71), views the classroom as a place where cooperation can take place to deal with problems in a democratic atmosphere. Educators and learners build the learning process, planning together according to their experiences, capacities, and needs. Learners are active in deciding the goal they want to reach. Members who choose the topic they would like to investigate, form the group. After presenting the plan to the educator they start reading, searching for information, interviewing specialist in the field, performing experiments, and making observations.

They prepare a report as a group, including some demonstrations where possible. After being sure that they learned and mastered the topic, they teach it to the rest of the class (Hertz-Lazarowitz et al. 1994: 71).

In the Group Investigation, learners cooperatively plan their inquiry, collect data, and prepare the report. The educator serves as a facilitator and resource person. He visits the groups, and encourages social interaction, mastery of communication skills, participation and reacts non-judgmentally.

This method of cooperative learning is summarized by the Northern Province Department of Education (2001:19) as a method where learners work together in groups which they choose to join, to produce a group product on a topic which they have selected, and which they teach to the whole class. Each member of a group makes a particular contribution. The following procedure that might be followed during the Group Investigation is suggested:

- Identify the topic to be investigated and establish the groups;
- Plan the group investigation;
- Carry out the investigation and prepare the report and presentation/demonstration;
- Present the report;
- Evaluate the process, product and learning.

The benefits of this method are included in the discussion of the importance of cooperative learning (section 2.2.3). As can be seen from this section and the previous one (section 2.3), there are lots of similarities between the Jigsaw and Group Investigation methods. In order to help teachers to apply cooperative learning methods in their instruction, Trowbridge and Bybee (1990) provide the following structure.

Objectives

1. *Objectives for the lesson should be clearly specified*. The teacher should make clear the two types of objectives: academic and collaborative skills. The former are those used in most lessons. The latter provides students with the specific skills used for cooperative learning during the lesson.

Decisions

2. *Deciding on group size.* Time, materials, equipment and facilities may influence this decision. A general recommendation for beginning science teachers is to use pairs or groups of three.

3. *Deciding on who is in the groups*. Generally, the recommendation is to have heterogeneous groups randomly assigned by the science teacher. Other alternatives include homogenous grouping and “select your own group”.

4. *Deciding on the room arrangement*. Again, this decision may be influenced by facilities and equipment. For optimum cooperative learning, group members should sit in a circle and be close enough for effective communication. Be sure you have easy access to each group.

5. *Deciding on the instructional materials to promote interdependence*. In early stages of developing cooperative learning groups attention should be paid to the ways materials are used to facilitate interdependence. Three ways are suggested: *materials interdependence*, e.g. one set of materials for the group; *information interdependence*, e.g. each group member has a resource needed by the group; and *interdependence with other groups*, e.g. inter-group competition.

6. *Deciding on roles to ensure interdependence*. You can assign roles such as summarizer, researcher, recorder, observer, etc. that will encourage cooperation among group members.

Explaining

7. *Explain the assignment*. Be sure students are clear about the academic task. Connections should be made to past experience, concepts and lessons. Define any relevant concepts and explain procedures and safety precautions. Check on students’ understanding of the assignment.

8. *Explain the collaborative goal*. It is of critical importance that students understand that they are responsible for doing the assignment and learning the material and that all group members learn the material and successfully complete the assignment.

9. *Explain individual accountability.* Each individual should understand that he/she is responsible for learning; and that you will assess learning at the individual level.

10. *Explain inter-group cooperation*. Sometimes you may want to extend the cooperative group idea to include the entire class. If so, the method and criteria of access should be clear.

11. *Explain the criteria for success*. In the cooperative learning model evaluation is based on successful completion of the assignment. So it is important to explain the criteria by which work will be evaluated.

12. *Explain the specific cooperative behaviours*. Students may not understand what is meant by cooperative work, so it is important to give specific examples of your expectations of their behaviours. For instance, “stay as a group”, “talk quietly”, “each person should explain how he/she got the answer”, “listen to other group members” and “criticise ideas, not people” are all suggested behaviours.

Monitoring and Intervening

13. *Monitor student work*. Once the students begin work your task is to observe the various groups and help solve any problems that emerge.

14. *Provide task assistance*. As needed, you may wish to clarify the assignment, introduce concepts, review material, model a skill, answer questions and redirect discussions.

15. *Teaching collaborative skills*. Because collaboration is new, it may be important to intervene in groups and help them learn the skills of collaboration.

