THE IMPACT OF COOPERATIVE INSTRUCTIONAL STRATEGY ON THE PERFORMANCE OF GRADE 09 LEARNERS IN SCIENCE

BY

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DECLARATION

"I declare that The Impact of Cooperative instructional Strategy on the Performance of Grade 09 Learners in Science is my work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references"

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NWOSU C. M

28 November 2013.

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The completion of this dissertation has been a long walk to success.

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ABSTRACT

Several studies and reports have indicated that grade 09 learners are underperforming in science. The underperformance of learners in science is very concerning and has evoked research interests into teaching strategies that can be used to improve the performance of learners in science. This study investigated the impact of student teams achievement divisions (STAD) cooperative instructional strategy on the performance of grade 09 learners in science.

A mixed method approach specifically quasi-experimental design and interviews were used to collect data. The population for the study composed of grade 09 learners from Baltimore circuit in Limpopo. The sample consisted of sixty learners from two purposively selected secondary schools. The dependent samples t-test was used to analyze the data collected.

The results revealed that student teams achievement divisions (STAD) cooperative instructional strategy resulted in better performance of learners in science than traditional teaching method. In addition, learners expressed an increased interest, motivation and self-efficacy after exposure to cooperative learning.

KEY TERMS

Cooperative learning, Student teams achievement divisions (STAD), Performance, Motivation, learner and Achievement test.

DEDICATION

This dissertation is dedicated in memory of my late mother Mrs. Josephine Nwosu (1933 – 2008) who departed this world after a long battle with cancer. Mama may your gentle soul rest in peace.

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CHAPTER 1

INTRODUCTION AND RATIONALE

1.1 INTRODUCTION

South Africa is one of the countries that conduct national assessments to determine the level at which learners are performing in science (Limpopo Department of Education, LDoE 2011: 10). The performance of learners in science in the General Education and Training band (GET) is an issue of great concern for the Limpopo Department of Education (LDoE) and the country as a whole, this is in view of the fact that grade 09 learners are underperforming in natural sciences (LDoE, 2011: 10). The poor performance of learners in science has been confirmed by various studies which include, Trends in International Mathematics and Science Study (TIMSS, 2007), Southern African Consortium for Monitoring Educational Quality (SACMEQ, 2004) and (LDoE, 2011: 10, Masibi, 2004: 8). For instance the provincial study by Limpopo department of Education in 2011 to evaluate learners' performance in grade 09 natural sciences indicates that learners performed poorly with a mean score of 21.7%. The findings of the study also showed that the percentage of learners in grade 09 attaining acceptable levels (>50%) in natural sciences is 1.89% (LDoE, 2011: 10).

Similarly the national study conducted in 2009 by the national department of education to evaluate the performance of grade 09 learners in natural sciences indicated that learners underperformed with a mean score of 21.4% (LDoE, 2011: 10). Prominent factors identified by research as contributing to the persistent learners' underperformance in science include amongst others, ineffective teaching methods adopted by science teachers, lack of infrastructure and teaching materials, lack of professionally qualified teachers, inadequate mastery of subject content by some teachers and poor terms and conditions of service for teachers (Aluko, 2008: 32, Makgato & Mji, 2006: 253-266, Muraya & Kimamo, 2011: 728). I also have the view that learners have a perception of science as a difficult subject to pass. This negative perception causes some learners not to try hard enough in science tasks and in their studies because they have concluded that no matter how hard they try, they can never pass the subject. This I believe is also contributing to poor performance of learners in science.

The poor performance of learners in science if left unchecked could undermine the developmental outcomes of the National Curriculum Statement (NCS) (amended as Curriculum and Assessment Policy Statement, CAPS) which amongst others envisage that learners achieve and make meaningful contributions in the life of local, national and global communities (RNCS, 2002: 1). According to the Programme for International Student Assessment (PISA), the performance of a country's learners in science influences the role the country will play in tomorrow's advanced technological sector, and determines its general international competitiveness in science (PISA, 2003). This view is also shared by Aluko (2008: 32) who alleges that for a nation to develop in science and technology, the teaching and learning of science need to be improved (Aluko, 2008: 32).

In practical terms, without good performance in science, the chances of learners gaining admissions in higher institutions to pursue science related courses are slim. As a result, their employment prospects suffer, which in turn undermines their standard of living and the prospects of contributing to the economic development of the country (Mwamwenda, 2004: 388). I concur with Mwamwenda's view and would argue that the poor performance of grade 09 in natural sciences would mean that few learners would study pure science in the Further Education and Training (FET) phase, and this could translate into fewer learners gaining admissions into higher institutions to study science related courses. This would not be good for the South African economy as the country will be producing fewer science professionals with scarce skills.

Research has shown that the performance and motivation of learners to learn significantly depends on the teaching strategies adopted by teachers (Makgato & Mji, 2006: 253-256). According to Mwamwenda (2004: 235), the extent to which learners learn depends on their level of motivation which can be stimulated by the nature of the learning environment and the teaching strategy adopted by the teacher. He further argues that the teacher's role is to influence the motivation of learners to learn by using teaching strategies that can impact learners' attitudes towards learning, build on their self-concepts and raise their educational aspirations (Mwamwenda, 2004: 235). Van Wyk (2007: 110) concurs with this view and alleges that the teacher's role is to create opportunities that can stimulate the motivation of learners to learn (Van Wyk, 2007: 110). I share the views of both Mwamwenda and Van Wyk because the way learners perceive and participate in lessons depends on how they are presented or the teaching strategy used by the teacher. The use of inappropriate teaching strategy or continuous dependence on the same teaching method could bore learners and make them lose interest in the lesson. Teachers should see to it that they use innovative teaching strategies that maximize the motivation of learners to learn.

The importance of motivating learners to study science can never be overemphasized. According to William & Gerald (2003: 2)), if learners are motivated to learn science, they can be expected to take initiatives for their learning, spend more efforts in science tasks, be persistent when experiencing difficulties, employ effective learning strategies, pursue understanding and meaningful learning, and eventually reach a high level of performance and achievement. Thorndike (in Mwamwenda, 2004: 184) also emphasized the need to motivate learners to learn and states that how hard learners work on a given task is determined by their level of interest or motivation. The greater their motivation, the harder they will work and the lower their motivation, the less hard they will work. The bid to improve learners' performance and motivation to learn science has given rise to important research question: Could cooperative instructional strategy be used to improve the grade 09's performance and motivation to learn science?

The rationale for this research emanates firstly from the fact that grade 09 learners in Limpopo schools are underperforming in natural sciences (LDoE, 2011: 10), and there is urgent need to solve this problem. Secondly, Science is needed for the economic and technological development of South Africa, and this requires that the performance of learners in science be improved. One way to achieve this is to investigate teaching strategies that can be used to enhance the teaching and learning of science. This is in line with the views of Van Wyk (2007: 151) who states that the promotion of an effective teaching and learning situation necessitates a new teaching method or strategy. This research therefore investigated the impact of cooperative instructional strategy on the grade 09's performance in science. The findings of this research would help science teachers especially those that teach in grade 09 to make informed decisions on appropriate teaching strategies that can be used to stimulate the motivation of learners to learn.

Many benefits of cooperative instructional strategy have been reported by several research studies. According to Omrod (2004: 417), when proper activities are designed, cooperative instructional strategy has the potential to ensure that learners have a higher self-efficacy about their chances of being successful, express more intrinsic motivation to learn school subject matter, participate more actively in classroom activities and exhibit more self-regulated learning. I am of the view that the use of cooperative instructional strategy be strengthened in the teaching and learning of natural sciences in grade 09 considering the many benefits it offers as stated by Omrod.

While cooperative instructional strategy has been widely acknowledged as a constructive and viable teaching strategy, there are however, certain disadvantages associated with this strategy (Van Wyk, 2007: 218). One of its major disadvantages is that grouping learners together will almost form a group in which there are gifted learners or learners who learn and work faster. The learners who need more time to understand the work may feel frustrated at being left behind. Alternatively gifted learners who learn faster may feel delayed or held back by having to wait for the ones that learn more slowly (Woolfolk, 2010: 332). I also think that parents whose children are brilliant might object to cooperative instructional strategy. They might think that cooperative instructional strategy would be unfair to their children who have to learn and share ideas with other learners whom they might consider not to be as brilliant as their children.

Several studies have investigated the impact of cooperative instructional strategy on learners' performance. Some of these studies include that done by Muraya & Kimamo (2011: 726-745) that investigated the effects of cooperative learning approach on biology mean achievement scores of secondary school learners. They found that cooperative learning approach resulted in significantly higher mean achievement scores compared to regular teaching method. Khumalo (2001: 53-56) researched on the effect of cooperative learning on the performance of learners in English as a second language. Findings of the study revealed that learners in the cooperative learning group showed improvement in academic performance in English. Similarly Effandi and Zanaton (2007: 35-39) reported that an experimental group of learners taught mathematics through cooperative learning strategy performed better in a mathematics achievement test than the control group that was instructed through the traditional teaching method. Aronson (2002: 216) also reported that elementary learners taught through jigsaw cooperative learning approach learnt the material faster and performed better on examination than a control group that were taught the same material through regular teaching methods.

I have to point out here that none of these research efforts focused on grade 09 learners and natural sciences in particular. This research therefore bridged this gap as it investigated the impact of cooperative instructional strategy on the grade 09's performance in science.

Among the studies that explored learners motivation to learn as a result of cooperative instructional strategy was that done by Nichols and Miller (1994: 167-178) on high school learners studying algebra. They found that cooperative instructional strategy enhanced achievement and motivation than traditional teaching strategy. Ho and Boo (2007: 1) also found a strong correlation between motivation to learn and learners' achievement as a result of cooperative instructional strategy. Similarly Liao (2005: 179-196) found that cooperative instructional strategy impacted positively on the motivation and grammar achievement of English second language learners.

It is of noteworthy that in this study, the researcher improved on the design of the earlier study by Muraya and Kimamo (2011: 726-745). In their 2011 study on the effect of cooperative instructional strategy on the mean achievement biology score of secondary school learners, Muraya and Kimamo had used two experimental cooperative learning groups and two control groups (4 non-equivalent control group designs). One of the experimental groups was pretested while the other group was not pretested. Similarly one of the control groups was pretested while the other group was not. The problem with this design is that not pre-testing all the groups in the study could affect the outcome of the study as one would argue that those that did well in the posttest did so because they were pretested and not as a result of the treatment. One might also argue that those that did not do well in the posttest did so because they were not pretested. To avoid any plausible rival hypotheses as a result of not pre-testing all the groups, the researcher of the current study used non randomized control group pretest-posttest design and ensured that all the groups used in the study were pretested at the commencement of the study.

1.2 STATEMENT OF THE PROBLEM

Natural science is an important subject in grade 09 that deals with the promotion of scientific literacy (RNCS, 2004: 4). Good performance of grade 09 learners in natural science is very important as it lays the foundation for further studies in science in grades 10-12 and prepares learners for future economic activities. Unfortunately there has been a consistent poor performance of grade 09 learners in natural science in Limpopo schools and the country in general (LDoE, 2011: 10). The 2011 study conducted by the Limpopo department of education to evaluate the performance of grade 09 learners in natural sciences indicated that learners performed poorly with a mean score of 21.7% (LDoE, 2011: 10). The disturbing aspect of these findings is that the percentage of grade 09 learners who attained acceptable levels (>50%) in natural sciences is 1.89% (LDoE, 2011: 10).

It is necessary that the performance of learners in science be improved in view of the fact that science plays an important role in the development of a country. According to the Programme for International Student Assessment (PISA), the performance of a country's learners in science is used as a yard stick to determine the role the country will play in tomorrow's advanced technological sector (PISA, 2003). The poor performance of grade 09 learners in science has necessitated that a research be conducted to explore teaching strategies that can enhance the performance and motivation of learners. This view is also shared by van Wyk (2007: 151) who states that the promotion of an effective teaching and learning situation necessitates a new teaching method or strategy (Van Wyk, 2007: 151). The question that arises now is: Could cooperative instructional strategy be used to improve the grade 09's performance and motivation to learn science?

1.3 PURPOSE OF THE STUDY

The purpose of this study was to investigate the impact of cooperative instructional strategy on the grade 09 learners' performance in science. This research emanates from the fact that grade 09 learners are performing poorly in natural sciences and there is need to explore effective teaching strategies that can be used to improve performance in science. The significance of this research lies in the fact that it investigated teaching strategies that can be used by science teachers to enhance the teaching and learning of science in grade 09 classrooms. The findings of this research would help science teachers especially those who teach in grade 09 to make informed decisions on appropriate and effective teaching strategies that can be used to improve the performance and motivation of learners.

1.4 AIM OF THE STUDY

The primary aim of this study was to investigate the impact of cooperative instructional strategy on the grade 09 learners' performance in science. As a secondary objective, the study was aimed at exploring teaching strategies that could be used to increase the motivation of learners to learn science and ultimately to add to the existing body of knowledge on cooperative learning.

1.5 RESEARCH QUESTIONS

This study attempted to answer the following research questions:

- What is the impact of cooperative instructional strategy on the grade 09 learners' performance in science?
- How would performance in science differ between learners taught using cooperative instructional strategy and learners taught using traditional teaching strategy?
- How would levels of interest and motivation in science differ between learners taught using cooperative instructional strategy and learners taught using traditional teaching strategy?

1.6 DEFINITION OF TERMS

For the purpose of this study, the following terms have been defined:

Cooperative Instructional strategy

It refers to a teaching strategy in which learners engage in communal learning in group context to ensure that group members engage in joint learning and achieve group outcomes at the end of the cooperative learning lesson (Gawe, 2004: 2). In cooperative instructional strategy, heterogeneous grouping, positive interdependence, and individual accountability are emphasized. The specific method of cooperative learning used in this study was student teams achievement divisions (STAD).

Student Teams Achievement Division (STAD)

STAD is a cooperative learning method that emphasizes equal opportunities for success by focusing on students' improvement. The method consists of five main steps: teacher presentation, teamwork, individual quizzes, individual improvement scores, and group recognition (Slavin, 1995).

Performance

Holistic or integrated demonstrations of mental, affective and manual activities. Performances also express particular values. Demonstrations of performance for assessment also require completion of specific tasks that are observable and measurable (Mothata, 2000: 126)

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Motivation

Motivation may be defined as the force that energizes, directs and sustains behavior toward a goal (Baron, 1999, Pintrich & Schunk, 1996). In the educational context, Brophy (1988: 205-206) described motivation to learn as a student’s tendency to find academic activities meaningful and worthwhile when deriving the intended benefits of those activities.

Learner

Any person, ranging from early childhood development to the adult education phases, who is involved in any kind of formal or non-formal education and training activity, the term learner also refer to persons studying in ordinary public schools (Mothata, 2000: 94).

Achievement Test

An achievement test aims to assess what knowledge and skills students have learned from a particular course or set of materials. An achievement test is usually directly anchored in course objective (McMillan & Schumacher, 2010: 191-192). It contrasts with a proficiency test, which aims to assess learners’ general ability (Brown, 1996).

1.7 ORGANIZATION OF THE STUDY

Chapter 1 contains the introduction and rationale for the study, statement of the problem, research questions, purpose of the study, aims and significance of the study and also the definition of terms used in the study.

Chapter 2 presents a review of relevant literature from books, journals, newspaper articles, reports, and internet searches on the topic of the study. This chapter is divided into six sections.

Section 1: provides discussions on different theories that underpin cooperative instructional strategy.

Section 2: provides brief historical development of cooperative instructional strategy.

Section 3: provides details of the features and various models of cooperative instructional strategy.

Section 4: presents claimed benefits and shortcomings of cooperative instructional strategy.

Section 5: outlines studies on the performance of grade 09 learners in science.

Section 6: presents research findings that supported the effectiveness of cooperative instructional strategy and research findings that do not support the effectiveness of cooperative instructional strategy in enhancing academic achievement.

Chapter 3 contains the methodology and procedures used to collect data for the study. The study was designed as an experiment in which teaching strategy is the independent variable and the performance of learners in science the dependent variable. The design for the study was a quasi-experimental non randomized control group.

Chapter 4 contains the results and analysis of the data obtained in the study. The data obtained are presented in the form of tables and graphs. Statistical methods were used to analyze the results.

Chapter 5 presents the summary, implications and recommendations for future research. The findings of the research including limitations of the study are outlined in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter primarily focuses on literature pertaining to cooperative instructional strategy. The literature review is subdivided into six sections. The first section begins with the discussions of the various learning theories that underpinned cooperative instructional strategy. The section concludes with the summary of the various learning theories that underpinned cooperative instructional strategy. The second section provides a brief historical development of cooperative instructional strategy.

The third section focuses on the essential features of cooperative instructional strategy. Similarly the fourth section presents discussions of the various models of cooperative instructional strategy.

The fifth section presents claimed benefits as well as shortcomings of cooperative instructional strategy. This is followed by the sixth section which outlines the studies on the performance of grade 09 learners in science.

The sixth section presents available research findings that supports the effectiveness of cooperative instructional strategy as well as findings that do not support the effectiveness of cooperative instructional strategy in enhancing academic achievement. The section concludes with the summary of the literature study on cooperative instructional strategy.

2.2 THEORETICAL UNDERPINNINGS OF COOPERATIVE INSTRUCTIONAL STRATEGY

The success of cooperative instructional strategy is largely based on its having a clear theoretical foundation (Johnson & Johnson, 2009: 366). According to Slavin's (1995) model of cooperative learning, cooperative instructional strategy is supported by two major categories of learning: motivational and social cognitive theories. Therefore, this section presents discussions of the relevant theories pertaining to cooperative instructional strategy. The theories discussed in this section are: information processing theory, social interdependence theory, and social cognitive theories which include: Vygotsky and Piaget's theories respectively.

2.2.1 THE INFORMATION PROCESSING THEORY

The information processing theory is a group of theoretical frameworks that address how human beings receive, think about, mentally modify, and remember information and on how such cognitive process change over the course of development (McDevitt & Omrod, 2004: 186). The three areas of the memory that hold information are called the sensory register, the working memory and the long term memory. Information from the environment is first received at the sensory register; it is then processed by the working memory, and after some other complex processes it may be transferred to the long term memory (McDevitt & Omrod, 2004: 186).

There are many factors that cause information to move through these memory banks. These factors include: attention, rehearsal, organization and elaboration. Information processing theorists, claim that group discussion in cooperative learning helps learners to rehearse, elaborate and expand their knowledge. Furthermore as learners discuss, rehearse, organize, listen and elaborate on the learning tasks, they trigger the process that supports information processing and memory (Woolfolk, 2010: 324). Group discussion in cooperative learning also promotes learning as it helps learners perceive, understand, use and remember the information they are given during group work (McDevitt & Omrod, 2004: 186).

2.2.2 THE SOCIAL INTERDEPENDENCE THEORY

The social interdependence theory is based on the claim by social scientists that peer interaction and relationships play an essential role in socialization and learning (Johnson & Johnson, 2009: 367-374). It provides the frame work for understanding the role of positive interdependence among group members in promoting learning. According to Susan (2005: 445), the social interdependence perspective began in the early 1900s, when one of the founders of the Gestalt school of psychology, Kurt Kafka, proposed that groups were dynamic wholes in which the interdependence among members could vary.

