The Implementation of Cooperative Teaching and Learning in South African Science Classrooms

by

Mekidela Zeru Belay

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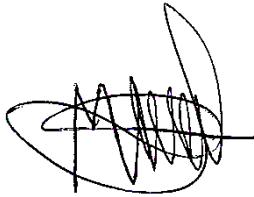**UNIVERSITY OF PRETORIA**

Supervisor: Dr. K. Mathabathe

Co-supervisor: Prof. E. Gaigher

SEPTEMBER 2021

Declaration

I declare that the dissertation/thesis, which I hereby submit for the degree Masters in Science, Mathematics, and Technology Education at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

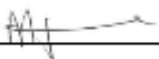MEKIDELA ZERU BELAY

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Ethical Statement

The author, whose name appears on the title page of this thesis, has obtained, for the research described in this work, the applicable research ethical approval.

The author declares that s/he has observed the ethical standard required in terms of the University of Pretoria's code of ethics for researchers and the policy guidelines for responsible research.

Dedication

I dedicate this thesis to my better half Belish and my delightful kids Abigo and Ami.

Acknowledgements

This thesis would not have been possible without the grace and tireless mercy of the Almighty God and our mother Holy Saint Mary. There were many days when I thought it might not be the time to pursue my study due to the unexpected incidents but His grace helped me to continue and He gave me a supervisor who is like a sister to me. "I will praise thee, O Lord, with my whole heart; I will shew forth all thy marvellous works." Psalm 9:1.

I extend my humblest gratitude to my down-to-earth, humble, and knowledgeable supervisor and co-supervisor, Dr Kgadi Mathabathe and Prof Estelle Gaigher, for their continuous, marvellous, and tireless support and guidance through each step of the study. The completion of this study is due to their insightful and timeous feedback.

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Abstract

The general view of the literature is that there is not ample research on the implementation of Cooperative Teaching and Learning Strategy (CTLS) in South African science classrooms. This study explored the implementation of CTLS by following a qualitative case study approach. The study focuses on the description of CTLS, factors which facilitate and hinder the implementation of CTLS, as well as the implementation of CTLS in real classroom contexts. The full sample consisted of 21 purposively selected science teachers with four of the teachers observed while applying CTLS in their classrooms. Non-participant observation was used to observe the activity of the teachers, and their engagement with the learners, as they implemented CTLS in their classrooms. Video recorded classroom observations were supplemented by an observation checklist. Data from the participating teachers was collected through audio recorded interviews and semi-structured questionnaires.

Content analysis was used deductively to gather insights into the status quo with regards to the understanding of CTLS by the participants as well as their experiences of implementing CTLS. The findings indicated important aspects to consider. Firstly, the teachers who have the necessary training regarding CTLS, and are encouraged by the school environment, implement CTLS frequently. Secondly, the major obstacles to using cooperative learning include large class size, teaching load, and the lack of laboratory resources. Lastly, the teachers' years of teaching experience do not affect the proper implementation of cooperative learning. On the contrary, their motivation and interest in using CTLS play a vital role.

Key Terms: Cooperative Teaching and Learning Strategy (CTLS), Cooperative learning, Facilitating factors of cooperative learning, hindrances of cooperative learning

Language editor's letter

Postnet Suite 248, Private Bag X1, Melrose Arch, 2076

Chirne22@gmail.com

082 782 7376

EDITED

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The Implementation of Cooperative Teaching and Learning in South African Science Classrooms
Author: Mekidela Zeru Belay

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List of abbreviations

CTLS	Cooperative teaching and learning strategy
CAPS	The curriculum and assessment policy
PCK	Pedagogical content knowledge

Table of Contents

List of Figures

List of Tables

1.   CHAPTER 1: INTRODUCTION TO THE STUDY

1.1   INTRODUCTION

Cooperative teaching and learning strategy (CTLS) is one of the learner-centred teaching methodologies and uses group work to promote learning. Regardless of different academic abilities and backgrounds, learners work together towards a common goal to accelerate their own and each other's learning (Serafin, 2016). CTLS is informed by social constructivism which advocates for learning in social contexts to reduce cognitive load and promote in-depth learning and student engagement.

Eymur and Geban (2017) asserted that cooperative learning is active learning that can enhance cognitive development, develop scientific conceptual understanding, diminish misconceptions, increase sociability, and increase the positive attitudes of learners towards the subject matter. Also, Huang, Wang, Chen, and Chou (2017) mentioned that CTLS is advantageous towards the growth of decision making, problem identification and solving, critical thinking, and social skills. Moreover, it advocates for mutual respect and an understanding of learners' individuality. These skills develop through the successful implementation of CTLS and are essential skills for the current work environments (Serafin, 2016).

However, all of the outcomes which are achieved through CTLS require appropriate implementation. Following a qualitative research design approach, this study aims to investigate the execution of CTLS in South African science classrooms. This introductory chapter explains the background of the study, the study's rationale, the problem statement, the significance, the scope and delimitation of the study, the concept clarification, and the researcher positionality.

1.2   BACKGROUND OF THE STUDY

Education is one of the most important contributing factors to the economic development of a country. Through education, a suitable environment for teaching and learning is created in order to promote the desired changes in learners. The essence of teaching and learning is to plan content and implement assessment strategies that can be used to gauge the extent to which the expected learning outcomes are met and ascertain to what extent the learners have acquired the intended competencies

(Sutanto, Minantyo, & Kodrat, 2017). The current global problems associated with graduates are the lack of the necessary skills for the work environment and the consequent increase in unemployment in the workforce (Sutanto et al., 2017). Graduates are deficient in creative, interactive, and application skills that are important to interrelating the theory learned with real challenges experienced. This deficiency is aggravated in subjects related to science (Stéphan, Carlos, Mathias, Meritxell, Gwénaël, Joaquin, & Quentin, 2019). This is attributed to the teaching and/or learning methodologies that are being implemented in schools and tertiary education institutions (Okolie, Igwe, Nwosu, Eneje, & Mlanga, 2020).

South Africa embarked on an outcomes-based education system after the fall of the apartheid government in 1994. It was replaced in 2011 by the current Curriculum Assessment Policy Statements (CAPS). These curricula focus on a learner-centred teaching methodology. The current education system of South Africa encourages teachers to use CTLS to help learners to develop 21st century skills such as interpersonal, problem-solving, and negotiation skills. Additionally, it encourages the learners to embrace and share their cultures and indigenous knowledge.

The Curriculum and Assessment Policy Statements (CAPS) of South Africa state that learners should be able to identify and solve problems and make decisions using critical and creative thinking. "Working individually and with other team members, organize and manage themselves and their activities responsibly and effectively, collect and analyse, organize, and critically evaluate information." (DBE, 2011, p. 4). This list of required skills may demonstrate the interest of the South African education system in encouraging teachers to implement teaching methodologies such as CTLS.

CTLS is one of the innovative teaching and learning methodologies which require learners to work together towards shared goals. Numerous studies have reported that this teaching methodology, if implemented correctly, is the preferred strategy to develop communicative, social, and discussion skills, to enrich the self-esteem of learners, and to enhance the cognitive development of learners with different academic abilities (Baghcheghi, Koohestani & Razaei, 2011; Baker & Clark, 2010; Gillies

& Boyle, 2008; Jolliffe, 2007; Millis, 2010; Nurhayati & Hartono,2017). However, this strategy requires the ability, knowledge, and interest of the teachers (Johnson & Johnson, 1986).

Different aspects must be considered for the successful implementation of CTLS to occur. According to Baker and Clark (2010), Johnson et al., (2014), and Brodie and Pournara (2005), the mandatory elements to consider for the successful implementation of CTLS are group size, resource allocation, well-organised tasks, as well as the content and pedagogical knowledge of the teachers.

The success of the cooperative learning aspect of the strategy depends on the presence of positive interdependence, face-to-face interaction, individual accountability, social engagement, and coordinated group activity amongst the group members. Formal evaluation of group processes through formative and summative assessment methods is also key in the implementation of CTLS (Jolliffe, 2007).

The South African curriculum advocates for learner-centred instruction and the education system strives to achieve the successful implementation of learner-centred teaching through in-service training and other support mechanisms (Omodan, 2019). However, there is no adequate research on its effectiveness and implementation in the schools (Brodie & Pournara, 2005). Singaram, Van der Vleuten, Stevens, and Dolmans (2011) stated in their study *For most Africans, we do not just speak...* that there is a need for qualitative research, as first-hand observer in a contextual situation, on the implementation of CLTS. In light of this, studying the implementation of CTLS in the current context of South Africa was imminent.

The study intends to understand and explore the status of the implementation of CTLS in science classrooms in selected high schools in Pretoria, South Africa. Furthermore, it attempts to pinpoint the factors which either facilitate or hinder the implementation of CLTS through a qualitative case study research approach.

1.3   RATIONALE OF THE STUDY

As a science teacher, the researcher is interested in studying the implementation of CLTS for several reasons. Firstly, due to an experience and observations made whilst

teaching chemistry in secondary schools in Ethiopia. The schools encouraged teachers to train learners on the aspects and outcomes of CTLS and their responsibilities towards the successful execution of CTLS at the beginning of each year. However, most teachers simply taught the learners based on the training booklet as they were not exposed to the necessary training on this teaching methodology during their tertiary studies. Due to this, the implementation of CTLS was not successful. Instead, learners, especially top achievers, became frustrated by the workload that they experienced. Only a few teachers were able to implement CTLS according to expectations and to achieve the outcomes successfully.

Secondly, CLTS requires learners of different academic abilities to work together (Baker & Clark, 2010; Alexander & Van Wyk, 2014; Wyk, 2012) to develop social engagement, decision making, and critical thinking skills (Millis, 2010; Sharan, 2010; Wyk, 2012; Eymur & Geban, 2017). Its implementation requires positive interdependence, face-to-face interaction, interpersonal skills, individual accountability, and group processing (Baghcheghi et al., 2011; Johnson et al., 2014). Thus, CTLS is recommended for the preparation of learners for the current working conditions and lifestyle requirements.

Thirdly, there is insufficient research in the teaching methodology category on the implementation of CTLS in South African classrooms specifically. Nevertheless, the outcomes envisaged by the CAPS can be acquired through CTLS and teachers are encouraged to use it as one of the methods of group work. Therefore, the study is motivated by the researcher's interest in group work teaching methodology, particularly the implementation of CTLS, and to explore factors that obstruct or support it.

To the researcher's knowledge, similar research has not been conducted previously in South Africa at high school level. In light of this, the study may provide evidence of the following:

- How CTLS is being implemented in South African science classrooms
- Whether or not science teachers have an adequate understanding of CTLS and its implementation

4

- Teachers' opinions on the relevance of CTLS for the academic and personality development of learners
- Identification of the elements that influence the successful implementation of CTLS in science classrooms

This evidence would have paramount importance to Basic Education by indicating the challenges teachers face in the implementation of CTLS as well as the types of training and support that ought to be offered to science teachers to enable them to implement CTLS properly. In addition, it may motivate successfully similar research on a large scale to investigate the topic throughout the country.

1.4   RESEARCH PROBLEM

Following the fall of the apartheid government in South Africa, the education system has been focusing on inclusive learning. It focuses on learner-centred instruction methodologies which can prepare learners for their future careers (Nel, Müller, Hugo, Helldin, Bäckmann, Dwyer, & Skarlind, 2011). Several research studies have been conducted on the implementation of CTLS internationally. However, no qualitative studies have been conducted on the implementation of CTLS in South African science classrooms.

The South African education system intends to empower learners in science theory as well as practical knowledge and attempts to develop learners' critical thinking, problem identifying and solving, and interpersonal skills. However, these goals of the curriculum are yet to be achieved as expected (Seehawer, 2018). CTLS has a theory base through research and practices internationally, and it is a well-known method of instruction for the development of learners' cognitive skills. Nevertheless, in South Africa, most research focuses on the effectiveness of the new curriculum and teachers' perceptions of inclusive teaching (Fataar, 2018). Thus, the implementation of learner-centred methodologies in science classrooms through observation needs to be researched (Zenda, 2017). Hence, the current study is imperative to bridge this research gap to provide research outputs on cooperative learning in South Africa. It will open the door for a large-scale study to be conducted on cooperative learning.

1.5 PURPOSE OF THE STUDY

This study aims to explore and identify methods to manage the implementation of CTLS in South African science classrooms in Gauteng province. Furthermore, it determines the enabling and obstructing factors teachers face when they implement this teaching strategy. Finally, recommendations are made to the Gauteng Department of Basic Education and pertinent stakeholders regarding opportunities to address the existing challenges.