16. *Provide closure for the lesson*. At the end of the lesson it may be important for you to intervene and bring closure. Summarize what has been presented, review concepts and skills and reinforce their work.

Evaluation

17. *Evaluate the quality and quantity of student learning*. Evaluate the previously decided upon product, e.g. report.

Processing

18. *Assess how ell the groups functioned*. If group collaboration is truly a goal, then some time should be spent on this. Point out how the groups could improve next time.

All the technical issues contained in the foregoing were taken into consideration when applying the Jigsaw and Group Investigation methods in the empirical investigation. The following section will concentrate on the discussion of the science process skills.

2.5 **THE SCIENCE PROCESS SKILLS**

Science process skills are defined by Screen in Arena (1996: 34), as the sequence of events that are engaged by researchers while taking part in scientific investigations. They may be classified into basic science process skills and integrated science process skills. Brotherton and Preece (1995:6) classified the basic science process skills as observation, classification, inferring, communication, recording, using numbers, predicting, using space/time relation, controlling variables, collecting data, measuring, and scientific thinking. They classified integrated science process skills as graphing, hypothesizing, interpreting data, formulating models, experimenting, and defining operationally.

2.6 BRIEF DESCRIPTION OF THE SCEINCE PROCESS SKILLS UNDER INVESTIGATION

This research investigates two basic science process skills (observation, controlling variables) and two integrated science process skills (graphing, experimenting). A description of these science process skills is given here to give an overview of what they are and the context in which they may be used.

2.6.1 ***Observation***

The skill of observation is seen by Miller and Driver (1987:42) as an activity in which all the people, young and old, engage in throughout their lives. It is said to be theory dependent in that what we see is dependent to some extent on the theories that we hold. They further aver that children's ability to observe involves the learning of a conceptual framework that identifies the elements of a complex situation that is scientifically worth observing.

Only when the framework has been grasped is the observation possible. They point out that what is done in science lessons where accurate observation plays a major role is not to develop observation but to train learners in scientific observation. That is, learners are helped to see the situation, find it useful and productive to see it.

2.6.2 ***Controlling Variables***

Brotherton and Preece (1995:6) classify controlling variables as a basic science process skill. Controlling variables is the ability to recognize dependent and independent variables. In practical investigations, the practical group is usually exposed to some treatment (the independent variable) while the control group is not exposed to the treatment.

According to Ross (1990:524), the skill of controlling variables needs to be learned. He found that controlling variables, like a complex intellectual skill, is improved by using the rule-governed approach to science instruction.

Before the variables can be controlled, they need to be identified. The ability to identify variables improves with time. The learner's ability to identify variables and to search for specific relationships between identified variables improves with the number of investigations in a specific context. The improvements may be attributed to meaningfulness, familiarity, and similarity (Ross 1990:524).

2.6.3 *Graphing*

Graphs are modes of representing quantitative data and are important means of communicating scientific data. Graphs present concepts in a concise manner, thereby displaying a wealth of information in a small space (Mckenzie and Padilla 1986:572). Complex, multi-parametric relationships can usually be presented more succinctly with graphs than with any combination of prose and tabular formats (Bracell & Rowe 1993: 63). Graphs allow us to explore data to see overall patterns and to see detailed behaviour. They allow us to view complex mathematical models fitted to data (Cleveland 1994: 5).

Brasell and Rowe (1993: 69) are of the opinion that learners need to have repeated experience with a variety of graphs used as an integral part of communicating information in many courses and contexts. In all walks of life masses of data are accumulated. Graphs are an efficient and effective tool for making sense of the pile of information. They are used in newspapers and magazines as well as technical reports and textbooks. According to Brasell and Rowe (1993: 69), graphs should not just be present in the curriculum, but should become cognitively available to learners. Room must be made in the curriculum to teach adequate graphing skills.

2.6.4 *Experimenting*

Miller and Driver (1987:49) describe experimenting as an integrated process skill that includes other process skills like observation, interpretation, planning, reporting, and selfreliance. Observation refers here to the ability to observe accurately and read instructions in correct sequence. Observations, numerical data, and diagrams are interpreted. Learners should be able to calculate and make predictions. Under planning, learners should be able to devise simple experimental procedure. The observed data should be reported using scientific language, either written or verbal. The other skill in experimenting is to know when to ask for assistance.