Kurt Lewin (in Susan, 2005: 445) refined Kafka's notions in the 1920s and 1930s, stating that: (a) the essence of a group is interdependence among members (created by common goals), which results in the groups' being a "dynamic whole" so that a change in the state of any member or subgroup changes the state of any other member or subgroup; and (b) An intrinsic state of tension within group members motivates movement toward the accomplishment of the desired common goals (Susan, 2005: 445).

Morton Deutsch (quoted in Johnson and Johnson, 2009: 366), extended Lewin's notions by examining how the tension systems of different people may be interrelated. He conceptualized two types of social interdependence, positive and negative interdependence.

Building on the work of Deutsch, David Johnson and Roger Johnson developed the social interdependence theory (Susan, 2005: 445). The social interdependence theory assumes that the way social interdependence is structured determines how individuals interact, and this in turn determines outcomes (Susan, 2005: 445). The social interdependence theory supports the use of cooperative learning as it emphasizes positive interdependence or cooperation which encourages and motivates group members to facilitate each other's efforts to learn. This in turn helps the group to achieve their learning goal.

In cooperative learning, positive interdependence can be created by having group members take on complementary roles such as checker, recorder, elaborator, time keeper, reporter and group leader (Woolfolk, 2010: 327-328). However, this would depend on the group's goal. Assigning roles to group members would encourage them to work cooperatively, participate fully in the learning tasks, and ultimately lead to effective learning. In line with this view point, Slavin (2009a: 10-11) posits that when group members are assigned roles in cooperative learning, it creates in them the feeling of positive interdependence and challenges them to encourage and help one another achieve the group's goal. Other strategies that can be used to create positive social interdependence in cooperative learning include "task specialization" methods (Slavin, 2009a: 10). For instance in jigsaw method of cooperative learning, learners study a topic which is divided into subtopics and distributed among group members. Learners assigned the same subtopic meet in "expert groups" to share information on their topics after which they return to their teams, and then take turns teaching their topic to their team (Slavin, 2009a: 10).

2.2.3 SOCIAL COGNITIVE THEORIES

Based on Slavin's model (1995), cooperative instructional strategy facilitates learning not only by motivating learners with shared goals but also by situating learners in a social context which provides a stage for cognitive development through elaborated explanations, peer tutoring, peer modeling, cognitive elaboration, peer practice, peer assessment and correction (Liao, 2005: 26). This section therefore explores social cognitive theories that support the use of cooperative instructional strategy.

2.2.3.1 VYGOTSKY'S THEORY

Vygotsky's socio-cognitive theory perceives learning as a social process that takes place in a context that allows for social interactions and communication which eventually leads to the construction of knowledge and cognitive development (Mcleod, 2007: 4-6). According to this theory, learning first occurs through human interaction, after that, with help of tools (including language) and human mediation, it is eventually internalized (Fushino, 2008: 20). The internalization of knowledge, according to Vygotsky (1978: 57) is a progression that begins with an interpersonal process before it proceeds into an intrapersonal one. In other words, a learner's higher mental processes are first co-constructed during shared activities with other learners before they become internalized as part of the learner's cognitive development (Gredler, 2007: 233-238).

The fundamental concept in Vygotsky's theory is the zone of proximal development (ZPD). According to Vygotsky (1978: 68), the zone of proximal development is the area between the learner's current development level as determined by independent problem solving and the level of development that the learner could achieve through adult guidance or in collaboration with more capable peers.

According to this theory, learning is a path through the zone of proximal development, with the 'zone' referring to the space between that which a learner cannot do alone and that which he/she can do with the help, guidance and encouragement from capable individuals (Mcleod, 2007-4-6). Thus Vygotsky (1978: 68) believed that through help from more knowledgeable individuals, the learner can potentially gain knowledge already held by them. However, the knowledge must be appropriate for the learner's level of comprehension. According to Vygotsky (1978: 68), anything that is too complicated for the learner to comprehend that is not in their zone of proximal development cannot be learnt at all until there is a shift in the zone of proximal development. When the learner does attain his/her potential, this shift occurs and the learner can continue to learn more complex higher level material. From this, Liao

(2005: 16) argues that Vygotsky's theory supports the use of cooperative learning citing that when learners work closely within one another's level of proximal development, they can receive explanations that are presented to them in a simpler and more comprehensible fashion than if they were provided by one of a very different mental age. Further reinforcing the relevance of Vygotsky's theory in cooperative learning is Fushino (2008: 20) who contends that cooperative learning can improve learning as it offers learners the possibility of interaction and mediation during which more competent learners scaffold or provide learning support for their less competent peers.

2.2.3.2 PIAGET'S THEORY

Piaget's socio-cognitive theory proposes that when learners perceive a contradiction between their existing understanding and their experience interacting with others, cognitive conflict arises. In order to resolve this conflict, learners may examine their own ideas and beliefs again, pose questions to one another, and seek further information in order to reconcile the contradictory ideas (Fushino, 2008: 20). Piaget (1964: 19) argued that all cognitive developments consist of momentary conflicts and incompatibilities which must be overcome to reach a higher level of equilibration. Piaget's theory provides support for the use of cooperative learning considering that in cooperative learning, learners with different ability and viewpoints work together, this provides maximum opportunity for them to experience and resolve cognitive conflicts (Fushino, 2008: 20).

Advocates for Piaget's theory contend that cooperative learning improves learning as interactions in groups during cooperative learning creates cognitive conflict and disequilibrium that make learners to question their understandings and try out new ideas (Woolfolk, 2010: 324). Furthermore, in cooperative learning, learners engage in discussions in which cognitive conflicts occur and are resolved, and inadequate reasoning is exposed and modified leading to cognitive development (Susan, 2005:

445). The key concepts involved in Piaget’s theory include: schemas, assimilation, accommodation and equilibration. A schema describes both the mental and physical actions involved in a learner’s understanding and acquisition of knowledge (Kendra, 2012: 1). In Piaget’s view, a schema includes both a category of knowledge and process of obtaining that knowledge. As experiences happen, this new information is used to modify, add to or change previously existing schemas. According to Kendra (2012: 1), a child may have a schema about a type of animal, such as a dog. If the child’s sole experience has been with small dogs, the child might conclude that all dogs are small. However, if that child encounters a very big dog, he/she will take in this new information, and modify the previously existing schema to include this new information that some dogs are big. On the other hand, the process of integrating or taking in new information into the learner’s existing schema or internal structures is known as assimilation (Eames & Cates, 2008: 43).

Accommodation involves altering existing schemas or ideas as a result of new information or new experiences (Kendra, 2012: 1). In cooperative learning, as learners come across new information or experience in their learning teams, they may develop new schemas or alter their previously existing schemas (Eames & Cates, 2008: 43). Piaget believed that learners try to strike a balance between assimilation and accommodation; this according to Piaget is achieved through a mechanism called equilibration (Kendra, 2012: 1).

Equilibration according to Piaget is a process of achieving a balance between assimilation and accommodation which leads to cognitive development (Woolfolk, 2010: 33). In cooperative learning situations, the process of assimilation, accommodation and equilibration occur naturally as learners encounter new knowledge, skills and experiences in the context of team learning (Eames & Cates, 2008: 43).

2.3 SUMMARY ON THEORETICAL UNDERPINNINGS OF COOPERATIVE INSTRUCTIONAL STRATEGY

Reviewed literature showed that cooperative instructional strategy is supported by information processing theory and social interdependence theory. It is also supported by social cognitive theory proposed by Vygotsky and Piaget respectively.

Information processing theorists claim that group discussion helps learners to rehearse, elaborate, and expand their knowledge. As group members discuss questions and explain things to one another, they trigger the process that supports information processing (Woolfolk, 2010: 324).

The social interdependence perspective of cooperative instructional strategy proposes that the way social interdependence is structured determines the way learners interact, which in turn determines outcomes. Positive interdependence results in promotive interaction as learners encourage and facilitate the achievement of group goal (Susan, 2005: 445).

Proponents of Vygotsky's theory suggest that social interaction is important for learning because mental functions or cognitive development originate in social interactions and are then internalized by learners (Fushino, 2008: 20). Piagetian theory advocates contend that cooperative instructional strategy improves learning as interactions in groups creates cognitive conflict and disequilibrium that lead an individual to question his or her understanding and try out new ideas (Woolfolk, 2010: 324). The next section that follows provides brief historical development of cooperative instructional strategy.

2.4 BRIEF HISTORICAL DEVELOPMENT OF COOPERATIVE INSTRUCTIONAL STRATEGY

According to Van Wyk (2007: 154), Cooperative instructional strategy rests on the philosophy of John Dewey and his belief that democracy in school must be promoted in order to develop good citizenship amongst children. Dewey believed it was important that learners develop knowledge and social skills that could be used outside of the classroom, and in the democratic society (Allan and Francis 2009: 100). The contemporary cooperative learning movement dates back to the early 1900s and rooted from the school of gestalt psychology (Susan, 2005: 445). Kurt Koffka, a gestalt psychologist alleged that groups are dynamic units in which the interdependency of members can vary (Susan, 2005: 445).

Building on the ideas of Kurt Koffka, Lewin in the 1920s and 1930s, proposed that the essence of a group is the interdependence among members that results in the group being a dynamic whole (Johnson & Johnson, 2009: 366). Morton Deutsch (one of Kurt Lewin's top learners) extended Lewin's notions and in the 1940's, formulated his theory of cooperation and competition (Susan, 2005: 445).

Research studies in the 1950s on cooperative instructional strategy focused mainly on the effects of goal structures on group coherence (Van Wyk, 2007: 154). In the 1960s, research interests on cooperative instructional strategy heightened especially in the United States when public schools were forced to integrate causing educators to seek ways to construct social integration amongst learners from diverse racial backgrounds, and to help improve the minority learners' academic performance (Liao, 2005: 48). Similarly in the 1970s, research efforts in cooperative instructional strategy focused largely on the establishment of interpersonal relationships amongst diverse ethnic groups (Van Wyk, 2007: 154).

Still in the same 1970s, several cooperative learning models were developed. According to Liao (2005: 48), Elliot Aronson and his associates (University of Texas at Austin) developed the Jigsaw method, David Johnson and Roger Johnson (Cooperative Learning Centre at the University of Minnesota) developed learning together (LT), while David De Vries, Keith Edwards and Robert Slavin (Centre for Social Organization of school at the Johns Hopkins university) developed teams-games-tournament (TGT) and student teams achievement divisions (STAD). Still in the same period, another group of researchers in Israel, Shlomo Sharan, Yael Sharan, and Rachel Hertz-Lazarowitz (Tel-Aviv University), refined John Dewey's cooperative model and developed group investigation (GI).

2.5 FEATURES OF COOPERATIVE INSTRUCTIONAL STRATEGY

Lin (2006: 34-39) defines cooperative instructional strategy as a method in which learners work in small groups to accomplish a common learning goal under the guidance of a teacher. The three primary purposes of using cooperative instructional strategy are to develop learners' social and communication skills, increase tolerance and acceptance of diversity, and improve academic achievement (Lin 2006: 34-39). In contrast, traditional teaching method is teacher centred with teachers as the source of the knowledge while learners are passive receivers that must memorize things (Mahira & Azamat, 2013: 1). Traditional teaching approach emphasizes learning by listening which is a disadvantage for learners who prefer other learning styles (Guido & Amelie, 2010: 1).

According to Slavin (2011: 344) Cooperative instructional strategy comprises of instructional methods in which teachers organize learners into small groups, which then work together to help one another learn academic content. In contrast to the traditional learning setting where the majority of interactions are teacher-centred (Van dat & Ramon, 2012: 9), cooperative instructional strategy is learner- centred and focuses on coordinating, stimulating, and encouraging interactions among learners, with learners expected to learn from their own activities and interactions with their peers (Shimazoe & Aldrich, 2010: 52-57). Cooperative instructional strategy is therefore perceived as an alternative teaching method to traditional pedagogy which some researchers claim creates a competitive learning environment (Killen, 2007, Haman & Nguyen, 2010: 65-68).

Johnson and Johnson (2009: 366) list five essential elements for effective cooperative instructional strategy: positive interdependence, individual accountability, face to face interaction, interpersonal and small group social skills, and group processing. Although not included by Johnson and Johnson (2009: 366) as essential elements of cooperative learning, however, most researchers consider teacher supervision and heterogeneous grouping as essential for effective cooperative learning. The discussion that follows in the next section will focus on the features of cooperative instructional strategy.

2.5.1 HETEROGENEOUS GROUPING

The first step of cooperative learning is the formation of groups. In the context of cooperative learning, heterogeneous grouping means that groups in which learners work to carry out learning tasks are mixed on the basis of gender, ethnicity, social class, academic ability, language proficiency and diligence (George & Dan, 2004: 97-117).

When placing or grouping learners for cooperative learning, Dennis (2004: 12), notes that it is necessary to integrate learners who have the ability to communicate effectively and solve problems with those who cannot. By so doing, learners who are less competent in communication and general problem solving can be developed. The rationale for heterogeneous grouping according to Kagan (in Sunarti et al, 2006: 2) is that it provides the greatest opportunities for peer tutoring and support as well as improving cross-race and cross-sex relations and integration.

Heterogeneous grouping may also benefit high ability learners as it provides them with the opportunity to explain the learning task to other members of the group. In the views of Woolfolk (2010: 326), the more a learner provides elaborated and thoughtful explanation to other learners in a group, the more the learner learns.

According to Liao (2005: 36), there can be two types of heterogeneous group formation namely; teacher assigned grouping and interest grouping. In teacher assigned grouping, the teacher forms small heterogeneous groups based on factors such as achievement level, gender, ethnicity and socio-economic background. The teacher assigned grouping is often adopted by tutoring-oriented cooperative learning methods including: student teams achievement divisions (STAD), teams -games tournament (TGT), teams assisted individualization (TAI), and cooperative integrated reading and composition (CIRC). The second type is interest grouping which is often adopted by project- oriented cooperative instructional strategy including: group investigation (GI).

2.5.2 TEACHER SUPERVISION

Without careful planning and supervision by the teacher, group interactions can hinder learning and reduce rather than improve social relations in class (Woolfolk, 2010: 324). Researchers consider carefully designed meaningful tasks ideal in cooperative learning because it ensures that group members actively participate in the learning process and contribute to the group goal.

As the group works on the tasks, the teacher moves around in the classroom so as to observe the activities. Through observation, the teacher can obtain a window into learners' minds and establish the degree of their understanding of the learning task (Johnson et al. in Dennis, 2004: 27). Furthermore, when learners engage in cooperative learning activity, hidden thinking processes become overt and a careful observer will make inroads into the learners' understanding of the assigned tasks (Johnson et al. in Dennis, 2004: 27). Monitoring the learning process according to Johnson et al. (in Dennis, 2004: 27), provides the opportunity for the teacher to clarify instructions, review important procedures and strategies, answer questions and teach skills related to the task learners are working on.

Adams and Hamm (in Van Wyk, 2007: 199) outline the role of the teacher in cooperative learning situations. These are summarized below:

- Setting clear outcomes for the cooperative lessons.
- Assigning learners to groups before the lesson commences.
- Explaining the project, structure and learning activities to the groups.
- Monitoring the effectiveness of the cooperative learning groups and intervening to provide them with advice and guidance, and

- Assessing the learners’ performance and discussing the way in which they are working together.
- Creating a climate conducive to the successful completion of cooperative learning activities.
- Assisting the groups to interpret their roles and responsibilities within the group.

2.5.3 POSITIVE INTERDEPENDENCE

According to Johnson and Johnson (2009: 366), positive interdependence exists when there is a feeling among learners that they can attain their goals only if other learners with whom they are cooperatively linked attain their goals. In the context of cooperative learning, positive interdependency can only be created if the group members have common goals, the work is distributed amongst the members, information is shared amongst group members, and the group is rewarded jointly (Van Wyk, 2007: 155). Most researchers agree that positive interdependence can be achieved through the following methods: division of labour, sharing of resources and assignment of complementary roles to group members. However, these methods are not independent of each other but are inter-linked.

Division of labour can be used to achieve positive interdependence by crafting learning tasks in such a way that each group member is responsible for doing one aspect of the task (Johnson & Johnson, 2009: 367). Resource interdependence can be achieved by sharing learning resources among group members to encourage their full participation in the learning task (Liao, 2005: 37). In the same vein, Woolfolk (2010: 327) suggests that educators can assign group members complementary roles such as recorder, checker, encourager, elaborator, time keeper, task master and quiet captain. This however depends on the purpose of the group, nature of the learning task and the age of the participants.

2.5.4 FACE-TO-FACE PROMOTIVE INTERACTION

In the context of cooperative learning, Johnson and Johnson (2009:368-369) defined face-to-face promotive interaction as actions that assist, help, encourage, and support the achievement of each other's goals. Fushino (2008: 22-23) points to the value of face-to-face Interaction in cooperative learning and asserts that it provides the opportunity for elaborated explanations that help both academically strong and weak learners to achieve the learning outcome. Furthermore, it enables learners to feel related to others, and allow them to exert some autonomy in their learning (Fushino, 2008: 23). Further reinforcing the value of face to face interaction, Mashile (2002: 73) posit that it provides group members the opportunity to discuss, clarify and explain the content they are learning. It also creates the conditions that enable learners to critique one another's ideas and performances and provide appropriate feedback, support and encouragement (Mashile, 2002: 73).

According to Johnson and Johnson (2009: 368-369), face to face promotive interaction is characterized by learners:

- Exchanging needed resources, such as information and materials, and processing information more efficiently and effectively.
- Providing efficient and effective help and assistance to group mates.
- Being motivated to strive for mutual benefit.
- Influencing each other's efforts to achieve the group's goals.
- Providing group mates with feedback in order to improve their subsequent performance of assigned tasks and responsibilities.
- Challenging each other's reasoning and conclusions in order to promote higher quality decision making and greater activity.
- Taking the perspective of others more accurately and thus being able to explore different points of view.
- Acting in trusting and trustworthy ways.
- Advocating exerting effort to achieve mutual goals

- Being motivated to strive for mutual benefit.

2.5.5 INDIVIDUAL ACCOUNTABILITY

The third essential element of cooperative instructional strategy is individual accountability. For group goals to be achieved in cooperative learning, each learner must be held accountable for his or her own academic learning and also for the task accomplishment of the group as a whole (Liao, 2005: 39). If individual accountability is not well structured or taken into account, learners could either fail to notice group members' need for encouragement and support or choose to loaf at the expense of other group member's efforts. These developments no doubt could diminish learners motivation to learn (Liao, 2005: 39). If however, there are mechanisms in place to ensure individual accountability and it is clear how much effort each member is contributing, then free riding or social loafing effect varnishes. (Johnson & Johnson, 2009: 368).