In conducting the research, the researcher referred to and analysed documents, observed classrooms while teachers used CTLS, interviewed teachers, and dispatched as well as collected the feedback of questionnaires to obtain the necessary data. Appropriate qualitative data analysis techniques were used to analyse the data in order to draw essential conclusions.

1.6 OBJECTIVES AND RESEARCH QUESTIONS

The objectives of the study were the following:

- To determine how South African science teachers describe CTLS
- To identify the factors that influence the use and non-use of CTLS in science classrooms
- To identify the challenges that teachers face while implementing CTLS in their science classes
- To determine how science teachers implement CTLS in South African classrooms

The following research questions informed this study:

1.6.1 The main research question

How can the implementation of CTLS in South African classrooms be understood?

1.6.2 Sub-questions

- How do South African science teachers describe CTLS?

- What factors facilitate the implementation of CTLS in South African science classrooms?
- What factors impede the implementation of CTLS in South African science classrooms?
- How do the participating science teachers implement CTLS in their classrooms?

1.7   DEFINITIONS OF KEY TERMS

⬥ Cooperative teaching and learning strategy (CTLS)

Cooperative teaching and learning strategy (CTLS) is one of the learner-centred teaching methods applied in small groups of learners to maximize individual learning through sharing responsibility, interdependence, face-to-face interaction, and requiring individual accountability (Johnson et al., 2014). For the current study, the term refers to a learner-centred teaching methodology that enables learners of varying academic ability to work together towards shared goals while supporting each other's learning.

⬥ Implementation of CTLS

Implementation is a process of execution of a plan that has been decided on (Simpson, 2009). For the current study, the term entails the implementation of CTLS by teachers in real classroom contexts.

⬥ Pedagogical content knowledge (PCK)

Pedagogical content knowledge (PCK) is a process of integration, organisation, and adaptation of content with a suitable teaching strategy to transform the content knowledge comprehensively for learners to develop knowledge by themselves (Mishra & Koehler, 2006). For the interests of this study, PCK is demonstrated by the ability of teachers to use CTLS with integrated science knowledge to achieve a comprehensive understanding of the lesson outcomes by the learners. The scope of this study does not include the measurement of the PCK of teachers. Instead, PCK is regarded as one of the factors that facilitate the implementation of CTLS.

♣ Facilitating factors

Facilitating is a process of making something possible or easy (Simpson, 2009). In this study, facilitating factors refer to factors that promote aspects of the successful implementation of CTLS.

♣ Impeding factors

Impeding is something that can stop something from progressing (Simpson, 2009). For this study, impeding factors are the factors that hamper the implementation of CTLS in one way or another.

1.8   RESEARCHER POSITIONALITY

Researcher positionality refers to the physiognomies of the researcher, which are gender, race, association, age, sexual alignment, immigration status, personal experience, trust, prejudices, preferences, theoretical, political, and ideological positions, as well as customs of conversations with the participants (Berger, 2015).

The implementation of CTLS can be explored best using a qualitative case study approach. Since the qualitative research approach is used to gain empirical evidence in a real-life context (Levitt, Bamberg, Creswell, Frost, Josselson, & Suárez-Orozco, 2018), the relation of the researchers with the topic being studied, the participants of the study, and the ideology of the researcher play a vital role in the findings of the research. As a result, the researcher should indicate his/her positionality in the research so that the reader can easily understand the findings of the study (Berger, 2015; Levitt et at., 2018). In this section, a portrayal of the researcher is provided in a bid to express how positionality may have influenced the discussion and interpretation made during the study.

I am a black female living in Pretoria, South Africa. I was born in 1988 and grew up in Addis Ababa, the capital city of Ethiopia. My home language is Amharic which is the national language of the country. All of the schools that I attended are public schools, except in grade nine. I went to a private school then came back to the public school because of the financial crisis that my family experienced.

Since pursuing Education, I have been following the philosophy of my parents which is that an education is everything that is required to accomplish all the good things in life. I was an active student, having equal interest in all my subjects, and was a top student until grade 12. I have no recollections of being expected to work in groups for most of my school years except in grade 11 when our mathematics teacher gave us group work and asked us questions randomly. If a group member failed to give the correct answer, the group would lose a mark. I believe that we formed a better understanding of the mathematical concepts when we completed the tasks in groups. During grades 11 and 12, we had to pay school fees and this led to working as a tutor to the lower grades to provide money for my school fee. After taking a national exam (grade 12 matric) in 2007, I obtained a passing mark to enter university. I was accepted by the University of Addis Ababa's College of Education to be a chemistry teacher with a major in chemistry and a minor in mathematics.

After three years, I completed my first degree. I was teaching chemistry to learners from grade nine to grade 12 in a public school from 2009 to 2014. In 2015, I joined the University of Pretoria to proceed with my honour's degree in the science, mathematics, and technology education department. It was during this time that I was introduced to research methodology in practice. Levitt et al. (2018) indicated that the ontological, epistemological, and methodological choice of a researcher depends on the researcher's worldview. To this end, my belief is informed by the constructivist worldview.

I cannot deny that my philosophical stance has impacted my topic choice and the research approach. This ultimately impacted my interpretation and discussion of the current study's findings. I trust that cooperative teaching and learning execution is better explored through classroom observations, interviews, and document analysis as this study seeks to better understand how South African science teachers implement CTLS. Such insight is better gained through a qualitative approach by understanding the concept in real-life contexts. Nevertheless, I followed all the procedures to ensure the trustworthiness and credibility of the gathered information and to ensure its discussion and interpretation are rigorous, transferable, and useful.

1.9   SIGNIFICANCE OF THE STUDY

Insufficient research has been done in South African secondary schools to investigate the effectiveness of cooperative learning and to identify the factors affecting the implementation of this strategy (Brodie & Pournara, 2005). Conducting this research contributed to theory and practice in the following ways:

- Participating teachers shared their experiences with regards to the implementation of CTLS;
- School principals will get a sense of the realities in terms of the implementation of CTLS, the factors that encourage and impede this implementation, and the actions that must be taken to find solutions for the challenges to the sustainable implementation of CTLS in their schools. As a result, they will obtain the necessary information to advocate for the appropriate training of their teachers;
- This research may be used as a starting point for other researchers to conduct similar research on a larger scale;
- Policymakers have been provided with information regarding the factors affecting CTLS in the current school environment. This may enable them to devise more conducive school and classroom contexts for the effective implementation of CTLS.

1.10   SCOPE AND DELIMITATION OF THE STUDY

This research aims to explore the implementation of CTLS in South African science classrooms. This study used observation, interviews, and questionnaires as data collection techniques. The study does not refer to all high schools in South Africa or claim to understand how all science teachers implement CTLS in their classrooms. Therefore, this study aims to investigate and understand the implementation of CTLS in selected secondary schools in Pretoria. However, it does not evaluate the content knowledge and other learner-centred pedagogical methodological knowledge of the teachers.

1.11   CHAPTER SUMMARY

This chapter presents an overview of this study which includes the background of the study and brief explanations of the rationale, the research problem, and the

significance of the study. In addition, the definitions of key terms, objectives, scope, and delimitation of the study have also been provided.

The next chapter addresses the literature review and conceptual framework which directs this study.

2. CHAPTER 2: LITERATURE REVIEW

2.1. INTRODUCTION

Currently, no specific literature on the implementation of CTLS in South African classrooms is available. However, many studies have been conducted elsewhere on CTLS and its implementation. It has been reported that CTLS is one of the group work strategies that enhances learners' performance and develops different social skills which are required for the current global environment (Laguador, 2014; Miller, 2017; Tadesse & Gillies, 2015).

The teaching and learning process of a country plays a vital role in the development of the country. The teaching environment must therefore be suitable for learners to acquire and develop critical scientific knowledge and science processing skills. Unfortunately, different challenges exist in the teaching and learning process at the moment. As a result, learners often acquire inadequate scientific knowledge that is incompatible with the global environment (Johnson, & Fankhauser, 2018). South Africa is being affected by these challenges and should address them adequately in order to direct the future generation correctly. One of the factors that negatively affect the quality of education is that teaching is mostly teacher-centred and thus deprives learners of the opportunity to actively participate in their own learning (Molla & Muche, 2018).

The quality of education in South African secondary schools is also being affected by other factors such as high teacher turnover, poor classroom management, unprofessional behaviour of teachers, lack of proper school management, and insufficient school resources (Hoadley, 2012). This literature review provides an overview of what CTLS means, the implementation of CTLS, as well as the factors that impede and facilitate the successful implementation of CTLS.

2.2 CTLS AND ITS MEANING

Group work is an influential instructional methodology which allows learners to discuss and share ideas during the process of solving the delegated task (Cohen, & Lotan, 2014). The goal of group work varies, based on the learning outcomes to be achieved.

12

There are three types of group work, namely, cooperative, collaborative, and focused on problem-solving learning, which are based on theory and intensive research (Bosch, 2017; Davidson, & Major, 2014). These three group work types involve active learning. This provides learners with the opportunity to discuss the subject matter, both inside and outside of the classroom, and helps them to think critically about the solutions to problems connected to the discussed matter.

social interdependence, cognitive development, behavioural learning, and cognitive collaboration theories cultivate CTLS. Therefore, it allows learners to develop the cognitive, affective, and psychomotor learning domains (Akavidson & Major, 2014; Laguador, 2014). Cooperative learning is one of the learner-centred teaching strategies that assist learners in developing sociability, interdependency, self-esteem and confidence, decision-making skills, and tolerance for others (Gillies, 2014). It is one of the group work strategies which cause each participant to take responsibility in his/her group and to work for the benefit of the entire group (Baker & Clark, 2010).

CTLS is an excellent method to stimulate the effective engagement of learners in the classroom (Millis, 2010). Thus, CTLS promotes small group structured learning. Johnson et al., (2013) defined cooperative learning as learners working together in a small group to reach a shared goal and during which all of the members of the group benefit from each other.

The merit of CTLS is its contribution to maximizing the learners' understanding by allowing all of the learners to participate in all of the components of the lesson and to acquire better knowledge by developing critical thinking, creativity, and decision-making skills (Davis, 1999). In addition, numerous studies have asserted that CTLS is paramount for the development of self-regard, academic achievement, the ability to retain knowledge, the ability to see things from a different point of view and level of reasoning, strong and positive attitudes towards schooling, and behaviours that help learners to learn, work, and live in any society (Baghcheghi et al.,2011; Gillies, 2014; Johnson et al., 2013; Miller, 2017).

Cooperative learning uniquely develops leadership skills, confidence and logical reasoning for making decisions, individual accountability, and new understanding

(Laguador,2014; Gisbert, Seuba & Coll, 2017; Raja, Qureshi & Albesher, 2017). The significant difference between traditional and cooperative teaching systems is that the latter promotes sociability and self-confidence rather than advocating competitive behaviour (Baghcheghi et al., 2011; Johnson et al., 2014).

Cooperative learning needs to be implemented effectively and interactively in order to gain all the benefits that can be acquired through this methodology. To achieve this, group members should understand and perform all of the duties related to each task. Learners should rotate the allocated roles (such as timekeeper, writer, speaker, manager, and resource provider) after each task. This enables every group member to experience all the various aspects of the tasks and to accept different responsibilities while working towards a common goal.

2.2.1. Elements of CTLS

Cooperative learning has five elements or principles that define it as cooperative and distinct from other forms of group work. These principles are positive interdependence, individual accountability, face-to-face interaction, sociability (interpersonal) skills, and group processing (Davidson & Major, 2014; Mentz, & Van Zyl, 2018).

2.2.1.1. Positive interdependence

To establish positive interdependence, group members have to understand that each member of the group has a significant contribution to make and ensure that they all are working towards achieving the group goals through cooperative task execution (Gillies, 2014; Miller, 2017). Thus, learners enhance their conceptual understanding and performance by working collaboratively with their peers (Sarafin, 2016). However, students must believe that one member's success is equal to the success of all of the group members (Melnichuk & Osipova, 2017).

Positive interdependence develops when resources, information, and materials relevant to complete the task are used to achieve shared goals through the division of responsibilities into roles for each member of the group. Once the group develops positive interdependence, they realise the need for one another and the positive impact of group work (Yi & Luxi, 2012; Melnichuk & Osipova, 2017).

2.2.1.2. Individual accountability

Individual accountability refers to understanding the responsibilities of each member of the group, recognising that each member has an obligation to do her/his separate work according to the work allocation, and motivating the other members to do the same, in order to ensure that all of the lesson outcomes are achieved (Gillies, 2014; Laguador, 2014; Miller, 2017). One aim of cooperative learning is to give responsibility to each team member as a strategy to achieve successful task completion (Johnson et al., 2014).