Miller and Driver (1987:49) indicate that integrated process skills are involved when learners conduct experiments. They formulate hypotheses; design experiments, and makes generalizations after collecting data. A central feature of experimentation is said to be the idea of control in order that possible alternative interpretations of a situation may be eliminated.

The process of experimentation depends on the learners' prior knowledge. Learners may appear to fail to undertake an experimental task correctly, not because they lack an appreciation of the notion of a fair test or the need to control variables, but because the task as presented does not reflect the way they are conceptualizing the concept (Miller and Driver 1987:49).

2.7 **LEARNING OF SCIENCE PROCESS SKILLS AT SCHOOL**

This section will concentrate on the general learning of the four science process skills under investigation. Detailed considerations including the theories of learning is beyond the scope of this study and will not be discussed below.

2.7.1 ***The learning of Basic Science Process Skills***

The basic science process skills under investigation are observation and controlling variable. Padilla and Pyle (1996:23) identified three steps that may be followed during the learning of basic science process skills, namely brainstorming observations about an object or phenomenon, creating inferences based on observations and testing the inferences through simple experiments. When teaching basic science process skills start with captivating phenomena and tell learners to use as many of their senses as possible.

When demonstrating, stand at a place where all the learners may be able to see everything that happens. If a learner tells an answer during an observation it must not be acknowledged as correct because the other learners' thinking will stop. Write some of the learners' observations on the board and allow the whole class (small groups) to select observations from inferences, and to separate variables. Allow each group to defend their reasoning. Padilla and Pyle (1996:24) found that for learners to observe more systematically, select activities for learners that will hold their interest and let them perform on their own.

Dixon, Adams and Hynes (2001: 163) identified the following steps that might be followed during the learning of the skill of controlling variables.

- Have the learners brainstorm to determine the factors that are involved in the investigation.
- Ask the learners how they might determine the set-up of the investigation that would result in the maximum solution of the problem. Lead the learners to the conclusion that they will need to compare only one factor at a time.
- Before beginning the data collection have learners work in groups to identify the factors that they will keep constant and those that they will vary during their investigations.

2.7.2 *The Learning of Integrated Science Process Skills*

Integrated process skills under investigation are graphing and experimenting. The same considerations in the learning of basic science process skills are needed for the learning of the integrated science process skills. After experimenting, learners may be requested to draw a graph or a graph may be given for learners to interpret. Interpretation of results is described by Roth and Roychoudhury (1993:146) as an integrated process skill that involves transforming results into standard form, graphing data, determining the accuracy of experimental data, defining and discussing limitations and assumptions, and explaining the relationship.

According to Kamii and Clark (1997: 116) integrated process skills may be developed and enhanced by using everyday activities. They hold that learners should be encouraged to struggle with a problem and to debate it among themselves.

2.8 ASSESSMENT OF SCIENCE PROCESS SKILLS

In the context of assessment, Swain (1989:252) defines a process skill as a series of connected actions, experiences, or changes, which go on internally within a learner and can usually be demonstrated externally. The following section will concentrate on how these series of connected actions, experiences, or changes are assessed in other countries and in South Africa.

2.8.1 *Assessment of Process Skills in other Countries*

Tamir, Doran and Chye (1992: 265) identified the assessment of the outcome of practical work as follows:

- Continuous assessment by the science teacher based on systematic observations and records;
- Evaluation of laboratory reports made by the learners on the basis of their laboratory experiences;
- Individual learner projects based on practical skills;
- Paper and pencil test items pertaining to laboratory experiences and related issues;
- Practical examination.

Tamir et al. (1992: 265) aver that in Israel, continuous assessment, evaluation of laboratory reports and individual learners' projects are used in the classrooms. Furthermore, practical examinations are designed specifically to measure objectives stressed in the laboratory.

Tamir et al. (1992:269) found that in the United States most laboratory practical skills are tested by paper and pencil. Practical tests, if used, concentrate on performance skills like observations and manipulating apparatus. In the United Kingdom practical work is always followed by practical examinations. The practical tests are restricted to the manipulation of apparatus, making observation, and performing investigations. Practical Laboratory tests are administered individually or in groups. Individually administered tests involve a learner who performs the required tasks and an examiner who observes and assigns marks. Group practical tests involve learners' written responses to questions which are based on observations, measurements, inferences, and reasoning by the learners during the performance.