Johnson et al (quoted in Liao, 2005: 40) suggest using the following methods to structure individual accountability:

- Keep the group small. The smaller the group size, the greater individual accountability could be.
- Give each learner an individual test.
- Randomly call on a learner to orally present the group's work in front of the whole group or the whole class.
- Observe group process and record the frequency of each learner's participation. Have the checker in each group check his or her member's comprehension by asking them to explain what has been learned or to elaborate the logic underlying the group's answer.
- Have learners teach what they have learned to their group members.

2.5.6 INTERPERSONAL AND SMALL GROUP SKILLS

To achieve group goals in cooperative learning, group members need to develop trust for one another, communicate clearly and unambiguously, accept and support each other, and resolve conflicts constructively (Johnson & Johnson, 2009: 369). In order to achieve all these, group members must possess the necessary group skills.

According to Kimamo and Muraya (2011: 730-732), group skills include: listening to all members of the group, allowing all members of the group to verbally participate in discussion, being critical yet supportive of alternative views, maintaining opinions until convincing contrary evidence is provided, effective communication, appreciation of others, conflict resolution and compromise among others. Since conventional teaching methods are dominant in schools, learners may not possess the necessary group skills needed for effective cooperative learning. It therefore becomes necessary that learners are taught group skills prior to cooperative learning (Woolfolk, 2010: 326).

Johnson and Johnson (in Liao, 2005: 40-41) recommended a few steps for teaching group skills. First, the teacher must provide the rationale for using group skills. This may include improvement of group dynamics and extra points for the use of group skills. Then, the teacher can model how and when to use group skills and ask learners to role-play the skills with their group members. Next, learners are reminded and encouraged to use the social skills they have learned so that they can go through the phases of unnatural enactment and internalize the skills.

2.5.7 GROUP PROCESSING

In a cooperative learning situation, group members must be able to reflect, evaluate and analyze how effective they are learning as a group (Johnson & Johnson, 2009: 369). According to Sunarti et al. (2006: 4), when learners engage in group processing they are able to identify their strengths, as well as their weakness and make improvements on those weaknesses going forward. Group processing also helps learners to improve their skills in working cooperatively, learn to address difficulties or tensions within the group and experience the processes of conflict resolution that are essential in workplaces (Muraya & Kimamo, 2011: 730-732).

Through reflection on the effectiveness of the learning process, group members are able to describe what member actions are helpful and unhelpful, and make decisions about what strategies to change or continue (Jensen et al. 2002: 29-34). Moreover, research has shown that learners in the cooperative setting with group processing condition had higher academic achievement than learners in the cooperative setting without group processing condition (Liao, 2005: 40).

2.6 COOPERATIVE INSTRUCTIONAL STRATEGY MODELS

Since its inception, many models of cooperative learning have been developed. However, in all these models the basic characteristics and components of cooperative learning are retained (Oludipe & Bilesanmi, 2012: 307-325). Amongst the numerous models of cooperative learning, the following, according to Sarah and Cassidy (2006: 1-5) have been mostly researched: student teams achievement divisions (STAD), learning together (LT), jigsaw technique, Group investigation (GI), teams-games-tournament (TGT), teams assisted individualization (TAI), and cooperative integrated reading and composition (CIRC). The discussion of the various models of cooperative learning will follow in the next section.

2.6.1 STUDENT TEAMS ACHIEVEMENT DIVISIONS (STAD)

Student teams achievement divisions (STAD), is a method of cooperative learning in which learners are assigned to 4-5 member learning teams that are diverse in performance level, gender and ethnicity (Estes et al. 2010: 272-274). The main purpose of STAD is to drastically improve and accelerate learner performance (Van Wyk, 2007: 181-184).

In STAD, the teacher presents a lesson, and then learners work within their teams to make sure that all team members have mastered and achieve the learning outcome. Finally, all learners within the teams take individual quizzes on the material, during which they may not help one another. Learners' quiz scores are compared to their own past averages, and points are awarded on the basis of the degree to which learners meet or exceed their own earlier performance. These points are then summed to form scores and teams that meet certain criteria may earn certificates or other rewards.

The whole cycle of activities, from teacher presentation, to team practice to quiz, usually takes three to five class periods (Slavin, 2009a: 19). The STAD is at present the most researched method of cooperative learning and has been used extensively in mathematics, science, social studies and other subjects (Estes et al., 2010: 272-274).

According to Slavin (1995: 71), the STAD method consists of the following components: class presentations, teams, quizzes, individual improvement scores, and team recognition. These components are discussed below.

2.6.1.1 CLASS PRESENTATIONS

This stage is characterized by whole class instruction during which the teacher introduces the lesson and explains what will be done. The lesson incorporates audio-visual presentations and various forms of multimedia. After the class presentations and briefings, learners work in their teams to review the worksheets, discuss problems, and help one another master the subject matter (Asherson, 2008: 19).

2.6.1.2 TEAMS

Teams consist of heterogeneous groups of four or five members composed by the teacher on the basis of performance, level of development, gender and ethnicity. Each week, the teacher introduces new subject matter and worksheets. The team members work in groups and study the learning material until all members have successfully mastered the subject matter and work assignments. The goal of the teams is for the members to help one another to learn and achieve the learning outcomes (Asherson, 2008: 19).

2.6.1.3 QUIZZES

To ensure individual accountability and learning within groups, learners take individual quizzes on the learning material at which time they may not help one another. The sum of the individual points scored by learners in the quiz serves as basis for the points allocated to the group (Slavin, 2009a: 19).

2.6.1.4 INDIVIDUAL IMPROVEMENT SCORES

This stage of cooperative learning provides all learners with an equal opportunity to contribute maximum points for their teams in the scoring system. Individual learners can achieve this by showing definite improvement over their past performance (Reena & Nandita, 2010: 95).

At the beginning of the programme, each learner is given a base score derived from the learner's average performance on similar quizzes. Then learners earn points for their teams based on how much their quiz scores exceed their base scores (Reena & Nandita, 2010: 95).

2.6.1.5 TEAM RECOGNITION

Teams earn daily points throughout the cycle for working well together and meeting certain criteria. Rewards are based on both the academic improvement of individual team members and the points learners in the teams earned. Certificates are awarded to teams that meet certain standards in terms of high levels of performance, which means that group members are motivated to do their best within the group (Van Wyk, 2007: 181-184).

2.6.2 LEARNING TOGETHER (LT)

Learning together (LT) instructional strategy was originally developed by David Johnson and Roger Johnson at the university of Minnesota (Slavin, 2009b: 7). In the LT method, learners work in four or five heterogeneous groups on a group assignment or a single topic and turn in a single project as a team. During group discussion, if learners ask the teacher a question the teacher refers such learners to their groups to find the answer. After the group discussion, a leader is chosen to present the group's result to the entire class, and groups receive rewards together. However, there is individual accountability because each group member must demonstrate learning. The scores awarded by the teacher to groups are based on both individual performance and the success of the group. The learning together model of cooperative learning provides a conceptual frame work for teachers to plan and tailor cooperative learning according to their circumstances, learners' needs, and school contexts (Ghazi, 2003: 451-476).

2.6.3 JIGSAW TECHNIQUE

The jigsaw cooperative learning model was developed by Aronson and colleagues in 1978 (Sarah & Cassidy, 2006: 1-5). In jigsaw technique, learners work together in groups of four or six on academic material divided into different sections. Each group member is given part of the material to be learned by the whole group. As soon as each learner has mastered his or her section of the subject matter, he or she goes on to learn the subsection of the other learners in the group. Learners remain in the same group for six to eight weeks, until they have fully studied and master the subject matter. Similarly in jigsaw II, members of groups given the same topic to master form separate groups to discuss the topic thoroughly. Such a group becomes known as expert group (Woolfolk, 2010: 331). After thorough discussion of the topic, the expert group members return to their original groups and teach the information to their group members. In the end learners take an individual test covering all the material and earn points for their learning team score (Woolfolk, 2010: 3310).

The jigsaw is an effective way of engaging learners both with course material and with each other. The peer teaching aspect requires that each learner becomes an expert or understands the material well enough to teach it to other group members (Slavin, 2009a: 10).

2.6.4 GROUP INVESTIGATION (GI)

Group investigation is a general classroom organization plan in which learners work in small groups using cooperative inquiry, group discussion, cooperative learning and projects (Susan, 2007: 63). This technique was founded by Shlomo Sharan and Hertz-Lazarowitz as a general class plan for organizing group investigation (Slavin, 2009b: 4). In group investigation method, learners form their own two-to six-member groups. After choosing subtopics from a unit that the entire class is studying, the group breaks its subtopics into individual tasks and carries out the activities that are necessary for group reports. Each group then makes a presentation or display to communicate its findings to the entire class (Slavin, 2009b: 4).

2.6.5 TEAMS-GAMES-TOURNAMENTS (TGT)

In teams-games-tournaments (TGT), learners are assigned to four member learning teams that are mixed in performance level, gender, and ethnicity. The teacher presents a lesson, learners then work within their teams to make sure that all members have mastered the learning content. Like other cooperative learning models, the main idea behind TGT is to motivate learners to encourage and help one another master skills presented by the teacher (Area Education Agency, AEA, 2007).

At the start of TGT, the teacher organizes the games which composed of content relevant questions designed to test the knowledge learners' gained from class presentations and team practice. Games are played at tables of three learners, each of whom presents a different learning team. Most games are simply numbered questions on a ditto sheet. A learner picks up a number card and attempts to answer the questions corresponding to the number. A challenge rule permits players to challenge each other's answers. The tournament is usually held at the end of the week, after the teacher has made a class presentation and the teams had practiced with the worksheets. For the first tournament, the teacher assigns learners to tournament tables-assigning the top three learners in past performance to table 1, the next to table 2, and so on. This equal competition makes it possible for learners of diverse ability levels to contribute maximally to their team scores if they do their best.

2.6.6 COOPERATIVE INTEGRATED READING AND COMPOSITION (CIRC)

Cooperative integrated reading and composition (CIRC) was developed to teach reading and writing skills in the upper elementary grades (Susan, 2007: 71). Like other methods of cooperative learning, CIRC begins with instructions from the teacher. Learners are assigned to different heterogeneous reading teams of four or more who operate at different reading levels. The teacher works with one team at a time, while learners in other teams work in pairs with their team members and focus on learning activities such as reading, summarizing stories, discussing texts, learning new words, and predicting how stories will end.

In CIRC, teams move through a sequence of teaching, team exercises, team evaluation and quizzes (Susan, 2007: 71). Quizzes are only held once the teams feel that their members are ready. Cooperative rewards are given which encourages teams to work toward recognition. Individual assessments are carried out to ensure individual learning. Scores obtained from individual assessments are averaged to create scores for student teams.

2.6.7 TEAM ASSISTED INDIVIDUALIZATION (TAI)

Team assisted individualization (TAI) is an instructional strategy that combines cooperative learning with individualized instruction. It is specifically designed to teach mathematics to learners in grades 3-6 or older learners not ready for a full algebra course (Slavin, 2009b: 4). In TAI, learners enter an individualized sequence according to a placement test and then proceed at their own pace. In general, four-member mixed ability teams work on different units. Teammates check each other’s work against answer sheets and help one another with any problems. Final unit tests are taken during which teammates are not allowed to help each other. Each week, the teacher totals the number of units completed by all team members and give certificates or other rewards to teams that exceed a criterion score based on the number of final tests passed, with extra points for perfect papers and completed homework (Slavin, 2009b: 4).

2.7 IMPORTANCE OF COOPERATIVE INSTRUCTIONAL STRATEGY

Cooperative instructional strategy has been reported to produce a range of positive social, affective and psychological outcomes, including social support, the quality of learner relationships, attitude to learning, learning skills, and self-esteem (Van Dat & Ramon, 2012: 87). According to Parr (2007: 21-23), one of the main benefits of cooperative instructional strategy is that it can foster an environment that embraces the great diversity of learners that are found in today's classrooms. This viewpoint is shared by Lord (2001: 30-38) who claim that cooperative instructional strategy allows learners to share their differences in a positive way and can add value to the team by bringing their different backgrounds to the group.

Shimazoe and Aldrich (2010: 52-57) provided several benefits of the use of cooperative instructional strategy. First cooperative instructional strategy promotes deep learning of materials. Second, learners achieve better grades. Third, learners learn social skills and civic values. Fourth, learners learn higher-order, critical thinking skills. Fifth, cooperative instructional strategy promotes personal growth. Finally, learners develop positive attitudes towards autonomous learning. Bilesami and Oludipe (2012: 308) affirmed the effectiveness of cooperative instructional strategy and claim that it creates a friendly learning environment in which learners are motivated to learn and are more confident to ask questions from one another leading to a better understanding of the tasks being learnt.

Van Wyk (2007: 167) emphasized the importance of cooperative instructional strategy and points out that it offers a different paradigm for teaching and learning, because learners discover and construct knowledge. Furthermore, cooperative instructional strategy gives learners the opportunity to develop new talents and skills, and optimizes teaching-learning interactions amongst learners and between learners and teachers.

Another benefit of cooperative instructional strategy lies in the fact that it promotes positive relationships among learners. Such positive relationships according to Johnson and Johnson (2005: 285-358) result in an increase in motivation and persistence in working toward the shared goals, satisfaction, commitment to group goals, productivity and personal responsibility for achievement. In addition to promoting positive relationships, cooperative instructional strategy also enhances the use of problem solving, critical thinking and oral communication skills because learners interact and exchange ideas during learning tasks (Johnson & Johnson, 2003: 285-358).

In addition to benefitting learners, cooperative instructional strategy allows for flexibility on the role of teachers in the classroom. Rather than being the sole authority, teachers can step back and monitor how well learners are learning the material. Shimazoe and Aldrich (2010: 52-57) believe that cooperative instructional strategy provides the opportunity for teachers to reflect on what is happening in the classroom, as they monitor and guide learners in their different groups.

The committee on increasing high school learners' motivation to learn (2004: 51) believes that when learners put their heads together in cooperative learning groups, they are more receptive to challenging assignments. The committee (2004: 51) further notes that collaborative work can help create a community of learners who have responsibility for each other's learning rather than a competitive environment which is alienating to many learners, particularly those who do not perform as well as their classmates. Liao (2005: 2) supports the claim that cooperative instructional strategy is academically beneficial and points out that when learners are close to one another in their levels of proximal development, they are able to describe things to one another in a simpler way that is easier to be comprehended than being explained by a person at a very different mental stage.

Omrod (2004: 417) maintains that when proper activities are designed, cooperative instructional strategy has the potential to ensure that learners have a higher self-efficacy about their chances of being successful, express more intrinsic motivation to learn school subject matter, participate more actively in classroom activities and exhibit more self-regulated learning. Omrod (2004: 417) further claims that cooperative instructional strategy predisposes learners to pro-social behavior; as learners work in heterogeneous and diverse ability groups to achieve a learning outcome.

Liao (2005: 2) supports the use of cooperative instructional strategy and claim that if properly designed and implemented, cooperative instructional strategy has the potential to ensure that learners are valued and cherished by their peers for who they are. More specifically higher achievers are valued for their knowledge as well as their ability and willingness to share what they know. Low achievers are accepted and also respected for who they are and their willingness to improve. The benefits of cooperative instructional strategy transcend academic learning and performance. Some educational researchers expressed the view that instead of focusing only on academic performance, education should also be aimed at instilling in learners the culture of working cooperatively with all kinds of people.

According to Aronson (2000: 91), most corporations are looking for employees who are not only good at the mastery of a particular set of academic skills but also have the ability to work harmoniously with a wide variety of co-workers as a cooperative team. Cooperative instructional strategy with its emphasis on team work appears to be suitable to prepare learners for the world of work.

2.8 LIMITATIONS OF COOPERATIVE INSTRUCTIONAL STRATEGY

While cooperative instructional strategy has been acknowledged as an active pedagogy that fosters high academic achievement (Van Wyk, 2007: 218), however there are certain disadvantages associated with this strategy. One of the main criticisms leveled by opponents of cooperative instructional strategy is that it is too informal to bring about a deep understanding of the subject matter. Others argue that it is too time consuming and disruptive due to the informality of the process (Lord, 2001: 30).

Anderson et al (in Woolfolk, 2010: 324) expressed concerns that in group learning, the ideas of low-status learners may be ignored or even ridiculed while the contributions of high status learners are accepted and reinforced, regardless of the merit of either set of ideas. There is also concern that simply putting learners in small diverse groups for purposes of cooperative learning is not a guarantee that they would cooperate and learn. Without careful planning and monitoring by the teacher, group interactions can hinder learning and reduce rather than improve social relations in classes (Woolfolk, 2010: 324).

Sharan (2010: 300-313) perceives cooperative learning as constantly evolving and considers this constant evolution as a threat that could make cooperative learning too complicated to be used in the classrooms by teachers. Another criticism of cooperative instructional strategy is that working in groups does not necessarily mean that learners would arrive at the correct answer. According to Woolfolk (2010: 323), learners who work in groups but arrive at wrong answers may be more confident that they are right. This has been described by Puncochar and Fox (2004: 582-591) as a case of “two heads are worse than one”.

Grouping learners on the basis of academic ability for purposes of cooperative learning could give rise to clash of interest between fast and slow learners. Fast learners might feel that they are being held back by their slower team mates (Woolfolk, 2010: 323). This sentiment is also shared by Sharan (2010: 300-313) who argued that teachers implementing cooperative instructional strategy could be met with resistance and hostility from learners who believe that they are being held back by their group members who work slower or by learners who are less confident and feel that they are being ignored or demeaned by their group members.

Van Wyk (2007: 218) also expressed concerns on the use of cooperative instructional strategy and argues that gifted learners could tend to take over the group rather than share and support leadership. He further notes that gifted learners could grow frustrated and bored if group members fail to honour their responsibilities and roles in the group according to the group project.

McCaslin and Tom (in Woolfolk, 2010: 323), list several other shortcomings of cooperative learning, stating that:

- Socializing and interpersonal relationships may take precedence over learning.
- Learners may simply shift dependency from the teacher to the “expert” in the group. In such case learning is still passive and what is learned could be wrong.
- Status differences may be increased rather than decreased. Some learners may learn to loaf because the group progresses with or without their contributions.
- Others become even more convinced that they are unable to understand without the support of the group.
- Rather than challenging and correcting misconceptions, learners support and reinforce misunderstandings.

2.9 STUDIES ON THE PERFORMANCE OF GRADE 09 LEARNERS IN SCIENCE

According to Vijay et al. (2006: 4) countries undertake national assessments and systemic evaluations of their educational system to monitor the performance of the system, improve accountability, and identify opportunities for improving learning outcomes. Participation in international achievement studies appears to allow for a comparison of performance with other countries, affords access to technical expertise in measurement and analysis of data, provides access to resources supporting data collection costs and most importantly increases government’s accountability for improving quality and performance within the education system (Vijay et al. 2006: 4). South Africa has participated in several international studies on learners’ performance in science, but in many of these studies low achievement scores were recorded (LDoE, 2011: 10). The underperformance of learners in these science studies is very concerning considering the fact that science plays an important role in the economic development of a country (Aluko, 2008: 32).