2.2.1.3. Interpersonal skills

Interpersonal skills refer to the skills and behaviours that help the learners to interact within the group without any difficulty. These skills include proper listening in group discussions, accepting other group members' ideas respectfully, stating comments without using inappropriate words, accepting duty without any complaint, giving criticism and reaching a conclusion regarding the group discussion, as well as sharing all of the resources equally (Gillies, 2014; Melnichuk & Osipova, 2017; Miller, 2017). In addition, interpersonal skills require learners to become acquainted with one another, to build trust with one another, and to constantly solve any conflict which arises in the group (Yi & Luxi, 2012).

2.2.1.4. Learner engagement

In this context, the engagement of learners involves the interaction of group members by motivating each other and acknowledging each group member's contribution towards the successful completion of the task (Yi & Luxi, 2012; Gillies, 2014; Miller, 2017). During face-to-face interaction, learners should be able to synthesise, elaborate, explain, and analyse their ideas and other members' ideas in order to develop a high level of critical thinking skills and communication skills (Melnichuk & Osipova, 2017; Laguador, 2014). Interaction is required in order to facilitate the cognitive process, to link prior knowledge with what is being learned, and to demand that each member make overt their thinking and reasoning. This interaction cannot be promoted unless learners develop social-communicative skills (Johnson et al., 2014).

2.2.1.5. Group processing

This is the last principle of cooperative learning, but it is as fundamental as the other principles. Group processing requires deep thought and reflection. It is a stage during which learners use reflection to evaluate each group member's understanding of the lesson and to which extent they are achieving the group goals (Melnicuk & Osipova, 2017; Miller, 2017). Group members review each member's contribution and make a conclusion after they have reached a consensus (Gillies, 2014). In addition, group members evaluate the ultimate performance of the group and whether the goals have been achieved or not. They critically evaluate each other's contributions, identify the weaknesses, and then plan to improve their shortcomings in future group activities (Yi & Luxi, 2012; Gillies, 2014).

Understanding that all five principles of CTLS are necessary for the implementation in any lesson. Therefore, the current research determines the teachers' descriptions of CLTS from their understanding of the advantages, features, and principles of implementing CTLS in science classrooms. An understanding of the need to develop positive interdependency, critical thinking, decision-making, and problem-solving skills is perceived as a strong indication that the teachers are aware of the five principles of cooperative learning and could use them as per the expectations.

2.3.   IMPLEMENTATION OF CTLS

The 21st century's work environment and lifestyle demand that learners communicate in diverse settings and have basic social skills (Miller, 2017). South Africa also has many diverse cultures and, therefore, these skills are essential to South African learners as the CAPS of South Africa state that learners should be able to "…*work effectively as individuals and with others as members of a team*…" These skills, as well as the ability to "*identify and solve problems and make decisions using critical and creative thinking,… organize and manage themselves and their activities responsibly and effectively, collect, analyse, organise and critically evaluate information*" (Department of Basic Education, 2011, p. 5), are developed through CTLS as confirmed by several authors (Hoadley, 2012; Tadesse & Gillies, 2015; Mohammadjani & Tonkaboni, 2015).

16

Therefore, South Africa's education system encourages and requires CTLS to be used as one of the teaching strategies in schools. The requirements for the proper implementation of CTLS will be discussed further.

2.3.1. Teachers' responsibility towards effective implementation of CTLS

The prerequisites for implementing cooperative learning sustainably are: teachers' understanding of cooperative learning theory and their willingness, competency, and confidence to implement it, as well as teachers' collaborative work with colleagues and their ability to coach all group activities (Jolliffe, 2015; Gillies & Nichols, 2015; Miquel, & Duran, 2017). Considering the purpose of the current research, this section delineates the role of teachers for the successful execution of CTLS.

Teachers are accountable for creating a learning environment that stimulates and encourages learners to work in small groups, comfortably engage with scientific thought, and freely reflect on their own ideas. In order to do this, teachers must have a profound understanding of how to implement and facilitate cooperative learning and to teach the necessary skills and principles of cooperative learning to their learners (Miller, 2017).

The implementation process of CTLS requires the teacher to be well organised and structured in the lesson (Johnson & Johnson, 1986). This includes constructing tasks or projects that are interesting and challenging to learners, that consider individual ability, and that are relevant, in order to accelerate learning (Slavin, 2014; Miller, 2017). In addition, teachers need to prepare suitable activities that can assist learners to mature conceptually and to understand the lesson. The teacher should provide support and teach the learners how to work cooperatively and how to convey their ideas to the group members and the rest of the class members (Gillies & Nichols, 2015; Laguador, 2014).

In addition to well-structured tasks, teachers must establish trustful and respectful classrooms, enhance the quality of facilitation, organise the arrangement of the class and accessibility of resources, build awareness in learners' minds in terms of how the

17

groups should cooperate, and provide a checklist to assess the process and outputs of the group work (Miller, 2017).

In order to construct a task that incorporates the five principles of CTLS, teachers need to divide the learners into small interdependent groups that consist of learners of different academic ability (high, medium, low) while considering their personal skills. In addition, teachers have to plan the lessons based on the objectives of the strategies, group sizes, classroom organisation, and resources available. Afterwards, teachers should explain the tasks, and the necessary skills for successful implementation, to the class (Slavin, 2014; Miller, 2017; Yi & Luxi, 2012; Johnson et al., 2014). It is also necessary for teachers to determine the prior knowledge of the learners in a group in order to understand the learners' comprehension of the underlying concepts and to determine how best to distribute or allocate the roles and responsibilities within the groups. Teachers should stimulate learners, emphasise individual accountability, and encourage student engagement (Yi & Luxi, 2012; Johnson et al., 2014).

The other roles of teachers include: facilitating a conducive environment for the group work, monitoring the group, and intervening in the group when necessary. Based on the insights gained from the learning experience, teachers should reflect and evaluate their lessons to determine when restructuring is required (Johnson & David, 1986; Jolliffe, 2007; Laguador, 2014; Johnson et al., 2014; Raja et al., 2017). Additionally, teachers should monitor each group's interaction, intervene when necessary, and encourage students to ask for help when experiencing difficulties (Yi & Luxi, 2012; Johnson et al., 2013; Laguador, 2014).

2.3.2. Teachers' role in ensuring the presence of the five CTLS principles during group work

Baker and Clark (2010), in their study which was conducted to examine New Zealand's experience in implementing CTLS in a multicultural group of learners in tertiary education, confirmed that the five CTLS principles had played a significant role in the successful implementation of CTLS. Raja et al. (2017) emphasised that teachers as facilitators should ensure the presence of these principles during group work. Furthermore, teachers should motivate, assist, and manage each group in order to

achieve the desired outcomes gained by implementing CTLS. Other researchers such as Baghchegi et al. (2011), Johnson et al. (2013), Gillies and Boyle (2010), and Abrami, Poulse and Chamber (2004) also supported the idea that teachers should ensure the presence of these critical principles in the groups.

The first principle is positive interdependence and there are different techniques to assist teachers to structure it effectively. Jolliffe (2007) states that teachers should give each group member the information and material required to achieve the goal of the task and encourage the success of joint group work through praise. Furthermore, teachers should construct tasks or assignments that require more than one answer and different materials (Sharan, 2014). For the ideal development of positive interdependence, teachers should emphasise the goal of group work and students' accountability for the group's success (Slavin, 2014).

Learners should understand that individuals cannot be successful in achieving the desired goals unless they work with others as part of a team. This understanding guides learners to develop the skills to work in groups and to gain the essential skills required for the work environment. Positive interdependence is the most critical principle of cooperative learning. However, in isolation it is not enough to fulfil the goals of CTLS.

The second principle of CTLS is individual accountability and its implementation is ensured when teachers formulate challenging tasks that demand each member's contribution (Jolliffe, 2007; Slavin, 2014). The other approach to ensure learners contribute to group work is to select one learner randomly to report his/her work to the rest of the class members. Alternatively, the teacher can instruct the group members to explain their group work to another group or instruct learners to write reports about their participation in a task after it has been completed (Jolliffe, 2007; Johnson et al., 2014; Slavin, 2014).

The third principle, face-to-face interaction, is better facilitated through the formation of small heterogeneous groups consisting of four or five learners with different academic ability, race, and gender. Cognitive activity is stimulated when learners challenge each other's reasoning and thinking (Jolliffe, 2007; Johnson et al., 2014).

19

Learner engagement is the fourth compulsory principle of CTLS. Teachers' efforts to ensure the development of this principle are essential (Gillies, 2014). Teachers should provide posters in their classes that mention the social and personal skills necessary for effective group work and orient learners regarding the requirement of these skills for the proper functioning of a group (Jollife, 2007). In addition to this, teachers should use group activity as training to create awareness about the need for the development of social and personal skills. The teachers should also choose a structure that supports the specific skills and model the skills to suit the whole class (Jolliffe, 2007; Sharan, 2010; Miller, 2017).

The fifth and last principle is group processing structure. The groups are instructed to set personal and group goals that can be evaluated at the end of the task, to evaluate all the processes followed, and to provide short evaluations of their work. Afterwards, teachers should provide well-constructed feedback (Jolliffe, 2007; Sharan, 2010; Sharan, 2014; Miller, 2017).

During social interaction and other constructive interchanges between learners, teachers have a great responsibility to encourage thought-provoking learner interaction, positive interdependence, and individual accountability (Buchs, Filippou, Pulfrey, & Volpe, 2017).

2.4. FACTORS AFFECTING THE IMPLEMENTATION OF CTLS

"Old teaching paradigms and habits die hard. If we had no trouble learning with them when we were in college, we can't understand why our students do" (Millis, 2010, p. 1). Schooling is a collaborative system that consists of teachers, principals, the community, and learners. Each representative body in the school community has its own role in the successful development of learners. Therefore, the focus of the school should be on the learners and the school should assist the learners by providing a conducive learning environment.

School principals play a vital role in facilitating this conducive learning environment (Abrami et al., 2004). Resources (textbooks, laboratory equipment, materials, and

printed tasks) are vital for the execution of CTLS as it cannot be implemented without the provision of all of the necessary information to complete the prepared task (Alias, Hussin, Hassan, Adnan, Othman, & Hussi, 2018). Yet, the significant portion of the responsibility lies with the teachers. Planning to implement the curriculum without teachers is like trying to create a loud sound by clapping with one hand.

Therefore, this section investigates the factors that impede the implementation of CTLS in South African high schools and explores the reflections of teachers towards solving these problems. The subject and pedagogic knowledge of the teachers play a vital role in this regard. Gillies and Boyle (2010) have listed the challenges teachers face in implementing cooperative learning.

The first challenge is that CTLS necessitates a well-organised and structured lesson (Johnson et al., 2013; Gillies & Boyle, 2008; Sharan, 2010). This challenge becomes a limitation due to the teachers' workloads. Achieving the level of organisation and structure required for a lesson using cooperative learning is immensely time-consuming (Buchs et al., 2017).

The second challenge that impedes the implementation of CTLS is the requirement to encourage diversity in the groups. According to Johnson et al. (2014), the purpose of CTLS is to transform learners' abilities from low to medium and from medium to high by mixing learners of different academic ability in the groups. Even though teachers believe in this concept, learners prefer to engage with their friends and similar genders (Gillies, 2014). The size of the group also plays an essential role in attaining the expected outcome as small groups perform better than large groups (Baker& Clark 2010; Sharan, 2010). Subsequently, CTLS requires a small group size. However, teachers have problems with class sizes since many small groups in one class demands large work areas (Gillies & Nichols, 2015). After forming the groups, the other challenge for implementing cooperative learning is the difficulty to monitor individual accountability within the groups and to facilitate interaction among the members (Alias et al., 2018).

The third challenge is structuring the task correctly. The task should be open-ended, challenging, and must consider the abilities of the learners and lead them to the

discussion of ideas, the exchange of ideas, and the critique of others' ideas (Gillies and Boyle 2010; Millis, 2010; Buchs et al., 2017).

Assessment is the fourth challenge when implementing CTLS. Learners' achievements increase when they receive feedback through formative and summative assessment. Even though some teachers believe that knowledge is constructed through social interaction, it is challenging to prepare a suitable assessment tool to evaluate the knowledge which is constructed through social interaction. The assessment for CTLS should include both academic aspects of learning and the principles of CTLS (Buchs et al., 2017).