The Second International Science Study as described by Tamir et al. (1992:291) used paper and pencil tests to measure science process skills. The achievement was then correlated with practical skill performance. The process items were categorized as to whether the science skill assessed was classified as performing, investigating or reasoning. This kind of assessment needs great care, commitment and the necessary skills from the administrator in the selection of assessment items. Care should be taken that the process skill items are balanced.

The Second International Science Study (SISS) used a station format to test practical skills. Each learner is given time to move to three stations where equipment and materials were assembled for a specific task. The learner upon completion of a specific task would move to the next station at times announced by the test administrator.

2.8.2 ***Assessment of Science Process Skills in South Africa***

The Northern Province Department of Education (2001:26) describe assessment as the process of gathering sufficient evidence of a learner's progress towards achieving the stated outcomes on an ongoing basis, and recording and reporting on the level of performance of learning. This is in line with the South African Department of Education (2002:6), which describes assessment in the new curriculum as a process of gathering valid and reliable information about the learner on an ongoing basis (CASS), against clearly defined criteria, using a variety of methods, tools, and techniques in different contexts.

In grades five to seven, science process skills are assessed by means of practical tasks and theoretical tasks in both the common tasks of assessment (CTA) and the continuous assessment (CASS) as indicated in the South African Department of Education (2002: 14). Each skill must be assessed by using specified criteria. The assessment criteria for the science process skills under investigation as indicated in the South African Department of Education (2002: 38) are listed below.

2.8.2.1 Observation

- Make some meaningful observations.
- Make meaningful relevant observations.
- Make meaningful reliable observations related to one variable.
- Make complex accurate observations related to more than one variable.

2.8.2.2 Controlling Variables

- Identify phenomena and the relationship between different phenomena.
- Formulate and refine questions to inform investigation action plans with reference to variables.
- Select appropriate pathways for an investigation, given its purpose and resources paying attention to ways of controlling variables.
- Plan procedures to investigate hypotheses and predictions involving two variables.

2.8.2.3 Graphing

- Correct title for the graph.

- Both axes correctly labeled.
- Scale for both axes appropriate.
- All coordinates plotted correctly.

2.8.2.4 Experimenting

- Select instruments and techniques in a group and / or individually to collect accurate and reliable data from more than one source.
- Present easy-to-follow steps, which are logical.
- Make meaningful, reliable observations related to one variable.
- Data table and / graph neatly completed and totally accurate.
- Logical sorting or classification of some data evident.

The teacher must construct an assessment rubric to measure the level of achievement of the skill. As an example, the following conversion from marks to level (table 2.1) is used for the achievement of a skill (Limpopo Provincial Department of Education, 2002).

Table 2.1: Conversion from marks to level

Level	Marks (%)	Description
1	0 – 34 %	Not achieved
2	35 – 39 %	Partially achieved
3	40 – 69 %	Achieved
4	70 – 100 %	Excellently achieved

This conversion which is used in 2003 replaces the one used in 2002 and contained in the "Guidelines for the Assessment of Learning in grade 9 in 2002", document dated 5 march 2002.

2.9 SUMMARY AND FINDINGS FROM THE LITERATURE REVIEW

In this chapter cooperative learning and science process skills were discussed. In particular the Group Investigation and the Jigsaw methods of cooperative learning were discussed. Two basic science process skills, which are observation and controlling variables, and two integrated science process skills, which are graphing and experimenting, were discussed.

The following findings from the literature about cooperative learning are provided:

- It facilitates positive ethnic relationships and increase academic achievement in heterogeneous classrooms; and

- It provides learners with learning environments in which they can practice and master social skills and feeling of responsibility.

The following findings from the literature about science process skills are provided. Science process skills:

- actively involve learners in learning and so reflect a more progressive pedagogy;

- help learners to integrate new information into their existing body of knowledge; and

- improve learners' interest, motivation, concentration, values and attitude towards the Natural Sciences.

From the aforementioned review, it is evident that both cooperative learning and science process skills are important in the learning of the Natural Sciences. However, the literature discusses the importance of cooperative learning in natural sciences and the importance of science process skills without explicitly giving the relationship between the two concepts.

It is the aim of this research to investigate the relationship between cooperative learning and science process skills.

Chapter three will focus on the research design and methodology of this research. An application of the Group Investigation method of cooperative learning will be done at school A, and an application of the Jigsaw method of cooperative learning will be done at school B.