In the 2003 grade 09 study conducted by Trends in International Mathematics and Science Study (TIMSS), 4261 learners from 238 schools participated. The average science scale score for South African learners at the grade 09 level was 267 (Vijay et al, 2006: 4). This average score is significantly low and is a cause for concern. The findings of the TIMSS 2003 study also indicated that out of 4261 grade 09 learners that participated in the science study, only 12.4% achieved scores higher than 400 (Vijay et al, 2006: 73).

In addition to the TIMSS studies, the national study by the department of education (DoE) conducted in 2009 to determine the level of grade 09 learners performance in natural sciences showed that learners underperformed with a mean score of 21.4% (LDoE, 2011: 10). Similarly the provincial study by Limpopo Department of Education (LDoE), conducted in 2011 to evaluate grade 09 learners' performance in natural sciences indicated that learners underperformed with a mean score of 21.7% (LDoE, 2011: 10). The findings of the study also showed that the percentage of learners in grade 09 attaining acceptable levels (>50%) in natural sciences is 1.89% (LDoE, 2011: 10). Based on the consistent low scores of learners in these sciences assessment studies, recommendations are that achievement information be used to inform policy and practice issues in the education domain with a view to improving learners' performance in Science.

2.10 REVIEWED RESEARCH STUDIES ON COOPERATIVE INSTRUCTIONAL STRATEGY

In this section of the literature study, the researcher briefly provides research findings on cooperative instructional strategy with regards to academic achievement. The section begins with research findings that support the effectiveness of cooperative instructional strategy in enhancing academic achievement. This is followed by research findings that oppose or do not affirm the effectiveness of cooperative instructional strategy in promoting academic performance.

2.10.1 RESEARCH FINDINGS IN SUPPORT OF COOPERATIVE INSTRUCTIONAL STRATEGY

There is a great deal of evidence that supports the effectiveness of cooperative instructional strategy in promoting academic achievement. In a study by Parveen and Sadia (2012: 154), the effect of cooperative instructional strategy on science achievement of 9^{th} grade learners was investigated. The sample consisted of 36 grade 09 learners who were equally distributed into experimental group and control group. The experimental group was taught through cooperative instructional strategy while the control group was taught through conventional lecture method. The results showed that cooperative instructional strategy resulted in higher academic achievement as compared to conventional lecture method. This study lends support to the claim that cooperative instructional strategy can promote academic achievement.

The research findings of Dennis (2004: 46-72) supports the effectiveness of cooperative learning as a teaching strategy. The researcher investigated the effects of cooperative learning strategies on the test results of science learners at N3 level at the Port Elizabeth College for Further Education and Training (FET). The study involved two groups of 30 learners. The one group (experimental) was subjected to an intervention, namely the student-teams achievement divisions (STAD) cooperative learning method while the other group (control) was taught using the traditional method of talk and chalk. The intervention took place over a period of four weeks. The results indicated that the experimental group out-performed the control group by a significant margin.

In addition, the research by Bilesami and Oludipe (2012: 307-325) corroborated the effectiveness of cooperative instructional strategy in enhancing academic achievement. Their study investigated the effect of cooperative instructional strategy on junior secondary school learners' academic achievement in science. The sample consisted of 120 learners selected from three intact classes. The two experimental groups were taught using cooperative instructional strategies (learning together and jigsaw II) while the control group was taught using conventional teaching method. The findings of the study showed that cooperative instructional strategy was more effective in enhancing learners’ academic achievement and retention in science than the conventional teaching method.

The effectiveness of cooperative instructional strategy in enhancing academic achievement is also supported by the research study of Samuel and John (2004: 26-35). The researchers investigated the effects of cooperative class experiment (CCE) teaching method on secondary school learners’ chemistry achievement in Kenya’s Nakuru District. The findings of the study showed that cooperative instructional strategy facilitated learners’ chemistry learning and achievement more than the regular teaching method.

Another support for the effectiveness of cooperative instructional strategy in enhancing academic achievement comes from the study of Adeyemi (2008: 691-708). The researcher investigated the effects of cooperative instructional strategy on junior secondary school learners’ achievement in social studies. The sample consisted of 150 learners (80 boys and 70 girls) selected from three public schools. The results showed that learners exposed to cooperative instructional strategy performed better than their counterparts taught using the traditional teaching method.

Similarly, Christian and Pepple (2012: 109-120) found that cooperative instructional strategy resulted in enhanced academic performance. The researchers carried out a four week study involving 370 senior secondary school learners. Learners in different groups were taught chemistry using cooperative, individualistic, and conventional teaching strategies. At the end of the study, learners were post-tested to evaluate the effects of the teaching strategies. The results showed that learners in the cooperative group performed better than their counterparts in the individualistic and conventional learning groups.

In the same vein, Armstrong et al (2007: 163-171) compared cooperative instructional strategy and traditional lecture method in an undergraduate biology course. Their results showed that the experimental group that was instructed through cooperative instructional strategy showed greater improvements in overall test scores than the control group that was taught using a traditional lecture method.

Further affirming the effectiveness of cooperative instructional strategy in enhancing academic performance is the study of Effandi and Zanaton (2007: 35-39). The researchers investigated the effect of cooperative instructional strategy on the academic performance of learners in mathematics. Their results showed that learners in cooperative group instruction performed better than learners taught using the traditional lecture method.

The findings of Fengfeng and Barbara (2007: 249-259) corroborates that of Effandi and Zanaton (2007: 35-39). They investigated the effects of teams-games-tournament (TGT) cooperative learning method on learners' achievement in mathematics. Multivariate analysis of variance was used to analyze the data collected. The results showed that cooperative games instructional strategy was more effective in enhancing learners' mathematics achievement than conventional teaching method.

Similarly the result of the study of Barcin and Leman (2007: 349-373) on the impact of cooperative instructional strategy on the grade 09 learners' understanding of metallic bonding showed that the mean score of learners in cooperative learning group was significantly higher than the mean score of their counterparts in the traditional lecture method.

2.10.2 RESEARCH FINDINGS NOT SUPPORTIVE OF COOPERATIVE INSTRUCTIONAL STRATEGY

As there are many research findings that lend credence to the effectiveness of cooperative instructional strategy, there are also studies that did not consider cooperative instructional strategy effective in promoting academic achievement. This section of the literature study describes some of these findings.

The study by Asherson (2008: 2) did not support the effectiveness of cooperative instructional strategy in enhancing academic achievement. The researcher investigated the effect of student teams-achievement divisions (STAD) method of cooperative instruction on the academic achievement, motivation, and interpersonal relationships of 6^{th} grade science learners. The experimental group was taught using the student teams-achievement divisions (STAD) method and the control group instructed through the conventional teaching method. The result of the study did not show statistically significant improvement in science achievement between the experimental and the control group. However, the study did show that cooperative instructional strategy resulted in an improvement in motivation and interpersonal relationships amongst learners.

The study by Kurt and Samchai (2004: 1-10) also found cooperative instructional strategy ineffective in enhancing academic achievement. They investigated the effect of cooperative instructional strategy on the performance of learners in vocational studies. Their results showed that there was no significant difference between the achievement scores of learners in cooperative learning group and traditional learning group.

The study by Kurt and Samchai (2004: 1-10) is corroborated by the findings of Lawrence (2006: 55-64). The researcher compared biology achievement in individually competitive and cooperative learning environments. The results showed no difference in learners' achievement as both the treatment and control group obtained significantly higher posttest scores.

Moreover, the study of Martin and Rowland (2007: 29-41) does not consider cooperative instructional strategy effective in enhancing academic achievement. They compared the effects of jigsaw method of cooperative instruction and traditional teaching method on the achievement of grade 12 learners in physics. Their results revealed no significant differences between the two groups of instruction in learners' achievement in physics.

2.11 SUMMARY AND FINDINGS FROM THE LITERATURE REVIEW

In this chapter, the theoretical underpinnings, historical background, features and various models of cooperative instructional strategy models were discussed. The findings from the literature study claim that cooperative instructional strategy enhances learning, improves academic performance, promotes positive social interactions, and provides learners with social skills and civic values. In addition to the benefits of cooperative instructional strategy, the literature also discussed shortcomings of cooperative instructional strategy. While the majority of the reviewed studies acknowledged the effectiveness of cooperative instructional strategy in improving academic performance, some studies established no significant differences between cooperative instructional strategy and conventional instructional strategy in terms of improving academic performance. Reviewed studies on the performance of grade 09 learners in science showed that learners underperformed, this did partly influence the researcher's interest in this study.

2.12 CONCLUSION

Although there is overwhelming evidence in support of the effectiveness of cooperative instructional strategy, there are also empirical data that do not support the effectiveness of cooperative instructional strategy in promoting academic achievement. This also influenced the researcher's interest in the topic. The next chapter will focus on the research design and methodology of the study.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

The previous chapters have established an understanding of cooperative instructional strategy as well as the theories that support its use in the classroom. Insight gained from the literature proved vital in the design of this study. In this chapter, the researcher presents discussions on the research design and methodology of the study. According to Aldene (2006: 20), both quantitative and qualitative researchers use careful systematic methods to gather high quality data. However, differences in the style of research and the types of data needed mean that researchers will approach the data collection process differently (Neuman, 2003). In line with this view point, this study employed experimental design as it aimed to investigate the impact of cooperative instructional strategy on the performance of grade 09 learners in science. Therefore in this chapter, the researcher presents discussions on the research design, threats to internal validity, population, sampling procedures and data collection method. The chapter ends with discussions on the data analysis, interpretation methods and the ethical considerations of the study.

3.2 EXPERIMENTAL RESEARCH DESIGN

In an experimental design, the researcher manipulates or varies an independent variable and measures its effect on one or more dependent variable (McMillan & Schumacher, 2010: 257). According to Robson (2002), an experimental design is employed where participants are assigned to different conditions; there is manipulation of one or more independent variables, there is measurement of the effects of this manipulation on one or more dependent variables, and there is control of all other variables. In the views of Teresa and Richard (2009: 4), experimental research is based on a methodology that meets three criteria namely: (a) random assignments of participants to groups (b) experimental control in which all features of the treatments are identical except for the independent variable (c) appropriate measures for testing research hypotheses.

McMillan and Schumacher (2010: 258), state that experimental research is characterized by: theory driven research hypotheses, random assignment of subjects, manipulation of independent variable, measurement of dependent variable, use of inferential statistics and control of extraneous variables. In a review and analysis of educational research, Shavelson and Towne (2002: 110) concluded that from scientific perspective, experimental research designs are ideal for establishing whether one or more factors caused change in an outcome because of their strong ability to enable fair comparisons.

3.3 TYPES OF EXPERIMENTAL RESEARCH

McMillan and Schumacher (2010: 19) categorized experimental studies into three general types namely:

- True experimental design
- Quasi-experimental design
- Single subject design

3.3.1 TRUE EXPERIMENTAL DESIGN

According to McMillan and Schumacher (2010: 21), true experimental design is characterized by random assignment of subjects to different groups. Random assignment entails that subjects used in the study are selected in such a way that they have an equal chance of being in either the experimental or control group. Through random assignment, any differences that might exist between subjects in each group are neutralized before intervention begins. In this way, the researcher can conclude that the results are not due to differences in characteristics of the subjects or to most extraneous events (McMillan & Schumacher, 2010: 21).

3.3.2 SINGLE SUBJECT DESIGN

Single subject designs involve research done with individual subjects in order to study the changes in behavior that are associated with the intervention or removal of the intervention. Single subject design is used by researchers in situations where it is impossible or inconvenient to study the entire group of subjects (McMillan & Schumacher, 2010: 22). It is also used in a situation where the researcher may be interested in one or two subjects rather than large group of subjects (McMillan & Schumacher, 2010: 22). Similar to quasi-experimental research, single subject research investigates cause-and –effects and does not involve random assignment of subjects.

3.3.3 QUASI-EXPERIMENTAL DESIGN

In a quasi-experimental design, the researcher does not randomly assign participants to comparison groups usually because random assignment is not feasible. (McMillan & Schumacher, 2010: 22). The main purpose of quasi-experimental design is to determine cause and effect (McMillan & Schumacher, 2010: 22). A common situation for implementing quasi-experimental research involves research in which several classes or schools are used to determine the effect of teaching methods. In such a situation, it is possible to give an intervention to some of the classes and treat other classes as the control group (McMillan & Schumacher, 2010: 22).

In this study, a mixed method approach specifically quasi-experimental design and interviews was used to collect data. A mixed method design is a research in which the investigator collects and analyzes data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study (Tashakkori & Cresswell, 2007: 4). Similarly, quasi-experimental design is a research in which there is no random assignment of subjects (McMillan& Schumacher, 2010: 278). It was considered appropriate for this study as it allowed for comparison of the experimental and control groups, manipulation of independent variable, measurement of dependent variable, use of inferential statistics and provide for maximum control of extraneous variables (McMillan & Schumacher, 2010: 258). In addition to quasi-experimental design, focus group interview was used to capture the phenomenological views of learners on the effectiveness of cooperative learning as a teaching strategy.

The table below adapted from McMillan and Schumacher (2010: 278) illustrates the quasi-experimental design used in this study.

Table 3.1: Non-randomized control group pretest-posttest design.

Group	Pretest	Treatment	Posttest
A	O1	X1	O2
B	O1	Xo	O2

In table 3.1 the letters A and B represent the sample selected for the study. Group A represent the experimental group while group B constitute the control group. O1 represents the pretest that was administered to all the groups prior to the treatment. The experimental group (A) received instruction through cooperative instructional strategy (X1) while the control group (B) was taught using the traditional teaching method (Xo).

O2 represents the posttest that was administered to all the groups at the end of the treatment period. The independent variable manipulated in this study was the teaching strategy which differed in the experimental and control group. The experimental group was taught using cooperative instructional strategy while the control group was taught using traditional teaching method. The dependent variable measured due to the different teaching strategies was the test scores of the groups in the posttest (O2).

The pretest (O1) and posttest (O2) scores for the groups were then compared for any statistically significant difference by implementing the dependent samples t-test.

3.4 THREATS TO INTERNAL VALIDITY

The internal validity of a study according to McMillan and Schumacher (2010: 264) refers to the judgment that is made concerning the confidence with which plausible rival hypotheses can be ruled out as explanations for the results. It illustrates the degree to which the independent variable influenced the experiment (Leedy, 2001: 300). According to Merriam (2002: 198-199), research findings are trustworthy to the extent that there has been some accounting for their validity and reliability, that is, the extent to which they can be replicated in another study. The quasi-experimental design provides reasonable control over threats to internal validity of a study (McMillan & Schumacher, 2010: 278). In this study, the threat of selection was controlled as the two selected secondary schools were randomly assigned to experimental and control group. In the same vein, the threat of maturation was controlled because the sample of the study consisted of grade 09 learners of approximately the same age and similar academic backgrounds. Both learners in the experimental and control group did not differ much in academic abilities.

The schools used in this study were far apart from each other as a result, conditions meant for one group were not transmitted to the other group. In this way, the threat of diffusion of treatment was controlled. The threat of history to internal validity was controlled to some extent in this study as there was no major school disruption or strike during the course of the study. However, there might be events or experience unique to individual learners in the course of this study that may have influenced the results.

Instrumentation was not considered a threat to internal validity for this study because both the experimental and control group were administered with the same standardized science achievement test (SAT). All the teachers who participated in this study were professionally trained and qualified and are currently teaching grade 09 natural science. In addition, the teacher who taught in the experimental group rehearsed thoroughly on the implementation of student-teams achievement divisions (STAD) method of cooperative learning. In this way the threat of experimenter effect to internal validity was controlled.

3.5 RESEARCH SITE

Research site refers to a place selected for the purpose of gathering data about the problem being investigated by a researcher (McMillan & Schumacher, 2010: 326). In other words, research sites are selected because they are likely to provide rich data about the phenomenon the researcher is investigating (McMillan & Schumacher, 2010: 326).This study investigated the impact of cooperative instructional strategy on the performance of grade 09 learners in science and therefore used two public schools where teaching and learning of science takes place. The selection of schools for this study was based on the knowledge of the researcher about the schools in Baltimore circuit. The two schools used in this study were both located in Baltimore circuit, Mogalakwena District. Both schools shared the following features in common:

- They are mixed schools

- They serve a low socioeconomic area
- They use English as a medium of instruction
- They have functioning libraries and science laboratories
- They have only one grade 09 class.

The grade 09 classrooms in the selected schools were spacious and conducive for teaching and learning. The treatment group was selected from the school where the researcher is currently teaching while the control group was from another school. Both schools were far apart from each other.

3.6 POPULATION

A research population refers to a group of individuals that is the main focus of a research and to whom the research results can be generalized (Joan, 2009: 1). All individuals within a certain population usually have common, binding characteristics or traits. Joan (2009: 1), categorized population into: Target population and Accessible Population.

3.6.1 TARGET POPULATION

According to McMillan and Schumacher (2010: 129), target population refers to a group of elements or cases, whether individuals, objects, or events that conform to specific criteria and to which researchers are interested in generalizing their conclusions. McMillan and Schumacher (2010: 129) gave an example of a target population and state that a researcher might want to carry out a research involving beginning teachers, the target population in this situation may be first year teachers across an entire country in all types of schools. The survey or accessible population may be a list of first year teachers from selected or participating states.

3.6.2 ACCESSIBLE POPULATION

The accessible population is a subset of the target population to whom the researchers can generalize their conclusion (Joan, 2009: 1). It is from the accessible population that researchers usually draw their samples (Joan, 2009: 1). When doing research, McMillan and Schumacher (2010: 129) advised that it is important for researchers to carefully and completely define both the target and the accessible population.

In this study, the target population was grade 09 learners in the Baltimore circuit – Mogalakwena District. From this population, a sample of 60 learners from two participating schools was selected. Grade 09 learners were considered appropriate for this study because science is compulsory in grade 09 and the performance of grade 09 learners in natural science significantly influences whether they would be in the science stream in the further education and training (FET) phase.

3.7 SAMPLING

A sample is a small subset of the population that has been chosen to be studied (Lunsford & Lunsford, 1995: 105). McMillan and Schumacher (2010: 129-138), categorized sampling into two types:

- Probability sampling
- Non-probability sampling

3.7.1 PROBABILITY SAMPLING

In probability sampling, subjects are drawn from a larger population in such a way that the probability of selecting each member of the population is known (McMillan &

Schumacher, 2010: 129). When properly done, probability sampling provides the most valid or credible results because they reflect the characteristics of the population from which they were selected (McMillan & Schumacher, 2010: 129). According to McMillan and Schumacher (2010: 129), probability sampling methods include: Simple random sampling, stratified random sampling, systematic sampling and cluster sampling. Brief discussions of the various probability sampling methods will follow in the next section.