Teachers who are experienced in using CTLS have a more positive inclination than the inexperienced ones. Due to the lack of understanding and experience in implementing CTLS instruction methods, many teachers prefer to use traditional instruction methods in their science classrooms (Robyn & Boyle, 2008). According to Abrami et al. (2004), even when teachers have had partial training on CTLS, they often do not implement it due to various circumstances. Gillies and Boyle (2008), in their study that focuses on the kinds of verbal terms that must be used during the implementation of cooperative learning and teachers' perceptions on this pedagogy, found that teachers use the appropriate terminology while implementing CLTS if they are aware of it and know how to implement it effectively. The limitation of this study is related to sampling. They only selected well-trained teachers with experience in implementing CTLS. It would be preferable to include inexperienced teachers in order to determine to what extent teachers' discourses affect the effective implementation of cooperative learning.

In addition to the above challenges, the training offered by the Department of Education and teacher-training institutions is insufficient to prepare teachers for the effective implementation of CTLS. The lack of collaborative work between colleagues in the school environment and the lack of skills to implement CTLS properly are the central obstacles for implementing CTLS (Baloche & Brody, 2017).

2.5. ASPECTS THAT FACILITATE THE IMPLEMENTATION OF CTLS

The foundation required by the education system for proper teaching and learning is both PCK and teachers' willingness to try innovative teaching strategies in their classrooms. Currently, there is widespread consensus that instruction has to be learner–centred and construct knowledge through social interaction. Yet, in order to be successful, it has to be used in conjunction with relevant PCK. According to Shulman (1986) PCK is a combination of content knowledge and instructional knowledge. It does not refer only to knowledge of the subject matter, but rather refers to the ability of the teacher to select an appropriate instructional method for teaching particular content as well as the ability to enable learners to create knowledge and construct meaning. These are crucial aspects for the successful implementation of CTLS as teachers must know how to structure lessons in ways that encourage the learners to work cooperatively to achieve the desired learning goals (Buchs et al., 2017).

Most teachers in well-developed countries are well equipped in subject matter content knowledge but do not always cope with the teaching methodology. The latter statement is not true in the South African context since the majority of teachers do not have intensive exposure to learning the content of the subject that they are teaching (Rollnick, Bennett, Rhemtula, Dharsey, & Ndlovu, 2008; Rollnick, 2017). Teachers struggle to identify the teaching methods that best suit the content due to, among others, the lack of understanding of the value and the goal of the curriculum, the lack of proper support from the school administration, and the lack of knowledge of the various teaching strategies which promote the creation of interactive teaching and learning environments (Laguador, 2014; Tadesse & Gillies, 2015).

PCK cannot be learnt overnight and requires more experience, practice, and willingness on the part of the teacher (Jang & Chen, 2010). Learners that are taught by teachers who had proper training in CTLS performed better than those who had been taught by untrained teachers (Robyn & Boyle, 2009). Some other factors need to be considered by teachers when they implement CTLS in science classes, for example, the required resources. This includes classroom size, teaching and learning

material, as well as sufficient time. It is impossible to implement CTLS properly without these resources even if teachers have adequate skills (Abrami et al., 2004).

Furthermore, teachers' beliefs play a vital role in the implementation of CTLS. Belief can be defined as an opinion or perception of a person about something which develops based on the knowledge and the experience that the person has regarding the particular aspect (Lumpe, Haney, & Czerniak,1998). Therefore, teachers' beliefs related to PCK refer to the assumptions and beliefs of the teachers regarding the methods of instruction that they use in the classroom. This is constructed by the exposure and the quality of knowledge that they have about instructional methodology (Abramczyk, & Jurkowski, 2020).

Gillies and Nichols (2015) specify that if teachers want to implement CTLS, they need to have excellent subject content knowledge and a positive belief in cooperative learning in order to support, encourage and apply this methodology. Therefore, teachers' attitudes and perceptions towards CTLS are key points for successfully implementing CTLS. Saborit, Fernandez, Mendez-Gimenez, and Aloso (2016) emphasise that teachers should have a positive attitude towards cooperative learning. Since implementing CTLS is not an effortless task, teachers must be trained and receive training continuously to develop appropriate knowledge and to practise the implementation of CTLS (Laguador, 2014).

According to Gillies and Boyle (2008), the size of a group is among the major factors that facilitate CTLS. Baker & Clark (2010) and Johnson et al., (2014) also state that cooperative learning is extremely effective when applied to small groups. Thus, a maximum of five learners in a group is referred to as a small group and one of the facilitating factors.

The other facilitating factors for the implementation of CTLS, as Gillies and Boyle (2010) state, are the complexity of the task, the language of interaction, and learners' academic and social behaviour. In addition, Gillies and Boyle (2010) identify other factors that promote the implementation of cooperative learning. The main ones are establishing task interdependence, designing an activity to ensure individual accountability on the part of the group members, designing assessment criteria and

rubrics to measure student learning in all aspects of cooperative learning, ensuring that all the information is appropriately dispatched among the group members, and posing discussion ideas that engage learners intensively. If all of these factors are properly applied, the expected outcomes will be attained successfully. The aforementioned aspects are also identified by Laguador (2014) who also states that teachers should make their classroom environments more interactive than teacher-centred in order to enable small groups to be formed by the teachers and to enable teachers to take their responsibilities as facilitators.

Nastasi and Clements (1991) state that the other major facilitating factor for implementing cooperative learning is social skills. Learners should have the ability to communicate, discuss, elaborate, motivate other participants, and acknowledge the importance of working cooperatively. The learners' interaction and social skills depend on each learner's nature, the instruction type, and his/her motivation. Teachers should accept their responsibilities correctly as active facilitators of cooperative learning by creating a suitable environment. All the teachers' responsibilities as facilitators are realised when they have the appropriate PCK. Thus, this research also attempts to identify the factors that facilitate the implementation of CTLS in science classrooms according to the participating teachers' points of view.

2.6. CONCEPTUAL FRAMEWORK

The conceptual framework of this study is shown in Figure 2.1 by illustrating the core of an activity theory as adapted from Vygotsky and Leontiev (1920). The description of the theory and how it relates to the proposed research is provided afterwards.

Vygotsky and his student Leontiev introduced activity theory in 1920 as they found that a psychological approach without consideration of the cultural and historical representation of activity is ineffective and narrows the focus and scope of the study. Activity theory also allows one to gain a better understanding of human activity (Hasan & Kazlauskas, 2014).

25
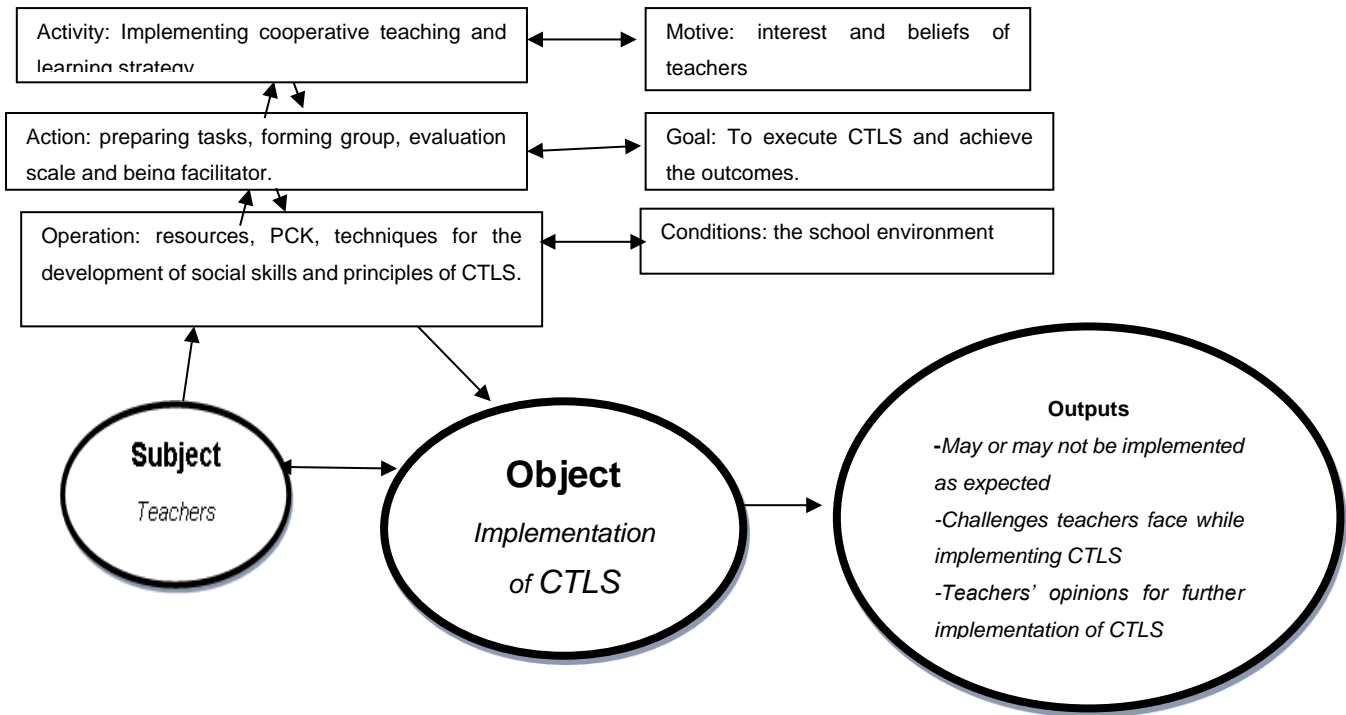
Figure 2.1: Core of an activity theory adapted from Vygotsky and Leontiev (1920)

Hashim and Jones (2007) define activity theory as a theoretical framework for the careful examination and understanding of the interaction between human beings, materials, and the tools which they make. It also addresses the connection between the cultural and historical interests of human beings regarding artefacts. Thus, it is a desirable theory for gaining a holistic and contextual understanding of a case that has been studied by qualitative and interpretative research.

Activity theory is a lens that views the interaction of human action and awareness in the given context. It is a medium to understand the actuality of human activity in cultural and historical contexts (Detlor, Hupter & Smith, 2016). Activity theory is chosen as a conceptual framework as the research aims to explore and understand the implementation of CTLS with a qualitative research approach by carefully examining science teachers' activities in natural contexts.

This conceptual framework consists of three parts (subject, object, and output) which are interconnected to one another as shown by the arrows in figure 2.1. This interconnection is known as an activity system. The double-sided arrow refers to the

affordances and constraint characteristics (dual interaction with contents) while the one-sided arrow refers to the object's outputs.

Subject refers to the persons being studied (Hashim & Jones, 2007: Hasan & Kazlauskas, 2014; Detlor et al., 2016) such as the four science teachers of the focus sample who are using CTLS as a teaching instruction. Object refers to the proposed activity represented by the subject executing the envisioned activity (Hashim & Jones, 2007; Hardman, 2007; Detlor et al., 2016). For the current study, the intended activity is the implementation of CTLS. Outputs refer to the results of the activity system which include the expected and unexpected results (Hasan & Kazlauskas, 2014; Detlor et al., 2016; Daniels, 2016).

Activity theory consists of a series of actions which are influenced by the goals of the activity that help to achieve the objective of the activity (Detlor et al., 2016). These series of actions are activity, action and operation. Activity is the performance of a chain of conscious actions which are influenced by the motives or interests of the subject (Hasan & Kazlauskas, 2014; Detlor et al., 2016).

The subject's motives determine the goals and generate the activity. Activity is made up of actions and these actions are performed in pursuit of the goal. The goal of the action is affected by conditions which are referred to as operations (Jonassen & Rohre-Murphy, 1999; Hashim & Jones, 2007; Park, 2015; Hasan & Kazlauskas, 2014; Detlor et al., 2016).

Therefore, for this research, the interests and beliefs of the four Natural Sciences teachers regarding CTLS led them to generate activity, which is the implementation of CTLS, and to set the goal of the proper implementation of CTLS. The proper implementation of CTLS requires certain actions and activities during its execution such as preparing tasks, forming small heterogeneous groups, and fulfilling the role of facilitator.

Once the actions are performed, we call them operations and this is indicative of the fact that the implementation of CTLS depends on the PCK of teachers, availability of

27

resources, and teachers' techniques to develop the social skills of learners, and is affected by conditions in the school environment.

The one-sided arrow from the object to the output of the activity refers to the ultimate outcomes of the unpredictable activity that rely on the dual interaction of subject and object of the study. Thus, the possible outcomes of this activity include observations that CTLS may or may not be implemented as expected, challenges that may impede its successful implementation, and the teachers' suggestions for support to further the implementation of cooperative learning.

In conclusion, the conceptual framework of this study governed the analysis and interpretation of the data.