3.7.1.1 SIMPLE RANDOM SAMPLING

According to Emily and Roger (2010: 114), simple random sampling is a probability sampling in which every member of a study population has an equal chance of selection. Selection in simple random sampling is done in such a way that each individual has an equal chance of being selected into the groups. With random sampling, bias is avoided as there is high probability that all the population characteristics will be represented in the sample (McMillan & Schumacher, 2010: 131). The strength of simple random sampling is that it is easy to understand; requires little knowledge of the population and free of subject classification error (Bruns & Mogharreban, 2007: 229-241). However, simple random sampling can potentially lead to a larger sampling error as it requires the numbering of each element in a non-electronic list of the population (Bruns & Mogharreban, 2007: 229-241).

3.7.1.2 STRATIFIED RANDOM SAMPLING

In stratified sampling, the population is divided into subgroups or strata on the basis of a variable chosen by the researcher, such as gender, age, location, or level of education. Once the population has been divided, samples are randomly drawn from each subgroup (McMillan & Schumacher, 2010: 134). The major strength of stratified random sampling is that it allows easy subgroup comparisons, and is more representative of the population (Bruns & mogharreban, 2007: 229-241). However, its major weakness is that it requires subgroup identification of each population element and this could be costly and cumbersome (Bruns & Mogharreban, 2007: 229-241).

3.7.1.3 SYSTEMATIC SAMPLING

In systematic sampling, every nth element is selected from a list of all elements in the survey population, beginning with a randomly selected element. For instance, in order to draw a 10 percent sample from a population of 100, a number from 1 to 10 is randomly selected as the starting point. If 5 is selected, every 10^{th} name on the list will then be selected as follows: 5, 15, 25, 35, and so on. Systematic sampling can be used only when the researcher has a sequential list of all the subjects in the population. Furthermore, it is easier than simple random sampling because not every member of the population needs to be numbered (McMillan & Schumacher, 2010: 133).

3.7.1.4 CLUSTER SAMPLING

In cluster sampling, the researcher identifies convenient, naturally occurring groups, such as neighbourhoods, schools, districts, and regions, rather than individual subjects, and then randomly selects some of these units for the study. Once the units have been selected, individuals are selected from each one (McMillan & Schumacher, 2010: 135). Cluster sampling is usually used in studies where the researcher cannot obtain a complete list of all members of the population but can identify groups, or clusters, of subjects (McMillan & Schumacher, 2010: 135). Cluster sampling is considered less representative of the population than either simple or stratified random sampling (McMillan & Schumacher, 2010: 135).

3.7.2 NON PROBABILITY SAMPLING

In non-probability sampling, the researcher does not randomly assign subjects to groups. Rather, the researcher uses subjects who happen to be accessible or who may represent certain types of characteristics relevant for the research (McMillan & Schumacher, 2010: 135). Non probability sampling are mostly used in quantitative studies, particularly experimental and quasi-experimental studies where it may not be possible to randomly assign subjects to groups (McMillan & Schumacher, 2010: 135).

McMillan and Schumacher (135-138) categorized non-probability sampling into:

- Quota sampling
- Convenience sampling
- Purposive sampling

3.7.2.1 QUOTA SAMPLING

According to McMillan and Schumacher (2010: 138-139), quota sampling is used when the researcher is unable to take a probability sample but is still able to select subjects on the basis of the characteristics of the population. In quota sampling, different composite profiles of major groups in the population are identified, and then subjects are selected non-randomly to represent each group. The major advantage of quota sampling is that it is less costly and easy to administer (Bruns & Moghrreban, 2007: 229-241). Quota sampling is however, subject to some weaknesses. First is the difficulty of guaranteeing that the description of the target population is accurate (Emily & Roger, 2010: 124). It also requires the knowledge of the characteristics of the entire population in order to set the right quota (Rafael & Russel, 2009: 95).

3.7.2.2 CONVENIENCE SAMPLING

A convenience sample refers to a group of elements that are readily accessible to, and therefore convenient for the researcher (Emily & Roger, 2010: 125). In convenience sampling, a group of subjects is selected on the basis of being accessible or expedient (McMillan & Schumacher, 2010: 137). Convenience samples could be a university class of a professor, who is doing research on college student learning styles, classrooms of teachers enrolled in a graduate class, school principals who participated in a workshop or volunteers (McMillan & Schumacher, 2010: 137). Convenience samples are widely used in both quantitative and qualitative studies because they provide the only option for the research to be accomplished (McMillan & Schumacher, 2010: 137).

3.7.2.3 PURPOSIVE SAMPLING

In purposive sampling, the researcher selects particular elements from the population that will be representative or informative about the topic of interest (McMillan & Schumacher, 2010: 138). Purposive sampling is appropriate where the researcher has previous knowledge of the population and has a specific purpose for the study and therefore relies on personal judgment to select a sample that includes subjects with needed characteristics (McMillan & Schumacher, 2010: 138). For Emily and Roger (2010: 124), purposive sampling is based entirely on the judgment of the researcher on the elements that will facilitate an investigation.

In this study, the researcher used purposive sampling to select two schools with comparable characteristics in terms of location, learners, teaching and learning facilities. Purposive sampling is based on what the researcher wishes to discover, understand, and gain insight and therefore must use a sample from which the most can be learnt (Merriam, 2002: 61).

3.8 DATA COLLECTION PROCEDURES

Murali et al. (2004: 1) defined data collection as the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes. For Creswell (2001: 185), data collection steps involve setting the boundaries for the study, collecting information through observation and interviews, as well as establishing the protocol for recording the information.

In this study, the researcher used standardized science achievement test (SAT) to collect data. At the commencement of the study, learners in both the experimental and control group were pretested using the SAT. Learners in the experimental group were taught using cooperative instructional strategy while learners in the control group were taught using conventional teaching method. At the end of the treatment which lasted for four weeks, learners in both the experimental and control group were tested (posttest) again using science achievement test so as to determine the effects of the teaching strategies that were used in the study. Both the pretest and posttest was administered under similar conditions in both the experimental and control group. The discussion that follows in the next section describes in detail the procedure used to collect data in this study.

3.8.1 TREATMENT / EXPERIMENTAL GROUP

In the experimental group, learners were divided into groups of four members. The decision to form groups of four members was based on research that suggested that groups larger than four presented problems, such as making it easier for unenthusiastic learners to play a smaller role in group activities (Asherson, 2008: 14).

Each group consisted of a mixture of high-and low-ability learners with an equal number of boys and girls. The rationale for forming heterogeneous groups was to maximize strength (Asherson, 2008: 14). A total of seven teams (30 learners) were formed in the experimental group. The learners in each group were assigned complementary roles such as leader, recorder, resource manager and time keeper. The group leader facilitated group discussions and ensured that group members' discussions are relevant to the learning task. The time keeper ensured that group members stick to time during group work. The recorder kept the groups' self-assessment records as well as other written records while the resource manager gathered and organized materials for group activities. Complementary roles were assigned to group members in this study as a strategy to maximize cooperation and learning (Woolfolk, 2010: 327).

In view of the assertion by Woolfolk (2010: 324) that simply putting learners in a group is no guarantee that they would cooperate and learn. Learners in the experimental groups were given orientation about cooperative learning and its importance. In addition, they were taught appropriate social skills needed for them to work effectively as a team. The taught skills included how to communicate effectively, how to help and support each other, and how to resolve conflicts constructively. The treatment during this study focused on three natural science topics, namely:

- Electricity
- Elements, Compounds and Mixtures
- Acids and Bases

The cooperative learning method used in this study was student teams-achievement divisions (STAD) which consisted of class presentations, teams, quizzes, individual improvement scores, and team recognition (Slavin, 1995: 71). In the experimental group, each lesson began as a whole class instruction during which the teacher introduced the topic, outlined the learning outcomes and instructed the learners on what to do during the lesson. Afterwards, learners moved into their teams where they were provided with worksheets that directed them on what to do. Within the topic on Electricity, learners were provided with three cells (battery), a bulb, connecting wires and a switch in their various groups. Next they were asked to make a functional circuit using the provided materials. In addition to this, learners were asked to draw the circuit diagram they had formed. On completion of this task, learners were provided with a table with the names of circuit components and were required to fill in their symbols as well as their functions. This was followed by another task in which learners were to perform calculations using Ohm's law. In the calculations, learners were presented with a circuit diagrams that required them to calculate the potential difference and current. Lastly, learners were asked to make a list of the various ways that electricity can be saved at home.

Within the topic on elements, compounds and mixtures, the researcher started the lesson by defining elements, compounds and mixtures. Learners were taught that elements and compounds are pure substances because they are made up of the same type of substance while mixtures are non-pure substances because they are made up of different substances. Furthermore, the researcher elaborated on the features and examples of elements, compounds and mixtures. At the end of the lesson presentations, learners moved into their various groups where they were provided with a copy of the periodic table and worksheets. In the first task, learners were given a list of fifteen different elements and asked to identify their groups and periods. Next, learners were asked to make a list of possible compounds that can be formed by using the elements in group 1 and group 7 of the periodic table. On completion of this task, they were asked to represent the formed compounds using Bohr's model structure.

In the second task, learners were asked to make a list of some of the important compounds and mixtures that they use daily at home. As learners worked in their groups, the researcher moved around to monitor how learning was taking place in the various groups. By moving around the class, the researcher was provided with the opportunity for one-on-one explanations with learners in their various groups.

Within the topic on acids and bases, the researcher started the lesson by defining acids and bases; and describing their properties. After the class presentations, learners moved into their groups where they were provided with work sheets. In the first task, learners were asked to make a list of the common acids and bases that they use at home. In the second task, learners were asked to carry out an experiment to test for the presence of acid and base in the following materials: Sunlight liquid, handy-Andy, tomatoes, vinegar, lemon juice, orange and bleach. In order to do this, the various groups were provided with red cabbage leaves from which they were to extract an indicator. In order to extract the indicator, learners were to chop three leaves and boil them in half a litre of water for ten minutes. After boiling, the mixture is allowed to cool after which the leaves are thrown out. The remaining liquid serves as an indicator. Learners were to put few drops of the indicator on the provided materials and observe for any colour change. Based on this colour change, learners were asked to classify the provided materials into acids and bases.

In the third task, learners were asked to use the information on how to balance equations to write a balanced chemical equation for:

1. Sulphuric acid reacting with sodium hydroxide
2. Hydrochloric acid reacting with potassium hydroxide
3. Hydrochloric acid reacting with sodium carbonate

Lastly, learners were asked to identify the name of the reactions that they have balanced.

In order to assess the various learning outcomes, quizzes were given to learners. The quiz consisted of 20 multiple choice questions which covered the various learning tasks that learners worked through in their groups to accomplish. Group members were not allowed to help each other during the quizzes. As a result, individual accountability for learning was strengthened. At the end of the quiz sessions, the scores of learners within groups were tallied and the team with the highest average scores were recognized and applauded. Time was allocated at the end of each lesson for learners to evaluate how effectively they worked with their team mates. In addition, teams filled out weekly self-assessment forms indicating how well and efficiently they worked as a team.

3.8.2 CONTROL GROUP

The control group consisted of 30 learners who were taught using the conventional teaching method. In this method, the teacher presented information on the topic to the whole class while learners listened and wrote notes at the end of the lesson. Learning activities were done by learners individually. The topics taught in the experimental and control group were the same. The treatment in both the experimental and control group lasted for a period of four weeks.

3.8.3 DATA COLLECTION INSTRUMENT

According to Pierce (2009: 37), data collection instrument refers to a survey, test, scale, rating or tool designed to measure the variables, characteristics or information of interest. In this study, science achievement test (SAT) was used to measure the achievement of learners in the experimental and control group before and after the study. The test was designed by the researcher and moderated by a natural science subject specialist for its content validity. The science achievement test (SAT) was based on the content taught during the study, and consisted of essays, matching and multiple choice questions. The total marks allocated for the test was 50 and time duration was one and half hour. In addition to the SAT, the researcher also interviewed the experimental group at the end of the treatment period to obtain their views on the effectiveness of cooperative learning. (See Appendix B of focus group interview).

3.9 DATA ANALYSIS AND INTERPRETATION METHODS

Data analysis according to Murali et al. (2004: 1) refers to the process of applying statistical and logical techniques to describe, illustrate, condense, recap, and evaluate data. For De Vos et al. (2005: 335), data analysis is a method of categorizing, ordering, manipulating and summarizing data to attain answers to a specific research question.

A key characteristic of data analysis in research is the production of high quality, meaningful and relevant data that makes it possible for valuable insights to emerge (Creswell, 2003: 203). Shepard (2002: 169-183) argues that an essential component of ensuring data integrity is the accurate and appropriate use of statistical analysis as improper statistical analyses could distort scientific findings, mislead casual readers, and may negatively influence the public perception of research. In line with this viewpoint, Murali et al. (2004: 1) list a number of issues that researchers should be cognizant of with respect to data analysis. They include: having the necessary skills to analyze, concurrently selecting data collection methods and appropriate analysis, following acceptable norms for discipline, determining statistical significance, providing clearly defined and objective outcome measurements; and providing honest and accurate analysis.

According to Shamoo and Resnik (2003: 32), the analysis of data in modern science involves the application of various statistical techniques such as chi-squares, t-tests, correlation, regression, analysis of variance (ANOVA) and so on. These techniques provide a way of drawing inductive inferences from data and extracting the phenomenon of interest from the study (Shamoo & Resnik, 2003: 32).

The data analysis method for this study was the t-tests. The t-test was used because the mean scores of learners were compared in the experimental and control group. According to McMillan and Schumacher (2010: 300), t-test is used in a situation when there is a comparison between two values to see if they are different. The discussion that follows in the next section will focus on the t-test technique.

3.9.1 The t-test

According to McMillan and Schumacher (2010: 491), the t-test refers to an inferential statistical procedure for determining the probability level of rejecting the null hypothesis that two means are the same. Bester et al. (2011: 47) state that there are two types of t-tests:

- The independent samples t-test
- The dependent samples t-test

These are described below.

3.9.1.1 The independent samples t-test

The independent samples t-test is used for two samples or groups that are not related. For example, a group of girls and a group of boys, or two groups that were selected by means of random sampling (Bester et al. 2011: 47). The purpose of the independent samples t-test is to determine if there is a statistically significant difference in the dependent variable between two different populations of subjects (McMillan & Schumacher, 2010: 300).

3.9.1.2 The dependent samples t-test

The dependent samples t-test is used for one sample of respondents. For example, if the scores obtained by one group in two different tests are known. The t-test for dependent samples is also used in instances in which two groups are related. For example, if they were compiled by means of the matching-selection technique (Bester et al. 2011: 47).

The steps to be followed when using a t-test is outlined by Bester et al. (2011: 47),

Step 1

Formulate the null hypothesis (Ho)

Step 2

Identify the appropriate t-test that should be used

Step 3

Calculate the t-value

Step 4

Calculate the number of degrees of freedom (df)

Step 5

From the t-distribution table, read the two critical values of t for a two tailed test at the 5% (0.00) and the 1% (0.01) levels of significance

Step 6

Interpretation: conclude whether or not the null hypothesis should be rejected. There are three possibilities or rules that are applied when deciding whether or not to reject null hypothesis (Ho),

(1) If the calculated t value is greater than the critical t-value at the 0.01 level, the null hypothesis is rejected at the 0.01 level and there is 99% confidence that a statistically significant difference between the two means does exist.

(2) If the calculated t value is greater than the critical t-value at the 0.05level (but not at the 0.01 level) the null hypothesis is rejected at the 0.05 level only, and there is 95% confidence that a statistically significant difference does exist between the two means.

(3) If the calculated t value is less than the critical t-value at the 0.05 level (the calculated value is therefore less than both critical t-values), the null hypothesis may

not be rejected. This implies that there is no significant difference between the two means.

In this study, the dependent samples t-test was used to determine the probability of rejecting the null hypothesis. The dependent samples t-test was used because the mean scores of learners in the pretest and posttest was compared in the experimental group and the control group. According to Bester et al (2011: 47), the dependent samples t-test is used in a situation if the scores obtained by one group in two different tests are known. The discussions that follow in the next section will focus on the ethical considerations of the study.

3.10 ETHICAL CONSIDERATIONS

In the context of research, ethics focuses on providing guidelines for researchers, reviewing and evaluating research, and establishing enforcement mechanisms to ensure ethical research (Rogelberg, 2008: 38). According to Neuman (2011: 116), ethical issues are the concerns, dilemmas and conflicts that arise over the proper way to conduct research.

McMillan and Schumacher (2010: 117) argue that research ethics are focused on what is morally proper and improper when engaged with participants or when accessing archival data. In the course of this study, consideration was given to the view of Christian (2000: 138-140) who states that in a research, subjects must agree voluntarily to participate, and this agreement must be based on full and open information, primary safeguard against unwanted exposure and anonymity. Cohen et al. (2007: 57) pointed out that social scientists generally have a responsibility not only to their profession in search of knowledge, but also for the subject they depend on for their work. Thus, it is important for the researcher to reveal fully his or her procedures of research to the subjects at the onset. In this study, the researcher requested the permission to embark on the research from the Baltimore circuit manager, the principals of the selected schools, and the grade 09 science teachers. In addition, the participants were fully notified about the purpose and procedure of the study. Learners were made aware that the study entails no harm to them and that they can withdraw their participation at any time without consequences.

3.10.1 CONFIDENTIALITY

Cresswell (2007: 44) pointed out that the anonymity of the participants must be protected at all times in a research study. This is in line with the code of ethics in research which requires that measures to protect the identities of participants against exposure be put in place (Denzin & Lincoln, 2000: 113). According to McMillan and Schumacher (2010: 122) confidentiality means that no one has access to individual data or the names of the participants except the researcher and that the subjects know before they participate who will see the data.

Confidentiality can be accomplished in several ways, including collecting the data anonymously, using a system to link names to data that can be destroyed, using a third party to link names to data and then giving the results to the researcher without the names, asking subjects to use aliases and reporting only group, not individual results (McMillan & Schumacher, 2010: 122). In this study, the researcher explained to the participants that their identity and the information they provided would be treated with strict confidentiality and that no information about them and their school would be disclosed. To achieve this, the researcher used alphabets instead of the learners' real names and their school when reporting the results.

3.10.2 INFORMED CONSENT

Informed consent entails that prospective research participants must be fully informed about the procedures and risks involved in research and must give their consent to participate (William, 2008: 1). According to McMillan and Schumacher (2010: 118), informed consent can be achieved by providing subjects with an explanation of the research, an opportunity to terminate their participation at any time with no penalty, and full disclosure of any risks associated with the study. Also when embarking on a research study, it is advised that the researcher obtain consent by asking subjects or the parents of minor subjects to sign a form that indicates understanding of the research and consent to participate (McMillan & Schumacher, 2010: 118). In this study, the ethical right of participants to make their own decisions about participation was observed (McMillan & Schumacher, 2010: 118). Consent forms were issued to the educators and learners to request their participation. Furthermore, they were informed that there would be no consequences or punishments if they decide to withdraw from the study at any time.

3.11 CONCLUSION

In this chapter, the research design, population, sampling, data collection methods and threats to internal validity of the study were discussed. The chapter ends with the discussion on the data analysis, interpretation methods and the ethical considerations of the study. The next section will focus on the results and analysis of the data obtained in the study.

CHAPTER 4

RESULTS, STATISTICAL ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

This study investigated the impact of student teams achievement divisions (STAD) cooperative instructional strategy on the performance of grade 09 learners in science. In order to collect data for this study, the following research questions were formulated:

- What is the impact of cooperative instructional strategy on the grade 09 learners' performance in science?
- How would performance in science differ between learners taught using cooperative instructional strategy and learners taught using traditional teaching strategy?
- How would levels of interest and motivation in science differ between learners taught using cooperative instructional strategy and learners taught using traditional teaching strategy?

To answer theses research questions, data was collected. In this chapter, the data collected in this study is analyzed, interpreted and discussed.

4.2 THE PRETEST AND POSTTEST RESULTS

This study basically investigated the impact of the student teams achievement divisions (STAD) method of cooperative learning on the performance of grade 09 learners in science. It was designed as an experiment in which the teaching strategy was the independent or the manipulated variable and the performance of learners the dependent or measured variable. Participants in the study consisted of sixty grade 09 learners from two schools that were purposively selected. The participants were divided into experimental and control group, with each group consisting of 30 learners. At the beginning of the study, both the experimental and control group were pretested with science achievement test (SAT). This was done to establish whether significant difference in academic ability existed between the groups before the start of the study. The study or treatment period lasted for four weeks during which the experimental group was taught using student teams achievement division (STAD) method of cooperative learning and the control group taught using traditional teaching method. The topics covered in both groups were the same and focused on the following natural science topics: electricity, elements, mixtures and compound; acids and alkalis. In order to determine the impact the different teaching strategies had on the performance of the learners, both the experimental and control group were tested (Posttest) using science achievement test (SAT). The following table below represents the pretest and posttest scores of learners in the experimental and control group. The pretest score reflects the scores achieved by learners in the science test at the beginning of the study while the posttest score is the score achieved by learners at the end of the four weeks treatment period. The questions in the posttest were based on the topics that were covered in both the experimental and control group. The tests lasted for one hour and were written under the same condition in both the experimental and control group. The scores obtained by learners in the tests were used as a measure of their performance in science.

Table 4.1: The pretest and posttest scores

Experimental group			Control group	
No.	Pretest score (%)	Posttest score (%)	Pretest score (%)	Posttest score (%)
1	22	64	40	60
2	16	48	24	26

3	38	68	20	24
4	24	36	32	42
5	26	66	30	48
6	20	44	34	26
7	24	68	26	26
8	32	42	10	02
9	16	34	34	26
10	24	72	26	44
11	12	38	30	34
12	28	78	12	22
13	36	72	20	16
14	32	76	26	70
15	22	66	28	26
16	38	84	26	10
17	42	80	16	20
18	34	44	36	46
19	32	70	34	62
20	24	76	52	50
21	34	66	28	28
22	18	48	36	32

23	26	70	26	18
24	16	60	22	22
25	20	36	24	34
26	32	72	22	32
27	30	68	22	46
28	40	76	30	44
29	28	60	14	34
30	12	42	28	48
Total	798	1824	808	1018
Means	26.6	60.8	26.9	33.9

From table 4.1, it can be seen that the pretest mean scores of the experimental and control group was the same (26.6% for the experimental group and 26.9% for the control group). This does suggest that both the experimental and control group were matched in terms of academic ability at the beginning of the study. The table also shows that the posttest mean score for the experimental group was 60.8%, while that of the control group was 33.9%. Since both groups were matched in terms of academic ability at the beginning of the study, any differences in the posttest mean scores could be attributed to the teaching strategies that were used in the experimental and control group during the course of the study. The result of the science test was further analyzed to determine the levels achieved by learners in the experimental and control group. The analyzed data is presented in the tables below.

Table 4.2: Analysis of the pretest scores

Level	1	2	3	4	5	6	7
	0-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-100%
Experimental group	18	10	2	0	0	0	0
Control group	19	9	1	0	0	0	0

The analysis of the pretest scores in table 4.2 above clearly show that both the experimental and control group were matched in terms of academic ability at the beginning of the experiment. This is in line with the assertion by Behr (1983) that in experimental or comparative study, the groups must be matched in all respect. The analyzed data in the table above also show that no learner in both the experimental and control group scored above 50% in the pretest. The analyzed data of the posttest for the experimental and control group is shown in table 4.3 below.

Table 4.3: Analysis of the posttest scores

Level	1	2	3	4	5	6	7
	0-29%	30-39%	40-49%	50-59%	60-69%	70-79%	80-100%
Experimental group	0	4	6	0	9	9	2
Control group	15	5	7	1	2	1	0

The analyzed data in table 4.3 clearly show that learners who were exposed to the student teams achievement division (STAD) method of cooperative learning performed better in the posttest than learners in the control group who were taught using traditional teaching strategy. The discussions that follow in the next section will focus on the statistical methods that were used to analyze data in this study.

4.3 STATISTICAL ANALYSIS

Statistics according to McMillan and Schumacher (2010: 149) are methods of organizing and analyzing quantitative data. They serve as tools that help the researcher to organize and interpret numbers derived from measuring a trait or variable. Statistical techniques are broadly categorized into two namely: descriptive and inferential statistics (McMillan & Schumacher, 2010: 149). The descriptions of the descriptive and inferential statistics are provided below.

4.3.1 DESCRIPTIVE STATISTICAL ANALYSIS

Descriptive statistical analysis transforms a set of numbers or observation into indices that describe or characterize the data. It uses mathematical formulae to organize and reduce large quantities of observation into a few numbers which represent the observation in each group of interest (McMillan & Schumacher, 2010: 149). Table 4.2 below shows the descriptive statistical analysis of the pretest and posttest scores of the experimental and control group.

Table 4.4: Descriptive statistical analysis of the pretest and posttest scores

Group	Pretest means	N	Pretest SD	Posttest means	Posttest SD
Experimental	26.6	30	8.16	60.8	10.67
Control	26.9	30	8.66	33.9	15.20

In the table above, it can be seen that both groups achieved the same pretest mean scores (26.6% for the experimental group and 26.9% for the control group); while there was a significant difference in their posttest mean scores (60.8% for the experiment group and 33.9% for the control group). The significant gain observed in the posttest mean score of the experimental group suggests that the experimental group that was taught using student teams achievement divisions (STAD) method of cooperative learning performed better in the posttest than their counterparts in the control group who were taught using traditional teaching method.

4.3.2 INFERENTIAL STATISITICAL ANALYSIS

Inferential statistical analysis studies the characteristics displayed by a sample of subjects with a view to making inferences or predictions about the population from which the sample is drawn (McMillan & Schumacher, 2010: 149). In this study, the inferential statistical method used to analyze data was the dependent samples t-test. The dependent samples t-test was used because the mean scores of the learners in the pretest and posttest were compared in the experimental and control group. This is supported by Bester et al (2011: 47) who assert that the dependent samples t-test is used in a situation if the scores obtained by one group in two different tests are known. The following formula taken from McMillan and Schumacher (2010: 480) was used to calculate the dependent samples t-test.

$$t = \frac{\bar{D}}{\sqrt{\frac{\sum D^2 - \frac{(\sum D)^2}{N}}{N(N-1)}}}$$

In the formula

$\bar{D}$ represents the mean difference for all pairs of scores

$\sum D^2$ represents the sum of the squares of the differences

$(\sum D)^2$ represents the square of the sum of the differences

N represents the number of pairs of squares

N-1 represents the degrees of freedom (which is one less than the number of pairs of scores)

The discussion in the next section will focus on the null hypotheses formulated and tested in the study.

4.4 THE NULL HYPOTHESES

According to McMillan and Schumacher (2010: 297), null hypothesis is a statement that there is no difference between the population means of two groups. That is, the population means are the same. In a research study, inferential statistical tests are employed to test or determine the probability that the null hypothesis is untrue. If the null hypothesis is false, it entails that there is a probability that there is a difference between the groups (McMillan & Schumacher, 2010: 297).

In this study, the following null hypotheses were tested

- There is no significant difference between the pretest mean scores and the posttest mean scores of the experimental group.
- There is no significant difference between the pretest mean scores and the posttest mean scores of the control group.

The results of the test will be discussed in section 4.5.1

4.5 DATA ANALYSIS AND INTERPRETATION

Data analysis is a method of categorizing; ordering, manipulating and summarizing data to attain answers to a specific research question (De Vos et al. 2005: 335). Data was analyzed through the systematic process of applying statistical and logical techniques in order to develop evidence for answering the research question (McQuillian, 2013: 1). Data interpretation involved applying statistical procedures to analyze specific facts from a study or body of research (Leigh, 2012: 1). The discussions that follow below will focus on the null hypotheses results.

4.5.1 THE NULL HYPOTHESES RESULTS

The level of significance is used to indicate the probability or chances of being wrong in rejecting the null hypothesis (McMillan & Schumacher, 2010: 298). It is also known as the level of probability (P-level), and is expressed as a decimal that indicates how many times out of a hundred or thousand one would be wrong in rejecting the null hypothesis assuming it is true. In other words, the level of significance tells one the chance probability of finding differences between the means. According to McMillan and Schumacher (2010: 298), the lower the level of significance, the more confident one is that it is safe to reject the null hypothesis.

In this study, the calculated t-value for the experimental group was 15.76 while the critical t-value at 0.01- level was 2.76. Since the calculated t-value is greater than the critical value at the 0.01 level, the null hypothesis is rejected. This means that there is a significant difference between the pretest mean scores and posttest mean scores of the experimental group. The experimental group performed significantly better in the posttest (mean of 60.8) than the pretest (mean of 26.6).

Similarly the calculated t-value for the control group was 6.1 while the critical t-value at 0.01- level was 2.8. Since the calculated t-value is greater than the critical value at 0.01- level, the null hypothesis is rejected. This entails that there is significant difference between the pretest mean scores (mean of 26.9) and posttest mean scores (33.9) of the control group. Student teams achievement divisions (STAD) instructional strategy, however, resulted in better performance (pretest mean= 26.6; posttest mean= 60.8) than traditional teaching method (pretest mean= 26.9; posttest mean= 33.9). The results of the dependent samples t-test is summarized in table 4.3 below.

Table 4.5: Dependent samples t-test results of the pretest and posttest scores

Groups	Tests	N	Mean	SD	df	t	p
Experimental	Pretest	30	26.6	8.16			
					29	15.76	<0.01
	Posttest	30	60.8	10.67			
control	Pretest	30	26.9	8.66			
					29	6.10	<0.01
	Posttest	30	33.9	15.20			

Table 4.5 above shows the dependent samples t-test results of the pretest and posttest scores. The dependent samples t-test results reveals that both the experimental and control group performed significantly better in the posttest ($p<0.01$). However, the mean scores of the pretest and posttest indicate a significant gain in the experimental group (Pretest mean = 26.6; Posttest mean = 60.8) than the control group (Pretest mean = 26.9; Posttest mean = 33.9). This entails that student teams achievement divisions (STAD) cooperative instructional strategy resulted in better performance in science than traditional teaching method.

4.5.2 GRAPHICAL PRESENTATION OF THE PRETEST AND POSTTEST SCORES

At the beginning of this study, both the experimental and control group were tested (Pretest) under the same condition to establish whether there are significant differences in terms of academic ability between the groups.

The results of the pretest established that both groups were academically matched prior to the treatment period. Having been pretested, the experimental group was taught using the student teams achievement divisions (STAD) cooperative instructional strategy while the control group was taught using the traditional teaching method.

At the end of the four weeks treatment period, both groups were tested (Posttest). This was done to establish how the student teams achievement divisions (STAD) cooperative learning method and the traditional teaching method impacted the performance of learners in the experimental and control groups respectively. The performance of the experimental group in the pretest and posttest is displayed in the line graph in figure 4.1. Similarly the performance of the control group in the pretest and posttest is displayed in the line graph in figure 4.2 below.

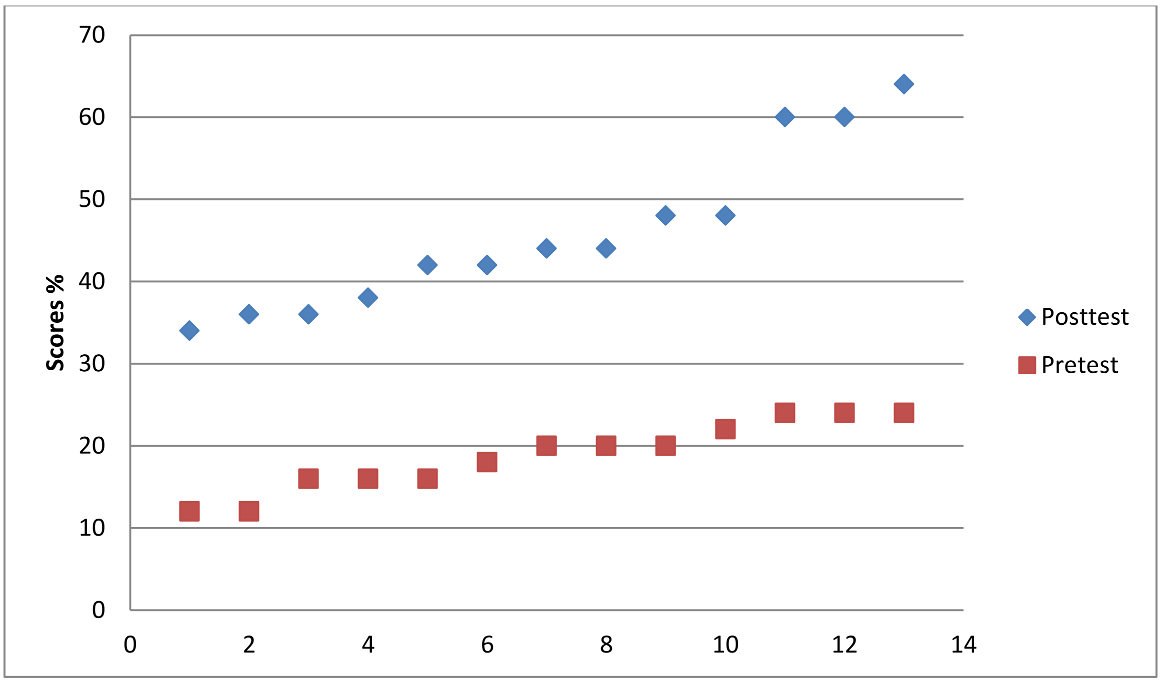

Figure 4.1: Comparative data of learners' pretest and posttest scores in the experimental group.

As evident in the graph in figure 4.1 above, learners in the experimental or cooperative learning group showed a remarkable improvement in the posttest scores when compared to their pretest scores. From the graph, it can be seen that the lowest score achieved in the pretest was 12%, this is in sharp contrast to the post test where the lowest score achieved was 34%. Similarly the highest score achieved in the pretest was 42%, this does contrast in the posttest where the highest score achieved was 84%. The graph also show that more learners achieved in the posttest as compared to the pretest after exposure to the student teams achievement divisions (STAD) cooperative instructional strategy. In the control group, there appears to be a smaller change between the pretest and posttest scores of the learners. As evident in the graph in figure 4.2, most of the pretest and posttest scores for the control group are clustered between 10% and 34%. In contrast to the experimental group (figure 4.1) where 66.7% of the learners scored above 50%, only 10% of the learners in the control group (figure 4.2) scored above 50% in the posttest. This again can be attributed to the difference in the teaching strategy that was used in the experimental and the control group.

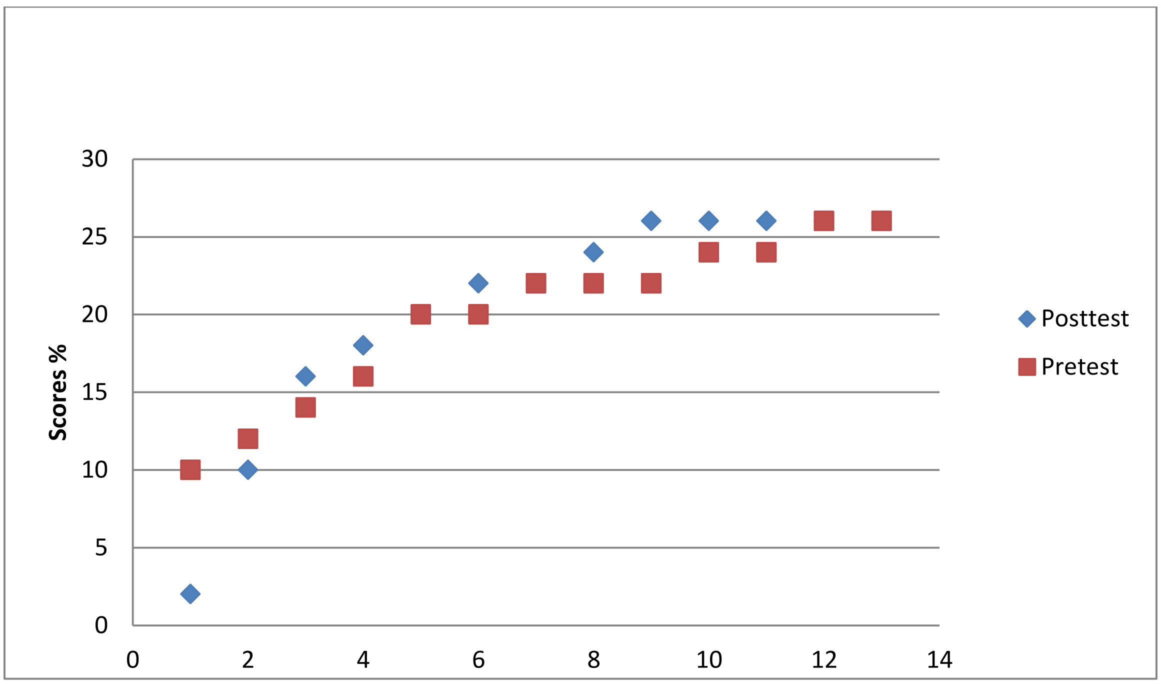

Figure 4.2: Comparative data of learners' pretest and posttest scores in the control group

In the experimental group, learners worked in small, heterogeneous groups during which they discussed the learning tasks, shared ideas and assisted one another in completing the learning tasks. Group discussions, interactions and exchange of ideas during cooperative learning are supported by Piaget's theory to promote learning. According to Piaget's theory, when learners perceive a contradiction between their existing understanding and their experience interacting with others, cognitive conflict arises. In order to resolve this conflict, learners may examine their own ideas and beliefs again, pose questions to each other, and seek further information in order to reconcile the contradictory ideas (Fushino, 2008: 20).

Another theory that provides reasons for the improved learning that occurred in the experimental group is the Vygotsky's theory of the zone of the proximal development (ZPD). Vygotsky (1978: 86) defined the zone of proximal development as the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with competent peers. In Liao's view (2005: 16), when learners work closely within one another's level of proximal development, they can receive explanations that are presented to them in a simpler and more comprehensible manner than if they were provided by one of a different mental age.

The change in the pretest and posttest mean scores for the experimental and control group is shown in table 4.3 below.