2.7. CHAPTER SUMMARY

This chapter endeavoured to review the literature addressing the meaning and implementation of CTLS. Based on the literature, the researcher presented the factors that may impede the execution of CTLS as well as the supporting principles that make CTLS successful. Ultimately, the conceptual framework that directs this study is defined and discussed. The next chapter explains the methodology that this study followed to answer the research questions initially presented in the first chapter.

3.   CHAPTER THREE: RESEARCH METHODOLOGY

3.1   INTRODUCTION

This chapter discusses the overall research methodology that was employed to explore the implementation of CTLS. It addresses such issues as the worldview assumption, which is the ontological, epistemological, methodological aspect that this study utilised. This chapter also discusses the research design, sampling techniques, and instruments used to collect the information and the logical reasons behind selections. The current study used the qualitative approach as methodology and the case study as a research design to build on the constructivism paradigm and to answer the research questions. Credibility, trustworthiness, and ethical consideration of the study are also discussed.

3.2   ONTOLOGICAL ASSUMPTION

Ontology refers to what is believed about the nature of reality and social reality. For the present study, the reality is multiple and socially constructed. The ontological stance of this research is constructivism which believes that meaning is socially constructed. According to Gray (2004) constructivism assumes that meaning is not discovered, but rather constructed within the social experience. Therefore, reality and its meaning does not exist somewhere that someone is going to search and find, but rather is created through the interaction of subjective reality. Creswell (2014) explained that constructivism is an ontological assumption and belief that reality or the meaning of reality is established based on the way one lives, one's experiences, and how one builds understanding about a certain phenomenon.

Thus, research that follows constructivism relies on participants' understanding and way of describing the phenomenon that is being researched. The constructivism assumption seeks to gain the truth from the participants of the study and gains information through the conversations between the researcher and the participants. However, the knowledge which is gained through constructivism is limited to the experiences of the participants (Durning, 2015; Willig, 2016).

The reason for the intended research is underpinned by constructivism as the ontological stance is that the nature of the study seeks to understand the implementation of CTLS as a variable of teachers' understanding and experience. The necessary information is thus gathered through the conversations between the researcher and individual Natural Sciences teachers in the form of interviews and classroom observations in natural classroom contexts.

3.3   EPISTEMOLOGICAL ASSUMPTION

Epistemology alludes to how human beings understand the nature of knowledge and give it meaning. Based on the interest of the researcher and the nature of the research questions, the epistemological assumption of the present study is interpretive based on the interpersonal methodology of the qualitative case study. As Cohen, Manion, and Morrison (2007) define the interpretive paradigm, the theory strives to understand and interpret the environment through individual experience and is formulated based on personal situations. Therefore, interpretation depends on the real experiences of human beings and how they give meaning to their day-to-day life.

Furthermore, the interpretive assumption is based on context (the reality somewhere might not be a reality elsewhere) and is time-dependent (the situation in the past may not be the same as in the current period). Interpretive research must be acquired knowledge through a deep understanding of the context in the experience of participants (Mack, 2010). It is vital to capture people's perceptions and awareness of the phenomena to understand how people give meaning to the existing knowledge (Hepwoth, 2016: Žukauskas, Vveinhardt, & Andriukaitienė, 2018). The researcher of this study believes that reality is multiple and is dependent on what is being researched as it understands and explores the relationship of the knower and the known during the process of researching.

Hence, the intended study aligns with interpretivism as an epistemological stance. The study uses small-scale research to obtain direct insights into how teachers practically apply CTLS in their classroom contexts through classroom observation in natural settings. A semi-structured interview is used to understand the phenomenon through the participants' perceptions. Additionally, lesson observations are used to see the

detailed process of the implementation of CTLS. Furthermore, questionnaires are employed to identify the frequencies of using the teaching strategies under investigation and enabling factors of the implementation of CTLS.

Thus, different data collection strategies were used to capture and reveal multiple realities. To interpret the collected data, a qualitative data analysis strategy is used. Subjective bias has been considered and, to minimise this bias, the interpretation of the data was cross-checked by the supervisor to establish inter-coder reliability.

In the study, the researcher interacted closely with four Natural Sciences teachers who were volunteers from an initial group of 21 teachers. The full sample of 21 teachers completed a questionnaire to provide their perceptions about CTLS and its principles, methods of application of the instruction, and to identify the factors that are encouraging and obstructing them from using CTLS in their contexts. For the focus sample of four teachers, classroom observations were conducted to obtain deep insight into the implementation of CTLS. Subsequently, the transcription of interviews and observations enabled the researcher to draw meaningful information from the responses and actions of the participants. Knowledge within the interpretive assumption is gained and observed from participants' experiences in a specific social context (Mack, 2010; Kelly, Dowling & Millar, 2018; Žukauskas et al., 2018). Therefore, the implementation of CTLS in science classrooms can be well captured by observation in the classroom context (empirical situation) and through enquiring about the experiences of science teachers.

3.4   RESEARCH METHODOLOGY

Žukauskas et al. (2018), Creswell (2012), Maree (2007), and Cohen et al., (2007) emphasised that the philosophical belief of the study influences the epistemology, ontology, and methodology of a specific study. The assumptions, methodological approach, design, analysis, and interpretation of the analysis are interrelated. Thus, the belief of this study is that the interpretive assumption connects to the qualitative methodology of research. The nature of this study necessitates that a qualitative approach is followed because the intention of the research was primarily to

comprehend how South African science teachers implement CTLS in their science classrooms.

Creswell (2003) describes qualitative research as an approach which explores the problem and creates an extensive understanding of the problem. The research problem in the current study is investigated through a small number of participants to arrive at a possible solution. Working with a small number of participants allows the researcher to follow more detailed data collection strategies. Yilmaz (2013) explains that qualitative research is emergent, inductive, interpretive, and naturalistic in its approach to the study of a person, case, phenomenon, social situation, and process in their natural settings to reveal in descriptive terms the meaning that people attach to their experiences of the world. It is further stated by Mondal (2018) and Willig (2019) that conceptual understanding of human behaviour is obtained from participants' responses, by observing their activity in empirical contexts, and by having insightful conversations with participants of the study. Accordingly, the researcher chose a qualitative research approach as it was perceived as useful for understanding the nature, value, and meaning of the human experience.

This study also seeks to understand the implementation of CTLS from teachers' experiences in order to gain an intellectual understanding of the case. Thus, classroom observations were conducted with the aim of justifying and gathering information about the implementation process of CTLS. The interviews with the teachers were conducted to obtain their perceptions about the strategy and to identify the factors that facilitate and impede the implementation of this teaching strategy. In addition, questionnaires were dispatched to the full sample of teachers to determine their understanding of the principles and features of CTLS. Document analysis was planned to explore the planning, structures of assessments, and frequency of the implementation of CTLS. Yet, this could not be executed as only one of the main participants provided the necessary documents.

The subjective nature of the qualitative approach and the disadvantages of using a small sample size are acknowledged. The researcher's subjectivity can be biased in the activity of data interpretation. The researcher has to be cautious by enabling the cross-checking of codes and themes by experts such as the supervisor and co-

supervisor. The number of the participants is small since this study strived to gain a better understanding of the phenomena in natural settings. This makes the findings of the study unrepresentative. However, the aim was to obtain a comprehensive understanding of the implementation of CTLS by first-hand analysis and interpretation of a selection of Natural Sciences teachers' responses and validating their responses against their actions observed during the implementation of CTLS in their classrooms. The data collected through the questionnaire and the classroom observations could be triangulated with the insightful conversations obtained through interviews. Therefore, employing a qualitative research approach was deemed most appropriate. Table 3.1 summarizes the characteristics of the paradigm and how it relates to the interests and purpose of the study.

Table 3.1: Features of the research methodology of the study

Feature	Description
The purpose of this study	To explore the implementation of CTLS in South African science classrooms.
Nature and interest of the study	To obtain understanding about the implementation of CTLS, teachers' descriptions of CTLS, and factors that hinder and facilitate the implementation of CTLS according to the participating natural science teachers.
Ontology (what is reality? Is social reality external to the individual? Or is it a result within the individual?) Constructivism	• Reality is a result of individual mindfulness. Reality can be created and modified as people assign meaning to their knowledge, experiences, and values in life through human interaction and experience. • Nature and the interest of the study lead the researcher to examine natural science teachers' actions in a real context. Responses towards the interviews and the questionnaire are a manifestation that there is a multiple reality of implementation of CTLS. • Physical science teachers' responses in the interview, questionnaire, their actions during the classroom observation, and the document that they had disclosed illustrate their understanding about CTLS and its application. There are theoretical and practical foundations of implementation of CTLS which were used to evaluate the actions and the responses of natural science teachers regarding the execution of CTLS.
Epistemology (the way of learning reality and its form; and the way of uncovering the knowledge of reality)	Some explanatory concepts about the implementation of CTLS and factors that obstruct or enable the implementation of CTLS were established through the experiences of natural science teachers.
Methodology (a procedure to comprehensively answer the research questions)	A qualitative approach is useful in acquiring an extensive understanding of the implementation of CTLS. Hence, rich information was gathered through interviews, classroom observation, questionnaires, and documents. The acquired information was analysed using content analysis.

33

3.5   RESEARCH DESIGN

Maree (2007) defines the case study as one of the qualitative approach methods which studies single or multiple cases in natural contexts of interest to enable the extensive understanding of the phenomenon through multiple data gathering techniques. Furthermore, it is used to answer the "how?" and "why?" aspects of research questions. This definition is also shared by Creswell, Hanson, Morales, and Clark (2007). It is one of the qualitative approach methods which endeavour to gain an in-depth understanding of a bound system or multiple cases that involve multiple sources of information. The report should be either a description of the case or case-based themes.

According to Cohen et al., (2007), because the case study focuses on an in-depth understanding of the phenomenon, it develops theory, which can help other researchers to understand other similar phenomena. In addition, the case study investigates the case through the perceptions of a few participants in a real context. Due to this feature of the case study, the findings cannot be applied generally to the entire population but rather provides detailed descriptions of the data collection process and findings to allow other researchers to duplicate the study in similar contexts.

The strength of the case study is that it uses multiple data gathering techniques and information to gain in-depth insight and understanding of single or multiple cases. However, the flaw of this research design is its narrow focus (on one or multiple cases) and small number of participants in the specific natural context. This study is focused on the implementation of CTLS in high school science classrooms and used interviews, questionnaires, and document reviews as data-gathering techniques. However, the classroom observations of only four participants in a natural setting could be included.

A case study was chosen as the research design for this study as the intention of the study is to understand how science teachers implement CTLS in the natural contexts of their classrooms. A case study must be in a natural environment (Millis, Harrison, Frankil, & Birks, 2017). Through the present study, a deep understanding of the cases

34

of a few participants was pursued through the use of classroom observations, interviews, questionnaires, and document analysis.

The case study as research design is a convenient method of acquiring an understanding of the cases through multiple information-gathering techniques and a thorough analysis in order to explore, describe and understand the phenomenon under study (Creswell& Creswell, 2017; Millis et al., 2017). Similar to all research designs, a case study has its limitations. The challenge of the case study is its subjectivity (Creswell, 2017). To intercept the limitation of the chosen design and to minimise possible bias, the transcriptions and interpretations of the data should be reviewed frequently through triangulation.

The choice of the research design for this study can also be justified by its purpose which is to provide a rich description and understanding of the cases in natural contexts. This study encompasses exploration rather than generalisation and is not intended to be applied to all South African science teachers.

3.6 SAMPLING

Sampling is the process of selecting participants or individuals from the population of the study. The qualitative study does not generalise the findings to the entire population as it rather attempts to understand the central phenomenon or cases. In a qualitative study, the sample is selected purposively and not randomly. Purposive sampling is a qualitative sampling strategy that selects participants based on an individual's knowledge and some related characteristics that are necessary for the proposed study (Maree, 2007: Cohen et al., 2007; Creswell, 2007).

This study used purposive sampling, specifically criterion sampling, to select the participants. According to Maree (2007), criterion sampling is one of the purposive sampling techniques which select participants based on specific criteria. This study can be classified by this definition as the participants were selected according to the research question as well as specific criteria that suit the central phenomena of this study. The purpose of the study was to understand how science teachers implement CTLS in their classrooms. Consequently, the criteria for inclusion in the sample

teachers who were teaching science to learners in grade 9 to grade 12 and using CLTS as one of the teaching methods. Of the 21 teachers who claim to use CTLS as one of their teaching methodologies, only four science teachers were willing to be observed while using CTLS.