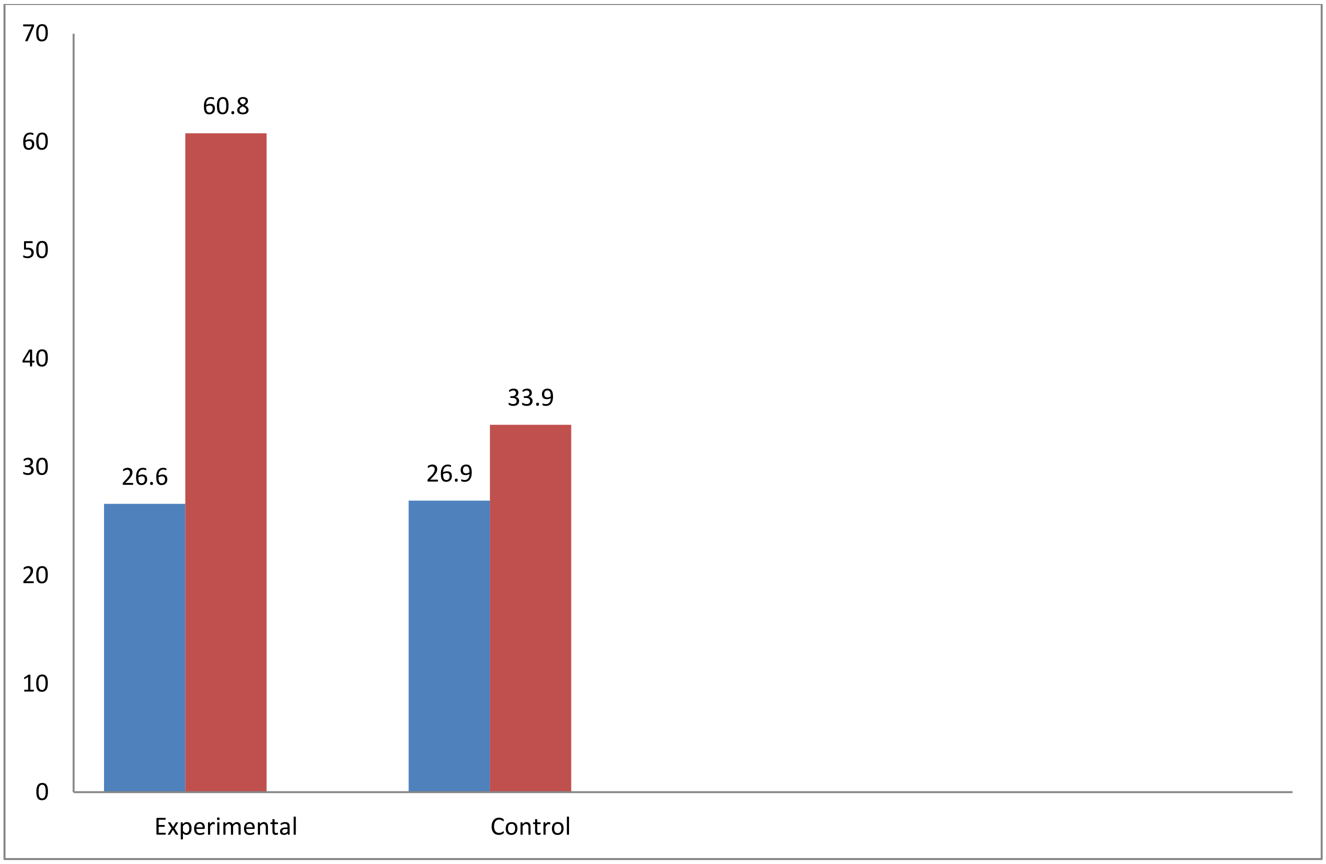

Figure 4.3: Change in pretest and posttest mean scores.

As evident in the bar graph, the posttest mean for the experimental group changed from the pretest mean by 37.2%, while in the control group the change from the pretest to posttest mean was 7%. Based on the analysis and interpretation of the data collected in this study, the conclusion reached is that learners taught using the student teams achievement division (STAD) cooperative instructional strategy performed better in science than learners that were taught using traditional teaching method. The results of this study is consistent with similar achievement studies previously reported by Van Wyk (2012: 265), Muraya and Kimamo (2011: 726-748) and Liao (2005: 179-196). The discussions that follow in the next section will focus on the findings of the interview of the learners on their experience of cooperative learning.

4.6 REPORT ON THE FINDINGS OF THE INTERVIEW

The interview was designed to explore the affective and social aspects of cooperative learning. It further sought to capture the phenomenological views of learners on the effectiveness of cooperative learning as a teaching strategy. In order to achieve the afore-mentioned objectives, a qualitative, open-ended methodology was selected as it allowed for maximum opportunity for the learners to express their views. An adapted interpretative phenomenological analysis (IPA) methodology was used to relay the narratives of the learners (Creanor et al. 2008: 28).

Interpretative phenomenological analysis (IPA) is a method for exploring how participants make sense of their own experiences and rests on the premise that the interviewee is the expert on that experience (Fade, 2004: 647-653). The use of interpretative phenomenological analysis (IPA) methodology necessitates a focused concentration on a small sample size (Reid et al. 2005: 20-23). The researcher interviewed a total of seven groups. Each group consisted of four learners, with one group having extra two learners (30 learners). For the experimental group that was interviewed, the treatment was their first experience of being taught using cooperative learning.

In response to the first question on learners' experience using cooperative learning, learners expressed that they found cooperative learning very exciting and engaging. They found the idea of assisting one another to complete a learning task very interesting. This is evident in the expression of learner A:

"Cooperative learning was exciting and enjoyable, we managed to help one another to learn and understand the task. We worked together as a group and never bored during the lessons" (Learner A).

In response to the second question on how learners' interest and motivation in science was impacted by cooperative learning, learners expressed more interest and motivation in learning science. They clearly indicated that successfully completing the assigned tasks increased their interest and motivation in learning science. This is indicated in the response of learner B:

"In our group all of us worked hard to complete the task, this has increased my interest in science" (Learner B).

In response to the third question on the impact of cooperative learning on the self-efficacy of learners in science, several learners expressed that cooperative had a positive impact on their self-efficacy in science. Learners made it clear that cooperative learning has increased their self- confidence and perception of their ability in science. This is evident in the response of learner C:

"Cooperative learning has made me realize that science is not too difficult as people say. In our group, we worked together and got high marks" (Learner C).

With regards to the fourth question that focused on the impact that cooperative learning had on the attitude and perception of science by learners, Learners expressed that cooperative learning made learning science enjoyable and much fun. The general expression by learners is that science is not that difficult. This was evident in the fact that they worked on their own in small groups and were able to complete the learning tasks. They also got good marks in the tasks. In the views of learner D:

"Science is not difficult, I now feel like science is the easiest subject that any person can do in school" (Learner D).

In response to the fifth question on how cooperative learning affected the relationship of learners in their groups, learners expressed that they worked well in their respective groups and encountered no problems. This was evident in the fact that learners were assigned complementary roles in their various groups. This increased their sense of responsibility, as learner E clearly expressed:

"I worked well with other members of my group; there were no dodgers in my group. We took everyone's ideas" (Learner E).

The discussions that follow in the next section will focus on the themes that emerged from the interview findings.

4.6.1 VIEWS ON COOPERATIVE LEARNING EXPERIENCE

One of the benefits of cooperative learning is that it offers a different paradigm for teaching and learning, in which learners discover and construct knowledge (Van Wyk, 2007: 167). The aforementioned benefit was evident in the experience of the respondents. Most learners explained that they found cooperative learning very exciting and interesting. For them, the treatment was their first time of being taught using cooperative learning. This caught their attention and kept them actively engaged in the learning activities. The expression by the following learners clearly illustrates this:

"Cooperative learning was very exciting for me, because we worked in group and assisted one another in completing the tasks. I discussed the problems with other learners in my group" (Learner F).

"The experience was great, we worked in group and I was not the only one coming up with the ideas. We worked together as a team and learn from one another" (Learner G).

The expressions above clearly show that learners engaged in discussions and exchanged ideas. Discussions and exchange of ideas during cooperative learning group work is supported by Piaget's theory to promote learning. According to Piaget's theory, when learners perceive a contradiction between their existing understanding and their experience interacting with others cognitive conflicts arises. In order to resolve this conflict, learners may examine their own ideas and beliefs again, pose questions to each other, and seek further information in order to reconcile contradictory ideas (Fushino, 2008: 20). From Piagetian perspective, the process of exchanging and reconciling contradictory ideas during cooperative learning group work results in cognitive development (Woolfolk, 2010: 324).

4.6.2 VIEWS ON INTEREST AND MOTIVATION

Motivation plays a huge role in the academic performance of learners. According to Thorndike, how hard learners work on a given task is determined by their level of interest. The greater their interest, the harder they will work, and the lower their interest the less hard they will work (Mwamwenda, 2004: 184). In the views of William and Gerald (2003), if learners are motivated to learn science, they can be expected to take initiatives for their learning, spend more efforts in science tasks, be persistent when experiencing difficulties, employ effective learning strategies, pursue understanding and meaningful learning, and eventually reach a high level of performance and achievement. Several of the learners expressed that cooperative learning increased their interest and motivation in learning science. This was particularly evident in the sense of commitment and dedication displayed by the learners during the treatment period. The expression of these respondents clearly illustrates this:

"For me, cooperative learning has made me wanting to know more about science. I find learning science much fun, I am now more inspired to learn science" (Learner H).

"Cooperative learning increased my interest and motivation in science. Where I did not understand, I asked my group members and where they did not understand, they asked me" (Learner I).

The expression by the respondent "….where I did not understand, I asked my group members and where they did not understand, they asked me" is supported by Vygotsky's theory of the zone of proximal development (ZPD) (Vygotsky, 1978: 81) where learners acquire knowledge and skills through interaction with capable others (Peers and educators). Vygotsky (1978: 81) asserted that socialization promotes learning because the process of interaction or working with others offers a learner an opportunity to operate within his or her zone of proximal development. The zone of proximal development according to Vygotsky (1978: 81) is the distance between the current level of development as indicated by what a learner can do without assistance and the level of potential development as what a learner can accomplish with assistance from either peers or adults. From this, Liao (2005: 16) argues that when learners work closely within one another's level of proximal development, they can receive explanations that are presented to them in a simpler and more comprehensible fashion than if they were provided by one of a different mental age (Liao, 2005: 16).

4.6.3 VIEWS ON SELF-EFFICACY AND PERCEPTION OF SCIENCE

One of the themes that emerged from the interview findings was an expression of increased self-efficacy and positive attitude towards science. Most of the learners expressed a positive sense of self-efficacy and change in attitude towards science. Particularly significant was the fact that learners who had earlier doubted their ability and perceive science as a difficult subject changed their attitude after exposure to cooperative learning. The expression of the following respondents clearly illustrates this:

"Many people say science is tough, but I think science is easy. If we use cooperative learning we will do well. Before my marks in science were low but now my marks are high because we used cooperative learning" (Learner J).

"Before I said that science was difficult but after we used cooperative learning I could say that science is very easy" (Leaner K).

The expressions above reinforces the claim by Omrod (2004: 417) that when properly implemented with well-designed tasks, cooperative learning has the potential to ensure that learners have a higher self-efficacy about their chances of being successful, express more intrinsic motivation to learn subject matter, participate more actively in classroom activities and exhibit more self- regulated learning.

4.6.4 VIEWS ON SOCIAL ASPECTS OF COOPERATIVE LEARNING

The benefits of cooperative learning transcend academic learning. Woolfolk (2010: 323) argues that in addition to academic learning, education can be used to instill in learners the culture of working harmoniously with all kinds of people. This view was taking into account in this study as the various cooperative learning groups consist of four learners that are diverse in terms of background, academic ability and gender. This was done to maximize learning and to improve the social relationship among the learners.

Remarkably learners were unanimous in their response on the positive impact that cooperative learning had on their relationship with other learners. They indicated that they worked together in a friendly manner with all group members putting in their best effort. This is reflected in the following expressions:

"We worked well as a group, I related well with my group members. We all tried our best to complete the tasks" (Learner L).

"We worked in a friendly manner; some of our members who did not understand the tasks were assisted by those who understood the task" (Learner M).

It is evident from the expression of respondents that in addition to making academic gains, cooperative learning improved their relationship with other learners.

4.7 CONCLUSION

In this chapter, the data collected in order to investigate the impact of cooperative instructional strategy on the performance of grade 09 learners in science was analyzed, interpreted and discussed. The analyzed data in this section showed that cooperative instructional strategy resulted in better performance in science than traditional teaching method. In addition, the interview findings revealed that learners in the experimental group experienced an increase in motivation, self-efficacy and positive attitude in science after exposure to cooperative learning. The next chapter contains the conclusions, limitations of the study and recommendations for further studies.

CHAPTER 5

SUMMARY, IMPLICATIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The poor performance of grade 09 learners in science has been a source of concern for stakeholders in education. In response to this poor performance in science, the researcher sought to explore teaching strategies that can be used to enhance the performance of grade 09 learners in science. The results of the study showed that the student teams achievement divisions (STAD) cooperative instructional strategy resulted in better performance than traditional teaching method. Therefore in this chapter, the researcher presents the summary, implications, limitations of the study and recommendations for further studies.

5.2 SUMMARY OF THE RESEARCH STUDY

This study investigated the impact of STAD cooperative instructional strategy on the performance of grade 09 learners in science. In order to collect data for the study, the research question was formulated: Would learners taught using cooperative instructional strategy perform better in science than learners taught using traditional teaching method? A mixed method approach specifically quasi-experimental design and interviews were used in order to answer the research question. Learners in the experimental group were interviewed to capture their phenomenological views on the effectiveness of cooperative learning as a teaching strategy. The target population was grade 09 learners from Baltimore circuit in Mogalakwena District. The sample consisted of sixty learners from two participating schools that were purposively selected. The sample was divided into experimental and control group with each group consisting of thirty learners. At the beginning of the study, both the experimental and control group were pretested with science achievement test (SAT).

The experimental group was taught using the student teams achievement divisions (STAD) cooperative instructional strategy while the control group was taught using traditional teaching method. At the end of the four weeks treatment period, both groups were post-tested using science achievement test (SAT). In addition to the post-test, learners in the experimental group were interviewed to obtain their views on the effectiveness of cooperative instructional strategy to their learning. The dependent samples t-test was used to analyze the pretest and post-test scores of the experimental and control group for purposes of establishing any statistical significant difference. The t-test results revealed that both the student teams achievement divisions (STAD) cooperative instructional strategy and traditional teaching method enhanced performance in science. However, the post-test scores of the learners showed that STAD cooperative instructional strategy resulted in better performance than traditional teaching method. In addition, learners in the experimental group expressed an increase in motivation, self-efficacy and positive attitude in science after exposure to cooperative instructional strategy. They were greatly motivated by the use of cooperative learning and enjoyed the interactive and learner centred aspects of cooperative learning. The results of this study is consistent with similar achievement studies previously reported by Van Wyk (2012: 265), Muraya and Kimamo (2011: 726-745) and Liao (2005: 179-196).

5.3 SUMMARY OF THE LITERATURE REVIEW

The literature review in this study was divided into six sections. Section one provided discussions on different theories that underpin cooperative learning. Among the learning theories discussed in section one were information processing theory, social interdependence theory, Piaget’s and Vygotsky’s theories. Section two provided brief historical development of cooperative learning. In section three, detailed discussion on the features and methods of cooperative learning was provided. Section four reviewed claimed benefits and limitations of cooperative learning. Section five provided discussion on the performance of grade 09 learners in natural science. Section six provided a review of the studies on the impact of cooperative learning on the academic performance of learners.

5.3.1 FINDINGS REGARDING COOPERATIVE LEARNING

The literature review indicated that cooperative learning is an instructional strategy where learners work in small heterogeneous groups to achieve a learning outcome. The success of cooperative learning as an instructional strategy is based on the fact that it has a clear theoretical foundation (Johnson & Johnson, 2009: 366). Reviewed literature showed that cooperative learning is supported by information processing theory, social interdependence theory, Piagtet's theory and Vygotsky's theory. The information processing theorists claim that group discussion helps learners to rehearse, elaborate, and expand their knowledge. As group members discuss questions and explain things to one another, they trigger the process that supports information processing (Woolfolk, 2010: 324). Group discussion in cooperative learning also promotes learning as it helps learners perceive, understand, use and remember the information they were given during group work (McDevitt & Omrod, 2004: 186).

The social interdependence theory supports the use of cooperative learning as it emphasizes positive interdependence or cooperation which encourages and motivates group members to facilitate each other's efforts to learn. This in turn helps the group to achieve their learning goal. Based on Slavin's model (1995), cooperative learning facilitates learning not only by motivating learners with shared goals but also by situating learners in social context which provides a stage for cognitive development through elaborated explanations, peer tutoring, peer modeling, cognitive elaboration, peer practice, peer assessment and correction (Liao, 2005: 26). The social cognitive theories reviewed in the literature study were Piaget's theory and Vygotsky's theory.

Piaget’s theory proposes that when learners perceive a contradiction between their existing understanding and their experience interacting with others, cognitive conflict arises. In order to resolve this conflict, learners may examine their own ideas and beliefs again, pose questions to each other, and seek further information in order to reconcile contradictory ideas (Fushino, 2008: 20). Advocates of Piaget’s theory contend that cooperative learning improves learning as interactions in groups during cooperative learning creates cognitive conflict and disequilibrium that make learners to question their understandings and try out new ideas (Woolfolk, 2010: 324).

Vygotsky’s socio-cognitive theory perceives learning as a social process that takes place in a context that allows for social interactions and communications which eventually leads to the construction of knowledge and cognitive development (Mcleod, 2007: 4-6). The fundamental concept in Vygotsky’s theory is the zone of proximal development (ZPD) which is the area between the learner’s current development level as determined by independent problem solving and the level of development that the learner could achieve through adult guidance or in collaboration with more capable peers.

Many methods of cooperative learning have been developed and tested. Most of these methods have been implemented in the classrooms and found to be effective in enhancing the academic achievement of learners. Some of the methods of cooperative learning reviewed in the literature include the student teams achievement divisions (STAD), the jigsaw method, learning together (LT), group investigation (GI), teams – games-tournament (TGT), teams assisted individualization (TAI) and cooperative integrated reading and comprehension (CIRC). The literature indicated that cooperative learning is characterized by positive interdependence, individual accountability, face to face interaction, interpersonal and small group social skills; and group processing.

Many benefits of cooperative learning were reported in the literature study. When properly implemented with well-designed tasks, cooperative learning has the potential to ensure that learners have a higher self-efficacy about their chances of being more successful, express more intrinsic motivation to learn the subject matter, participate more actively in classroom activities and exhibit more self-regulated learning (Omrod, 2004: 417). Cooperative learning has also been shown to improve social and communication skills among learners, increase tolerance and acceptance of diversity, and improve academic achievement. Some of the limitations of cooperative learning indicated in the literature study are the concern that cooperative learning is too informal to bring about a deep understanding of subject matter. Others also argued that cooperative learning is too time consuming and disruptive due to the informality of the process (Lord, 2001: 30). There is also concern that cooperative learning could make fast learners feel held back by their group members who learn much slower.

5.3.2 REVIEWED ACHIEVEMENT STUDIES ON COOPERATIVE LEARNING

In the literature study, fourteen studies on cooperative learning were reviewed for the purposes of finding outcomes for effects on academic achievement. Ten of these studies found cooperative learning effective in improving academic performance while four found it ineffective in improving academic performance. Among the studies that supported the effectiveness of cooperative learning is that of Parveen and Sadia (2012: 154) which found cooperative learning effective in improving the achievement of 9^{th} grade learners in science. The results of the study by Dennis (2004: 46-72) showed that student teams achievement divisions (STAD) method of cooperative learning resulted in better achievement in science than traditional teaching method for students at N3 level further education and training (FET) college. Similarly, the research study by Bilesami and Oludipe (2012: 307-325) showed that learning together and jigsaw methods of cooperative learning resulted in better performance of junior secondary school learners in science than traditional teaching method. The research findings of Fengfeng and Barbara (2007: 249-259) also showed that teams-games-tournament (TGT) method of cooperative learning resulted in better performance of learners in mathematics than traditional teaching method.

Reviewed studies that did not support the effectiveness of cooperative learning include the study of Kurt and Samchai (2004: 1-10) which found no significant difference between the achievement scores of learners in cooperative learning group and traditional learning group. The study of Martin and Rowland (2007: 29-41) which compared the effects of jigsaw method of cooperative learning and traditional teaching method on the achievement of grade 12 learners in physics; found no significant differences between the two groups of instructions on learners' achievement in physics.

5.4 IMPLICATIONS FOR STAKEHOLDERS

The findings of this study are very significant and support the effectiveness of cooperative learning as a teaching strategy. It has several implications for educators and other stakeholders in education with regards to teaching strategies that can be used to enhance the performance and motivation of learners in science. The extent to which learners learn depends on their level of motivation which can be stimulated by the nature of the learning environment and the teaching strategy adopted by the teacher (Mwamwenda, 2004: 235). The use of student teams achievement division (STAD) cooperative instructional strategy captured the attention of the learners in the experimental group. The novelty idea of working in small heterogeneous groups increased their motivation, self-efficacy and made learning very exciting.

While the research result supports the effectiveness of cooperative learning as a teaching strategy, it does not suggest that traditional or conventional teaching method is ineffective. Rather, it makes a case for cooperative learning to be integrated with conventional teaching method. The researcher is of the view that continuous dependence or use of the same teaching methodology could bore learners and make them lose interest in the lesson. As the researcher taught both the experimental and control group, he did observe the sense of excitement of the learners that were taught using cooperative learning. This contrasted sharply in the control group that was taught using traditional teaching method. This is not to say that learners in the control group were bored, they were simply used to traditional teaching method. They could not see any difference between the method used in the study and the method with which they have been receiving instructions. The findings of this study does suggest that STAD cooperative instructional strategy could be one of the avenues or strategies that could be used to enhance the performance and motivation of grade 09 learners in science.

5.5 RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

- Cooperative learning to be integrated with traditional teaching method in the teaching of natural sciences in grade 09.
- All grade 09 natural science educators to be trained on cooperative learning and be encouraged to use it in their classrooms.
- At the higher institutions, the use and implementation of cooperative instructional strategy in the classrooms be strengthened in the methodology courses of student teachers.

5.6 LIMITATIONS OF THE STUDY

Although several measures were taken to ensure that the outcome of the study was not compromised, however there could have been other extraneous variables or sources of error that could have placed some limitations on the reliability and generalizability of this study. These include:

1. The time frame of the study: The data collection or treatment period for this study lasted for four weeks. It is of the view of the researcher that the reliability

of the research findings would be enhanced further by a longitudinal study or a longer data collection period.

2. Potential language barriers: Although the medium of instruction in the schools in which the research was conducted was English, all the learners in these schools are English second language speakers. Therefore, it is possible that this could have influenced their understanding of the questions in the science test and the responses that they gave in the interview.
3. Some of the topics treated during this study might have been done by learners in grade 08; this could have influenced the outcome of the study.
4. Although the pretest mean scores of both the experimental and control group show that both groups were academically matched at the beginning of the study, however, individual differences in academic ability cannot be totally ruled out and could have influenced the post-test scores.
5. Size of the sample: The limited size of the sample used in this study could have influenced the degree to which the findings of the research can be generalized to other populations.

5.7 FURTHER STUDIES

In addition to contributing to the body of knowledge on cooperative learning, this research and its findings can inform further research in several areas as described below:

While the present study focused on the impact of STAD cooperative instructional strategy on the performance of grade 09 learners in science, the study may be replicated using other methods of cooperative learning such as jigsaw method, learning together (LT) and teams assisted individualization (TAI).

The research itself may be replicated but this time instead of focusing on grade 09 learners, it should focus on other grades for example grades 10, 11 and 12.

The present study investigated the impact of cooperative instructional strategy on the performance of grade 09 learners in science, future studies can focus on the impact of cooperative instructional strategy on the performance of grade 09 learners in other subjects such as mathematics, economics and management sciences (EMS) and human and social sciences (HSS).

In this study, one experimental and one control group was used. A parallel study may be carried out using more than one experimental and control group in order to see whether similar results can be obtained.

While the data collection period in this study was four weeks, a parallel longitudinal study may be conducted to see whether the result of the present study can be replicated.

5.8 CONCLUSIONS

This study investigated the impact of cooperative instructional strategy on the performance of grade 09 learners in science. In this chapter, the researcher presented a summary of the research study, literature review and the findings regarding cooperative learning. Further discussed in this section are the implications, limitations of the study and the recommendations for further studies. This chapter therefore marks the conclusion of the research study in which the research questions formulated were answered, data generated in the study analyzed and the aims of the study realized. It is hoped that the findings of this study would improve the teaching and learning of sciences in the grade 09 classrooms.

LIST OF TABLES AND FIGURES

APPENDICES

APPENDIX A: PERMISSION AND CONSENT LETTERS

P. O. Box 560

Mokopane

0600

11th of June, 2013

The Principal

Secondary school B

Dear Sir

PERMISSION TO CONDUCT RESEARCH PROJECT AT YOUR SCHOOL

I am writing to request for permission to conduct a research study in your school. I am studying for a master's degree in science education at university of South Africa (UNISA). The topic of my research is: The impact of cooperative instructional strategy on the performance of grade 09 learners in science. I have purposively selected your school because it can provide the data that I need in this study. The findings of this study would help science educators especially those that teach in the general education and training (GET) phase to make informed decisions on teaching strategies that can be used to improve the performance of learners in science. During this study, learners would be taught natural science using different teaching strategies after which they would be assessed using standardized science achievement test (SAT). I have already requested for permission from the Baltimore circuit manager and assure that there would be no lesson interruption or class disturbance during this study. For more information, feel free to contact me or my supervisor on the below contact details:

Dr. Motlhabane Abram	Nwosu C. M
motlhat@unisa.ac.za	chidieberenwosu@rocketmail.com
012 429 2840	083 768 9844

Thanks in anticipation of your cooperation

Yours faithfully,

Nwosu C. M.

LIMPOPO PROVINCE
SENIOR SECONDARY SCHOOL
2013 -06- 12
DEPARTMENT OF EDUCATION

P. O. Box 560

Mokopane

0600

11th of June, 2013

The Circuit Manager

Baltimore Circuit

Dear Sir

REQUEST TO CONDUCT RESEARCH PROJECT AT YOUR SCHOOL

I am writing to request for permission to conduct a research study at two schools in the Baltimore circuit. I am Mr. Nwosu Chidi, a master's degree student in science education at university of South Africa (UNISA). The topic of my research is: The impact of cooperative instructional strategy on the performance of grade 09 learners in science. The purpose of the study is to investigate the impact of cooperative instructional strategy on the performance of grade 09 learners in science. The study further seeks to explore teaching strategies that can be used to enhance the performance of learners in science. The findings of this study would help science educators especially those that teach in the general education and training (GET) phase to make informed decisions on teaching strategies that can be used to improve the performance of learners in science. I have purposively selected two secondary schools from Baltimore circuit for this study and hope that my request will be considered.

For more information, feel free to contact me or my supervisor on the below contact details:

Dr. Motlhabane Abram	Nwosu C. M
motlhat@unisa.ac.za	chidieberenwosu@rocketmail.com
012 429 2840	083 768 9844

Thanks in anticipation of your cooperation

Yours faithfully,

Nwosu C. M.

Approved

DEPARTMENT OF EDUCATION

2013 -06- 12

P.O. BOX 214 REBONE 0617

LIMPOPO PROVINCE

P. O. Box 560

Mokopane

0600

11th of June, 2013

The Principal

Secondary school A

Dear Sir

PERMISSION TO CONDUCT RESEARCH PROJECT AT YOUR SCHOOL

I am writing to request for permission to conduct a research study in your school. I am studying for a master's degree in science education at university of South Africa (UNISA). The topic of my research is: The impact of cooperative instructional strategy on the performance of grade 09 learners in science. I have purposively selected your school because it can provide the data that I need in this study. The findings of this study would help science educators especially those that teach in the general education and training (GET) phase to make informed decisions on teaching strategies that can be used to improve the performance of learners in science. During this study, learners would be taught natural science using different teaching strategies after which they would be assessed using standardized science achievement test (SAT). I have already requested for permission from the Baltimore circuit manager and assure that there would be no lesson interruption or class disturbance during this study. For more information, feel free to contact me or my supervisor on the below contact details:

Dr. Motlhabane Abram	Nwosu C. M
motlhat@unisa.ac.za	chidieberenwosu@rocketmail.com
012 429 2840	083 768 9844

Thanks in anticipation of your cooperation

Yours faithfully,

Nwosu C. M.

DEPARTMENT OF EDUCATION
SECONDARY SCHOOL
2013 -06- 12
P.O. BOX 214 REBONE 0617
LIMPOPO PROVINCE

Approved

P. O. Box 560

Mokopane

0600

12th of June, 2013.

CONSENT LETTER

TO WHOM IT MAY CONCERN

I am conducting a research for a master's degree in science education at the University of South Africa (UNISA). My research topic is: The impact of cooperative instructional strategy on the performance of grade 09 learners in science. I would like you to participate in this study. The purpose of the study is to investigate the impact of cooperative instructional strategy on the performance of grade 09 learners in science. Participation in this study is voluntary and you are free to withdraw from the study at any time, without any consequences or punishment. As a participant in this study, your identification will remain anonymous and the information you supply will remain confidential and will not be used for any other purpose other than for the purpose of this research. For more information feel free to contact me or my supervisor on the contact details:

Dr. Motlhabane Abram	Nwosu C. M.
motlhat@unisa.ac.za	chidieberenwosu@rocketmail.com
012 429 2840	083 768 9844

Yours Faithfully

Nwosu C. M.

I.. am aware of the purpose and the procedures of this study and hereby agree to participate. I am also aware that my participation is voluntary and that I can withdraw my participation at any time if I so wish.

....

Signature Date

APPENDIX B: PRETEST AND POSTTEST

Natural Science Test (Pretest)

Grade: 09

Date: 15.07.2013

Duration: 1 Hour

Marks: 50

Instructions: Answer all the questions and number your answers correctly.

Question 1

Four possible answers are given for each question; choose the correct letter (A-D) that corresponds to question numbers (1.1-1.10).

1.1 The pH of stomach in a normal person is most likely to be…

A 7 B 10 C 2 D 14

1.2 Sodium chloride, Nacl is an example of…

A mixture B compound C element D atom

1.3 Adding light bulbs in parallel……. the resistance in the circuit

A increases B decreases C stays the same D doubles

1.4 The pH of lemon juice is…….

A less than 7 B more than 7 C equal to 7 D approximately 7.8

1.5 Coca cola drink Is an example of…….

A element B mixture C compound D base

1.6 In an electric circuit, current is measured with

A voltmeter B ammeter C rheostat D resistor

1.7 Of the following, the property that most closely relates to acid is

A bitter taste B soap feel C sour taste D salty taste

1.8 The total resistance of a 2Ω and 4Ω resistors connected in parallel is…..

A 6Ω B 7Ω C 1.3Ω D 2Ω

1.9 Copper is an element because

A it consists of different materials B it is made up of different atoms

C it cannot be broken down into simpler substances

D it can be separated into its components

(10)

Question 2

Match the words in column A with the correct statement in column B. Write only the letter A-J that matches question numbers 2.1-2.10

Column A	Column B
2.1 pH	A circuit
2.2 Indicator	B Compound
2.3 Carbon	C An acid
2.4 spices	D Ampere

2.5 The unit of current	E Measures potential difference
2.6 Lemon	F C
2.7 Calcium carbonate	G supplies energy in a circuit
	H Concentrations of hydrogen ions in a substance
	I Mixture
	J Substance used to detect acid or base
	(8)

Question 3

3.1 Draw and complete the table below, provide the symbols for the circuit component in the table.

Component	Symbol
Cell	
Battery	
Light bulb	
Open switch	
Resistor	
	(5)

3.2 A group of grade 09 learners were provided with three cells of 1.5V each, a switch, an ammeter, a voltmeter, 2Ω and 3Ω resistors and a light bulb.

3.2.1 Draw a circuit diagram to show how you would connect the circuit components to light the bulb. (3)

3.2.2 Calculate the total resistance in the circuit if the two resistors were connected in

3.2.2.1 Series (2)

3.2.2.2 Parallel (2)

Question 4

4.1 Explain the following terms and give an example of each

4.1.1 Element (3)

4.1.2 Compound (3)

4.1.3 Mixture (3)

Question 5

1.1 Some common examples of household acids and bases are given below:

Soap, lemon juice, vinegar, oven cleaner and sodium bicarbonate. Draw the table below and complete it by writing the acids and bases in the correct column

Acids	Bases
	(5)

5.2 You are investigating the neutralization of a solution of caustic soda (Sodium hydroxide) and dilute hydrochloric acid. (2)

5.2.1 Write two common household products that are formed in the reaction (2)

5.2.2 Write a balanced chemical equation for this reaction (4)

Total: 50

Natural Science test (Posttest)

Grade: 09

Date: 09.08.2013

Duration: 1 Hour

Marks: 50

INSTRUCTIONS: ANSWER ALL THE QUESTIONS, NUMBER YOUR ANSWERS CORRECTLY.

QUESTION 1

Four possible answers are given for each statement, choose the answer that is correct and write the letter (A-D) of this answer next to the corresponding number (1.1-1.10) of the question.

1.1 Out of the following, the property that most closely related to acids is…..

A sour taste B contains the hydroxide ion C Bitter taste D salty taste

1.2 A substance with a pH of 3 is a/an…..

A base B acid C metal D carbon

1.3 Achar is an example of…..

A ion B compound C mixture D solution

1.4 When an acid reacts with a base………will form

A carbon dioxide B salt C compound D salt and water

1.5 Adding resistors in series….the resistance in the circuit

A increases B decreases C stays the same D doubles

1.6 A substance that has a pH of 8 is a/an…

A Acids B base C element D metal

1.7 In a circuit, an ammeter is used to measure the ….

A voltage B resistance C current D light

1.8 The symbol for potassium is….

A Na B P C K D pt

1.9 Carbon is an element because…..

A it consists of different atoms B it can be split into different atoms

C it cannot be broken down into simpler forms D it consists of different materials

1.10 The total resistance of 2Ω, 1Ω and 3Ω connected in series is….

A 5Ω B 2.5Ω C 6Ω D 7Ω

(10)

QUESTION 2

Write only the correct word for each of the following descriptions next to the question number.

2.1 The pathway of electric current

2.2 The chemical symbol for sulfur

2.3 The instrument in a circuit used to measure current

2.4 A substance that consists of two or more elements combined in a fixed ratio

2.5 The reaction between an acid and a base

(5)

QUESTION 3

Draw the table below and fill in the information

Name	Symbol	Function
Cell		
Closed switch		
Voltmeter		
Resistor		
Ammeter		

(10)

QUESTION 4

4.1 The table below shows group 1 and group 7 elements. Use it to answer the questions that follow.

Group 1	Group 7
H	F
Li	Cl
Na	Br
K	I

4.1.1 Write the formula of five different compounds using the elements in group 1 and group 7 in the table above (5)

4.1.2 List three examples of

4.1.2.1 Homogeneous mixture (3)

4.1.2.2 Heterogeneous mixture (3)

QUESTION 5

5.1 Consider the pH values given below and answer the questions that follow

1	2	3	4	5	6	7	8	9	10	11	12	13	14

What will be the pH of the

5.1.1 Strongest acid? (1)

5.1.2 Weakest acid? (1)

5.1.3 Weakest base? (1)

5.1.4 Strongest base? (1)

5.1.5 Neutral solution? (1)

5.1 List three examples of:

5.2.1 Domestic products that contain acids (3)

5.2.2 Domestic products that contain base (3)

5.3 Neutralization is a reaction between an acid and a base to form salt and water.

5.3.1 Write a balanced chemical equation for the reaction between caustic soda (NaOH) and hydrochloric acid (Hcl). (3)

TOTAL: 50

APPENDIX C: FOCUS GROUP INTERVIEW DATA

Table 1 Question 1: How would you describe your science learning experience using cooperative learning?

Learner A	Learner F	Learner G
Cooperative learning was exciting and enjoyable, we managed to help one another to learn and understand the task. We worked together as a group and never bored during the lessons.	Cooperative learning was exciting for me because we worked in group and assisted one another in completing the tasks. I discussed the problems with other learners in my group.	The experience was great, we worked in group and I was not the only one coming up with the ideas. We worked together as a team and learn from one another

Table 2 Question 2: How did cooperative learning impact on your interest and motivation in natural science.

Learner B	Learner H	Learner I
In our group all of us worked hard to complete the task, this has increased my interest in science.	For me cooperative learning has made me wanting to know more about science. I find learning science much fun, I am now more inspired to learn science.	Cooperative learning increased my interest and motivation in science. Where I did not understand, I asked my group members and where they did not understand, they asked me.

Table 3 Question 3: In what ways has the personal perception of your ability in science been impacted by cooperative learning?

Learner C	Learner D	
Cooperative learning has made me feel that science is not too difficult as people say. In our group, we worked together and got high marks.	Science is not difficult, I now feel like science is the easiest subject that any person can do in school.	

Table 4 Question 4: What impact did cooperative learning have on your perception of science as a subject?

Learner J	Learner K	
Many people say science is tough, but I think science is easy. If we use cooperative learning we will do well. Before my marks in science were low but now my marks are high because we used cooperative learning	Before I said that science was difficult but after we used cooperative learning I could say that science is very easy.	

Table 5 Question 5: How would you describe your relationship with other members of your group?

Learner L	Learner M	Learner N
We worked well as a group, I related well with my group members. We all tried our best to complete the tasks.	We worked in a friendly manner. Some of our members who did not understand the tasks were assisted by those who did understand.	I cooperated well with my group members. We all tried our best to complete the tasks.

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