3.6.1 Sampling procedures

This study followed two steps whilst sampling. Firstly, a questionnaire was administered to 30 high schools to identify the teachers who were using CTLS. Through the completed questionnaires, 21 of the teachers confirmed that they were implementing CTLS. Secondly, teachers who indicated that they were willing to be observed while teaching, were selected. This was done by considering the interests, motivations, background knowledge, and the school experiences of the teachers. This study aims to understand and explore the implementation of CTLS in relation to the factors which promote and hinder the implementation process. Four teachers, of which two teach at public schools and two teach at private schools, agreed to be observed while teaching.

3.6.1.1 Sampling procedure for schools

The sampling of the schools was done based on their locations, to be accessible to the investigator, as well as the teachers' willingness to be observed. The participating schools were two private high schools and two public high schools (focus sample). This allowed the data collection to be feasible.

3.6.1.2 Sampling procedure for the focus group

The participants of the study, specifically the focus group, were selected based on their willingness to participate in the intended research. The selection criteria were using CTLS in the classroom and being willing to be observed while teaching. The study followed two steps to select the participants. Firstly, questionnaires were distributed to identify teachers who were implementing CTLS in their classrooms and, secondly, teachers who were willing to be observed whilst implementing CTLS were identified. Laguador (2014) and Buch, et al. (2017) stated that to evaluate the implementation of CTLS, the teachers' experience in using the methodology is essential. There were 21 teachers who indicated that they were implementing CTLS

36

in their classrooms, but only four agreed to be observed while doing so. The group of 21 teachers who claimed to implement CTLS in their classrooms constitute the full sample and the four teachers who agreed to be observed are referred to as the focus sample.

3.7   DATA COLLECTION

To assess the implementation of CTLS in science classrooms, information was gathered through video-recorded classroom observations, audio-recorded interviews, and completed questionnaires. The details of the data-gathering instruments are described in the following sections.

3.7.1 Classroom Observations

The purpose of using observations in this study was to gain insight into the implementation of CTLS in real classroom contexts. Ultimately, four lessons were observed as each Natural Sciences teacher from the focus group was observed once. All four of the observations were conducted in real classroom settings. One classroom observation was done per teacher at each of the four schools for an average of 50 minutes. Each teacher used cooperative learning to attain different lesson objectives. The lessons were video recorded and the researcher used an observation schedule (Appendix I) to take notes of the classroom environments and the teachers' and learners' activities. The observation schedule was developed from the perspective of the research question after an intensive literature review investigating the implementation of CTLS.

The researcher observed the lesson as a non-participant observer. Maree (2007) states that the advantage of observation as a non-participant observer is that the researcher may gain a better and deeper understanding of the central phenomena being observed. Observation entails personally gathering information in a natural context. In fact, the observer is able to perceive reality as it develops.

3.7.2 Interviews

The purpose of the interviews was to determine how each natural science teacher would describe CTLS and which aspects influenced their use or disuse of CTLS. The

interviews were also essential to discuss the classroom observations. The semi-structured interviews were conducted with each teacher from the focus group and each interview took approximately 35 to 45 minutes. According to Maree (2007) and Creswell (2012), an interview is another qualitative technique that provides an in-depth understanding of the case. In addition, it is a suitable method of gaining access to the participant's perceptions which cannot be acquired through observation.

The semi-structured questions (Appendix II) were constructed based on teachers' understanding of CTLS and its implementation. Each Natural Sciences teacher was interviewed at the relevant school after the observation had taken place. This was the most convenient place and time for the participants. All of the interviews were audio recorded after each participant's permission was obtained.

3.7.3 Questionnaire

The main motive of the questionnaire in this study was to obtain insight into teachers' understanding of CTLS and its execution, as well as the factors which contribute to the implementation of CTLS.

The questionnaire consists of 30 questions that are categorised into two sections (Appendix III). The first section of the questionnaire has eight questions and requests information regarding the teacher's gender, qualifications, teaching experience, the grade(s) they teach, learners' performance, and whether they implement CTLS as one of their teaching methodologies. In addition, the section provides an opportunity to explain the reasons for not implementing CTLS in the classroom. Therefore, the first section aims to gather information about the full sample and to establish whether science teachers implement CTLS in their classrooms.

The second section of the questionnaire, questions nine to 30, addresses the concepts and implementation of CTLS. Questions nine to 13 explore the frequency of implementing CTLS per year, teachers' descriptions of CTLS, the number of in-service training events they have attended on CTLS, and their years of experience practically implementing CTLS. Questions 14 to 23 request that the teachers explain their group formation strategies and facilitation techniques.

The last section, Questions 24 to 30, provides the opportunity to indicate the factors that facilitate and those that hinder the implementation of CTLS as well as the teachers' suggestions for the sustainable implementation of it.

The first section of the questionnaire was distributed after the researcher obtained ethical clearance from the ethics committee of the University of Pretoria and the Department of Basic Education, Gauteng Province. It was distributed to 30 high school teachers in the targeted schools. In their feedback, 21 science teachers claimed that they were using CTLS as one of their teaching strategies. These 21 teachers formed the full sample of the study and they were instructed to complete the second part of the questionnaire. Of the 21 science teachers, only four participants agreed to be observed while applying CTLS in their classrooms. These teachers formed the focus sample of the study.

3.7.4 Document analysis

The purpose of the document analysis was to gain insight into the Natural Sciences teachers' understanding of the implementation of CTLS through their annual plans, lesson plans, portfolios, assessments, and evaluation plans. The document analysis checklist and protocol were developed based on the basic principles of the implementation of CTLS (Appendix IV). However, three of the participants did not have all of the documents and only one of the participants provided the researcher with one daily lesson plan and one learner portfolio. This is an insufficient sample and does not allow the proper examination of all of the aspects in the checklist that are related to the conceptual framework of the study. Therefore, the document analysis was not included in the study.

3.8   DATA ANALYSIS

Data analysis is essential to ensure that the essential features of the data are presented clearly. The study used content analysis as a qualitative data analysis technique. Content analysis is one of the qualitative data analysis techniques that strive to analyse texts to contribute to meaning, understanding, and effective interpretation. It intends to answer the research questions through the analysis of the

data collected in the natural contexts. The types of data suitable for content analysis are observations, conversations (interviews), voice or video recordings, and documents (Krippendorff, 2012; Grbich, 2013).

Renz, Carrington and Badger (2018) describe content analysis as the process of ascertaining key terms from texts in order to interpret and understand the proposed study through different perspectives as well as interactive and inductive systems. There are five main steps that content analysis follows, including, organising the data, understanding the data, creating codes, creating themes and their descriptions, and interpreting the meaning of themes (Grbich, 2013; Creswell, 2014Cre: Littman, 2017; Renz et al., 2018).

The classroom observations were video recorded and the interviews were audio-recorded. Afterwards, these recordings were transcribed to execute the first step in content analysis (Grbich, 2013; Creswell, 2014). The prepared data was then coded as coding is the second step in content analysis. It is a process of systematically identifying and defining key words and phrases to create a link between the raw data and its meaning (Banaquisto, 2012; Grbich, 2013; Lictman, 2017). This study used predetermined themes that were established by considering the research sub-questions, the literature, and the conceptual framework of the study.

Table 3.2: Summary of Predetermined and Emerging Themes

Sub-questions	Themes	Categories	Codes
How do South African science teachers describe CTLS?	**Theme 1:** Description of CTLS	**Category 1:** Definition of CTLS	**Sub-category 1:** Explanation and principles of CTLS **Sub-category 2:** Benefits of CTLS **Sub-category 3**: Problems with CTLS
		Category 2: Methods to ensure aspects of CTLS	**Sub-category 1:** Confirming the presence of the principles of CTLS **Sub-category:** Creating awareness of how the groups work
What factors facilitate the implementation of CTLS in South African science classrooms?	**Theme 2:** Facilitating factors	**Category 1:** School environment	**Sub-category 1:** Class size **Sub-category 2:** Encouragement from school management
		Category 2: Training and availability of resources	
		Category 2: Teachers' experiences and collaborative teaching	
What factors impede the implementation of CTLS in South African science classrooms?	**Theme 3:** Hindering factors	**Category 1:** Exposure to CTLS	**Sub-category 1:** Training on CTLS **Sub-category 2:** Experience of using CTLS
		Category 2: Curriculum Implementation	**Sub-category 1:** Time available **Sub-category 2:** Other challenges
How do participating natural science teachers implement CTLS in their classrooms?	**Theme 4:** Implementation of CTLS	**Category 1:** Classroom size and learners' arrangement	**Sub-category 1:** Number of learners per group **Sub-category 2:** Group formation and composition
		Category 2: Teaching and learning resources	**Sub-category 1:** Books and electronic resources **Sub-category 2:** Worksheets for all groups **Sub-category 3:** Social skills posters **Sub-category 4:** Laboratory equipment
		Category 3: Lesson introduction approaches	**Sub-category 1:** Communicating the rules of engagements **Sub-category 2:** Presentation of tasks **Sub-category 3:** Consideration of learners' prior knowledge
		Category 4: Teachers as facilitators	**Sub-category 1:** Confirming and ensuring the presence of the principles of CTLS **Sub-category 2:** Assisting learners and encouraging them to work in groups.
		Category 5: Assessment methods	**Sub-category1:** Select one learner from the group to present their work **Sub-category 2:** Collect the tasks in report form **Sub-category 3:** Ask questions randomly.

According to Krippendorff (2012), the process of analysis is objective and allows researchers to construct their contexts for inquiry (flexibility) and subjectivity. In order to avoid personal bias and to ensure the trustworthiness of the process, a portion of the data for this study was coded by the researcher's supervisor and the discrepancies were resolved through discussion. The analysis process was reviewed by the researcher's supervisor and co-supervisor.

3.9   VALIDITY, RELIABILITY, AND TRUSTWORTHINESS

The words "validity" and "reliability" are used for quantitative inquiry as they are useful for analysing quantitative data such as test scores. The qualitative inquiry contributes to the comprehension and exploration of the phenomena or situations through the view of the participants while considering the existence of multiple realities. Therefore, the most suitable constructs for reliability and validity in qualitative research are credibility and trustworthiness. According to Creswell and Miller (2000), two major aspects can guide the choice of techniques used to establish the credibility and trustworthiness of the study. These are the views of the researcher and the chosen paradigm of the proposed study (Tracy & Hinrichs, 2017). An interpretive view of inquiry tests the validity of the data and the findings by disconfirming evidence. According to Maree (2007) and Stewart, Gapp and Harwood (2017), multiple data-gathering techniques will lead to trustworthiness. Thus, with regards to qualitative research, we refer to crystallisation rather than triangulation.

Crystallisation refers to the convergence of facts gathered through multiple data sources to establish a new perception and method of inference (Tracy & Hinrichs, 2017; Stewart et al., 2017). Ongoing involvement and thorough and rigorous analysis are the most important contributions to the establishment of trustworthiness through crystallisation in qualitative research (Stewart et al., 2017).

For the study, to determine the accuracy and credibility of the findings, the qualitative data collected through video recordings classroom observations, audio recorded interviews with selected teachers, and questionnaires were transcribed and analysed. To ensure the trustworthiness of the coding of the data and consistency in the process of data analysis, the processes were continuously revised and confirmed.

Table 3.3: Summary of the main aspects of the research methodology

Research design	Qualitative case study			
Participants of the study	4 main participants (who were observed) and 21 natural science teachers (completed the questionnaire), including the 4 main participants who are using CTLS in their science classrooms.			
The main research question that guided the research	How can the implementation of CTLS in South African classrooms be understood?			
Sub-questions which support the main research question of the study	How do South African science teachers describe CTLS?	What factors facilitate the implementation of CTLS techniques in South African science classrooms?	What factors impede the implementation of CTLS in South African science classrooms?	How do participant science teachers implement CTLS in their classrooms?
Purpose of each sub-question	To determine the teachers' understanding of CTLS and its principles.	To identify the factors that influence the use of CTLS in science classrooms.	To identify the challenges that discourage the teachers from implementing CTLS in their science classes.	To determine the implementation of CTLS in South African science classrooms.
Data gathering technique and instrument	Interviews and questionnaire	Interviews and questionnaire	Interviews and questionnaire	Classroom observation and interviews
Data analysis method	Content analysis of the transcribed interviews and open-ended questions.	Content analysis of the transcribed interviews and open-ended questions.	Content analysis of the transcribed interviews and open-ended questions.	Content analysis of the transcribed video recordings and the observation notes.

3.10 ETHICAL CONSIDERATIONS

The ethical procedure was strictly followed per the rules of the University of Pretoria. Permission from the Ethical Clearance Committee of the University of Pretoria and Department of Basic Education, Gauteng Province, were obtained before starting with the data collection process. The participants were informed of the procedures and were required to sign informed consent (Appendix V) to indicate their participation in the research. Interviews were conducted and questionnaires completed at a time and place convenient for the participants. The classroom observations were conducted with the permission of the school principals and participating teachers. The research involved participants unrelated to the researcher to minimise possible bias. The data has been treated confidentially and all of the identities of the participants and schools have been reported anonymously using pseudonyms. The steps followed to ensure an ethical research process are summarised as follows:

- The researcher obtained permission from the Ethics Committee of the University of Pretoria's Faculty of Education (Appendix VI).
- The researcher applied for and obtained permission from the Department of Basic Education, Gauteng Province, to collect data from the schools (Appendix VII).
- The researcher wrote a request letter and sent it to school principals (Appendix VIII).
- Consent letters were issued for signature by the participants (Appendix IX) and the parents of their learners (Appendix X).

4. CHAPTER 4: RESULTS AND DISCUSSION

4.1. INTRODUCTION

In this chapter, the findings of the study are presented. The researcher strives to provide detailed descriptions of the findings that emerge from the data that was collected through classroom observation, interviews, and questionnaires. This research aims to explore the implementation of CTLS in South African science classrooms. Therefore, the findings of the research are organised according to the four predetermined themes highlighted as the building blocks of the conceptual framework that guides the study. The themes which frame the discussion and presentation of results are as follows:

- **Theme one:** Description of CTLS
- **Theme two:** Facilitating factors for the implementation of CTLS
- **Theme three:** Impeding factors for the implementation of CTLS
- **Theme four:** Implementation of CTLS

The themes consist of emerging categories and sub-categories. The main data sources were the participants' descriptions via interviews, questionnaires, video recorded classroom observations, and field notes. Throughout the section, relevant quotations are provided to give the reader a first-hand experience of the data related to the findings.

The findings reveal the descriptions, facilitating and impeding factors for the implementation of CTLS, and the implementation of CTLS by the Natural Sciences teachers who participated in this study.

4.2. POINTS TO NOTE BEFORE READING THIS CHAPTER

- Grade nine in the South African curriculum is taught in high school as part of the senior phase which ranges from grades seven to nine.
- The data collection did not focus on the content knowledge of the science teachers. The focus was rather on the PCK of the teachers, specifically in relation to CTLS.

- The sample includes Physical Sciences teachers as well as Life Sciences teachers who are collectively regarded as Natural Sciences teachers.

- The participants demonstrated the implementation of CTLS through a variety of teaching and learning activities, including a lesson focused on exam preparation using games and the perusal of past examination papers, written classroom tasks focused on problem solving, and a laboratory-based activity.

- The researcher strived to record and take note of all physical and verbal activities of participants during classroom observations.

- The descriptions of the findings are categorised as themes, categories, and sub-categories. Some of the findings are specific to some of the participants.

- 30 teachers completed and returned the questionnaire on their knowledge of CTLS. From these, 21 of the 30 reported that they use CTLS in their teaching and learning. These 21 were selected as the *full sample*. Four of the 21 teachers were willing to have their lessons observed by the researcher. These four teachers formed the *focus sample* of the study.

- Themes one, two, and three are described based on the feedback of the full sample of 21 teachers who completed the questionnaire with reference to extracts from the interview data of the focus group participants. Theme four is based on additional data collected from the focus sample through classroom observations and post-lesson interviews.

4.2.1 Description of the full sample

Of the 21 science teachers in the full sample who completed the questionnaire, 11 are female and 10 are male. Regarding their qualifications, seven teachers have BEd qualifications, 11 have BEd Honours degrees, and three have Master's degrees.

Of the four teachers who reported to have been teaching for less than five years, three have taught grades eight to 12 and one has taught grades nine and ten. These four teachers reported using CTLS as one of their teaching methodologies in one to two years of their time teaching. Another four teachers have experience teaching grades ten to 12 for between six and ten years. Among these four teachers, one reported to have spent six to eight years using CTLS as one of his/her instructional methodologies. Two others have used CTLS for only one to two years.

Most of the participants reported extensive teaching experience. Ten teachers have 11 to 24 years teaching experience and three have been teaching for more than 25 years. From the ten teachers with teaching experience ranging between 11 and 24 years, seven spent this time teaching grades ten to 12 and three teaching grades nine to 12. The teachers with more than 25 years' teaching experience have taught grades nine to 12. The more experienced teachers reported having used CTLS for more than eight years, while the rest reported having used CTLS in only one or two years of their time teaching.

The class size and learners' performance also varied from teacher to teacher. The majority of the teachers reported to have class sizes of more than 36 learners with the minority having class sizes ranging between 21 and 25 learners per class. The teachers reported having learners of varying academic ability, from below average to above average performers, in their classes.

In terms of the frequency of use, three teachers reported using CTLS as their daily instructional methodology while another three teachers reported using CTLS more than 13 times in a year. Overall, the majority of the teachers' frequency of using CTLS in their classrooms ranged from one to 12 times a year.

4.2.2. Description of the focus sample

Pseudonyms have been used to ensure anonymity in the study. Sifiso (pseudonym) is a black man who has 22 years of teaching experience with the qualification of a Master's degree in Science Education. He teaches Physical Sciences to grades ten and 11. Sifiso works at a public school and the minimum class size in his school is 36 learners and the maximum is 41 learners per class. The majority of learners fall within the racial category of black. He indicated that he has been using CTLS since the day he started teaching. However, he did not receive any formal training in CTLS. He was exposed to CTLS while completing his postgraduate studies. The learners, in the lesson observed by the researcher, varied in academic ability and the classroom had enough chairs and tables. The arrangement of the chairs was in the typical lecture format. The arrangement changed only when they started group work. The teacher

believes in the benefits of CTLS and he is using it to obtain the outcomes. However, the curriculum and the school setting are not encouraging and supportive of the frequent implementation of CTLS.

Nosipho (pseudonym) is a black female Physical Sciences teacher. She has 18 years' experience in teaching Physical Sciences. Nosipho holds a Bachelor of Education Degree (BEd) honours in Physical Sciences. She teaches learners from grade nine to grade 12 in a public school. The learners in the school are male and female, and the majority is black. The number of learners per class is between 36 and 55. She indicated that she has been implementing CTLS for the past three years without having any training on CTLS. The class size, content load, and lack of support from the head of the department (HoD) and principals discouraged her to frequently use CTLS in her lessons.

Chantel (pseudonym) is a young white female who teaches Natural and Life Sciences. She started teaching in 2014. At the time of data collection, it was her fifth year in the teaching profession. She holds a Bachelor of Education (BEd) degree in Science Education obtained in 2013. She teaches in a private school which consists of a composition of black, coloured, and Indian learners. The staff composition differs with a varied racial composition of black and white personnel. She teaches grade nine Natural Sciences and grade ten Life Sciences. The size of her classes range from 27 to 31 learners. She indicated that she has five years of experience in using CTLS. She completed training on cooperative teaching and learning and the school environment encourages the use of CTLS as one of the teaching and learning strategies. Her school has a reputation of 100 percent pass rate in all grades except in very rare cases when one or two learners repeated certain grades in the school.

Amanda (pseudonym) is a white female with 26 years of teaching experience. She teaches in a private school with the class size ranging between 20 and 28 learners per class. Amanda's school has a racially diverse learner population. She indicated that she has been implementing CTLS for the past ten years. Her school does not present any disadvantages with regards to professional development training opportunities, teaching and learning resources, or optimal class size. Whenever teachers want to

attend training or short courses that enhance their teaching methodology, the school is willing to cover the costs.

The table below summarize the main information about the focus sample.

Table 4.1: Summary of the main information of focus sample

pseudonym	Qualification	Year of experience in teaching	School time	Number of learners per class	Race of learners
Sifiso	Master's degree	22	Public	36 to 41	Black
Nosipho	BEd honours	18	Public	36 to 55	black
Chantel	BEd	5	Private	27 to 31	Mix of black, coloured and Indian
Amanda	Master's degree	26	Private	20 to 28	Diverse

4.3.   THEME ONE: DESCRIPTION OF CTLS

Theme one elucidates the Natural Sciences teachers' understanding of CTLS and its principles. The data presented in this section emerged from the full sample of teachers' responses to the questions posed in the questionnaire as well as the interview responses of the focus sample.

The teachers provided an explanation or definition for CTLS, alluded to the principles and benefits of CTLS, gave examples of how CTLS manifests in class, or explained how the implementation of CTLS can be assessed. This section is structured according to the following categories: (i) the definition of CTLS and (ii) methods to ensure the principles of CTLS are implemented. The categories and sub-categories of theme one are presented below in Figure 4.1.

```
┌─────────────────────────────┐
│      Description of CTLS     │
└─────────────────────────────┘
        │              │
┌──────────────┐  ┌──────────────────────────┐
│ Definition   │  │ Methods to ensure         │
│ of CTLS      │  │ principles of CTLS        │
└──────────────┘  └──────────────────────────┘
        │              │
┌──────────────────┐  ┌──────────────────────────┐
│ - Explanation    │  │ - Checking the presence   │
│   and principles │  │   of the principles       │
│   of CTLS        │  │   of CTLS                 │
│ - Benefits of    │  │ - Creating awareness      │
│   CTLS           │  │   about group work        │
│ - Challenges of  │  │                           │
│   CTLS           │  │                           │
└──────────────────┘  └──────────────────────────┘
```
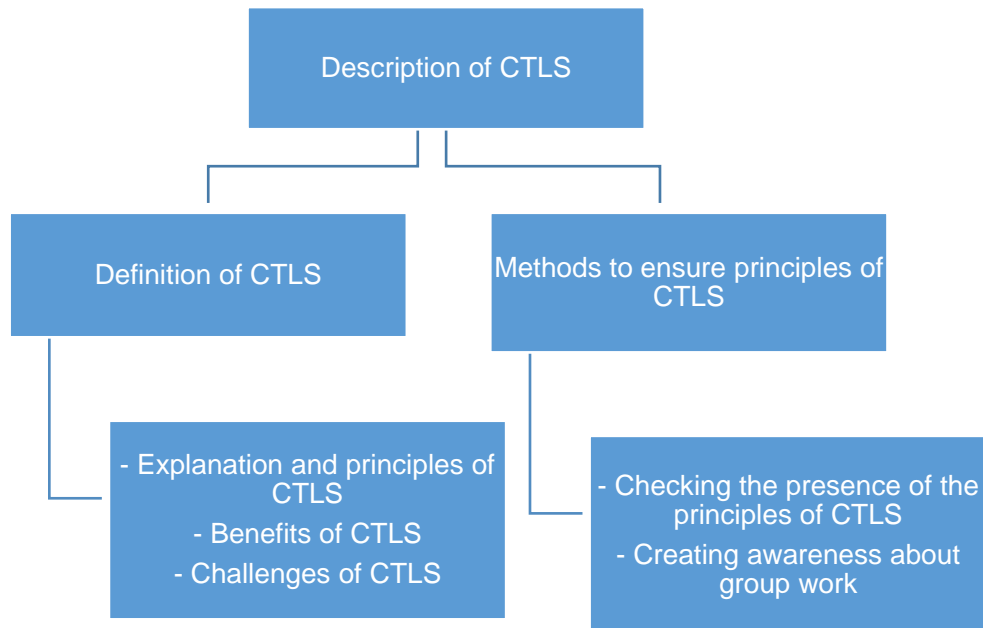
Figure 4.1: Description of CTLS based on teachers' responses

4.3.1. Definition of CTLS

This category refers to the meaning of CTLS and its features. This category has three sub-categories which include explanations and principles of CTLS, benefits of CTLS, and the disadvantages of CTLS.

4.3.1.1. Explanation and principles of CTLS

Generally, based on all the participants' (the full sample) questionnaire responses to item ten (What does cooperative learning mean to you?) from the questionnaire, the majority of the participants provided a clear description of what cooperative learning means to them. Many participants described cooperative learning as a learner-centred instructional methodology which allows all learners to be involved in the learning process and helps learners in a group to combine their different abilities to complete the given task.

Figure 4.2 illustrates the number of teachers who gave an appropriate description of CTLS and those who did not provide an adequate description.
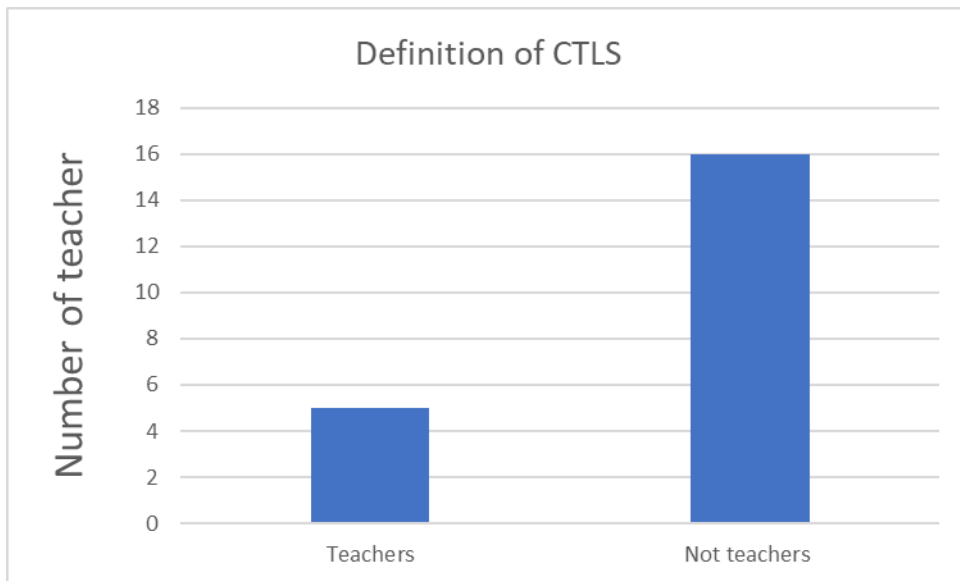
Figure 4.2: Definition of CTLS based on teachers' responses in the questionnaire

The following extract (Extract 4.1) provides examples of participating teachers' responses to item ten in the questionnaire.

Question (Q) 10: What does cooperative learning mean to you?

Teacher one: A teaching style in which learners learn through group activities. It allows students to learn from each other, promotes socialisation and allow learners to pool together their different abilities and skills to complete a task.

Teacher seven: Learning as group, each learner in group given responsibility, and learner's centeredness kind of teaching.

Teacher 11: Sharing, pulling each other and improve.

Teacher nine: Formulating a group of four learners. Each learner given responsibility.

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Question 20: Based on your opinion, when the students sit in a group, which of the following aspects should be present during group work? Please circle your chosen options (you may circle more than one option).

- A. Face-to-face interaction.
- B. Positive interdependence.
- C. Shouldering responsibilities.
- D. Individual accountability.
- E. Communication skills.
- F. Sociability.
- G. Decision making abilities.
- H. Ability to criticise.
- I. Ability to accept criticism.
- J. Set group and individual goals.
- K. Evaluate group effectiveness and accept weaknesses.
- L. Set new goals after completing each task

Based on the participants' responses to item 20 of the questionnaire, many Natural Sciences teachers in the full sample believe that the presence of face-to-face interaction, positive interdependence, communication skills, and decision-making skills play necessary vital roles in the success of CTLS. However, very few Physical Science teachers believe that the presence of individual accountability, taking responsibility, sociability, ability to criticise, ability to accept criticism, ability to set group and individual goals and evaluate the goals, and the ability to set new goals after each task is finished, are important while implementing CTLS. Figure 4.3 represents the elements of CTLS that were selected by the respondents to constitute the principles of CTLS.
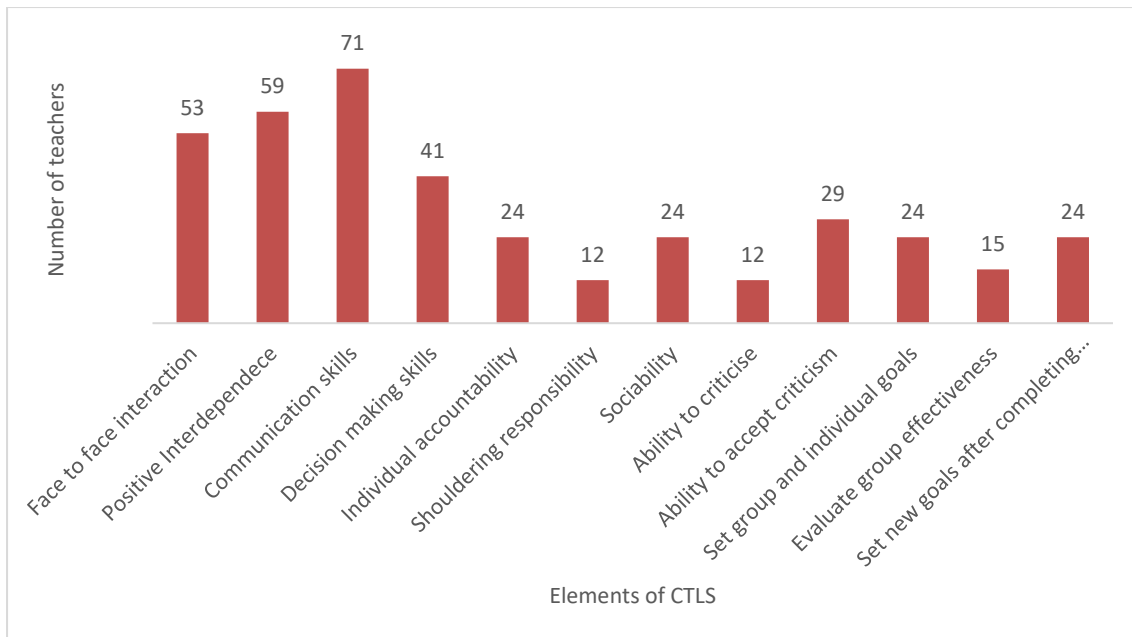
Figure 4.3: Preferred elements of CTLS according to the full sample's responses

The teachers who understand and are familiar with CTLS should be able to explain CTLS and its fundamental principles in terms of what separates it from other forms of group work strategies. However, very few of the science teachers managed to state all of the aspects of CTLS. The majority of the teachers mentioned two or three of them.

Sifiso expressed CTLS as a means of enabling learners to work collaboratively and to help one another to accomplish the tasks. Teachers guide learners to enable them to develop and express their understanding and to be ready to teach one another while engaged in the task. The following extract (Extract 4.2) provides an example from the transcript of Sifiso's interview followed by his response to Q10 of the questionnaire.

Researcher: What does cooperative teaching and learning strategy mean to you?

Sifiso: For me, cooperative teaching and learning means when the teacher gives a work to a group of learners and then give them to accept to work cooperatively, that is together and produce one common hand.

Question (Q) 10: What does cooperative learning mean to you?

Sifiso's response: When a group of learners help each other to complete a task.

53

Amanda expresses CTLS as learning that is based on the positive relationships between learners within a group and occurs when learners share their understanding and knowledge with one another and understand that they can work more effectively in groups than as individuals. She added that CTLS is a process of learning that motivates learners to develop comprehension and knowledge through the assistance required to achieve the outcomes of learning. The following extracts, identified collectively as Extract 4.3, provide Amanda's response to Q10 of the questionnaire and her response during the interview.

Researcher: What does cooperative teaching and learning instruction mean to you?

Amanda: To me it means that there is that the people sharing their knowledge with one another and using their own knowledge with one another and using their own knowledge and understanding to encourage others. You know, so that everybody benefits from working – the whole is bigger than the parts.

Question (Q)10: What does cooperative learning mean to you?

Amanda's response: Encouraging learners to have their understanding and knowledge in order to reach a common goal.

Nosipho explains CTLS as team teaching which occurs when teachers collaborate and combine their strengths, ask others for assistance with lessons that they struggle with, and ask questions when necessary. According to Nosipho, CTLS is implemented when teachers strive to help one another and form social learning experiences through the structuring of classroom activities.

The following extract (Extract 4.4) provides Nosipho's response during the interview.

Researcher: What does cooperative teaching and learning instruction mean to you?

Nosipho: For me, cooperative teaching and learning means like different teachers pulling their effort together, their experience, their strength even addressing each other weaknesses, like helping each other if you are struggling teaching these topics. If I feel confidence in that topic, you observe me teaching, you ask questions after the lesson maybe like learning from each other.

Her response in the questionnaire does not agree with her response during the interview when she described CTLS as constructing activities for the learners and activities that allow them to learn through observation. This is illustrated by the extract below (Extract 4.5):

Question (Q)10: What does cooperative learning mean to you?

Nosipho's response: Organising classwork activities in teaching and social learning experiences.

Chantel refers to CTLS as an approach that encourages learners to take responsibility for their own learning and teachers also have to be good facilitators who guide learners to engage in their learning and help learners to address misunderstandings. She further explains that teachers play an integral role in terms of using different methods to keep learners focused on their learning. Her questionnaire and interview responses are provided below (Extract 4.6).

Researcher: What does cooperative teaching and learning strategy mean to you?

Chantel: It facilitates accelerated learning… learners developing their own sense of learning… explaining to a friend… we are teaching them responsibility on their learning…. your expert knowledge by helping them by clarify misconception…

Question (Q)10: What does cooperative learning mean to you?

Chantel's response: To me, cooperative learning is a method that enable me to guide the learners to take responsibility for their learning. I have found that often this speeds up the learning process, but also that the learners become invested in their learning. My learners engage more readily with the work and with me as their teacher during discussions when I apply collaborative learning strategies more often.

Three of the teachers, Sifiso, Amanda, and Chantel, describe CTLS along with its unique features that distinguish it from other forms of group work. Sifiso and Amanda included the fundamental principles of CTLS, such as positive interdependence, in their descriptions. Chantel also described CTLS with its benefits that accelerate learning and encourage learner's engagement. However, Nosipho described CTLS in two different ways. She described CTLS as collaboration in a working environment among employees with the positive interdependence of teachers influencing learners

55

to own their learning and to share their understanding and knowledge. However, afterwards she described CTLS as the collaboration between learners.

CTLS differs from other forms of group work due to the presence of positive interdependence, face-to-face interaction, acceptance of responsibilities, social interaction, and group processes (set goal, evaluate goal, identify weaknesses, appraise strengths, and revise goals before the next task). A person who understands CTLS and knows its unique features is expected to mention the presence of these aspects within a group.

All four of the teachers, Sifiso, Amanda, Nosipho and Chantel, believe that, within the groups, the presence of positive interdependence, a convenient way of communicating, the acceptance of responsibilities, and short-term and long-term goals to achieve individually and as a group are essential for the successful implementation of CTLS. Sifiso, Amanda, and Chantel added that they believe in the importance of clarity as well as exchanging ideas and accepting ideas from others to arrive at a common decision as a group. However, Nosipho indicated during the interview that she regards CTLS as the cooperation between teachers, not learners.

All of the principles listed in question 20 of the questionnaire are essential for the successful implementation of CTLS. However, only Amanda and Chantel selected all of the important principles. The two principles chosen by Amanda and Chantel that were not selected by the other participants were evaluating the group processes which allow the learners to identify their weaknesses and strengths as well as setting new goals which incorporate methods to address the weaknesses that they encountered previously. The question specifically refers to learner interactions and Nosipho also selected most aspects, though it is possible that she was applying them to teachers. The responses of all four of the teachers to question 20 in the questionnaire are provided below (Extract 4.7).

> **Question (Q) 20:** Based on your opinion, when the students sit in a group, which of the following aspects should be present during the group work?

Sifiso's selection: Face-to-face interaction, positive interdependence, individual accountability, communication skills, sociability, decision making ability, ability to criticize and set group and individual goal.

Amanda's selection: Face-to-face interaction, positive interdependence, shouldering responsibilities, individual accountability, communication skills, sociability, decision making ability, ability to critics, ability to accept critiques, set group and individual goal, evaluate their effectiveness and accept weakness, and set new goals after each task is finished.

Nosipho's selection: Face-to- face interaction, positive interdependence, individual accountability, communication skills, ability of criticism, ability to accept criticism, set individual and group goals, evaluate group effectiveness and accept weakness and set new goal after completing each task.

Chantel's selection: Face-to-face interaction, positive interdependence, individual accountability, communication skills, sociability, decision making abilities, ability to accept weaknesses, set new goals after completing each task.

Chantel and Amanda provided explanations of CTLS that encompassed all of the essential principles. However, Nosipho and Sifiso did not indicate all of the basic principles of CTLS.

4.3.1.2. Benefits of CTLS

This sub-category describes the benefits of cooperative learning in the learning process specifically to develop the personal and educational skills of learners.

The focus sample answered questions regarding the benefits of CTLS and its positive impact on learners' educational and psychological development through the interviews and the questionnaire. All four of the teachers in the focus sample observed an increase in the levels of learners' confidence and development of their critical thinking skills after using CTLS as one of their instructional methodologies. In addition, learners became better prepared for learning as they had the opportunity to present their work to the rest of the class. The level of participation and engagement in the activities, the conceptual understanding, and the exposure to an empirical setting increased. Consequently, they are able to acquire the personal skills that are beneficial in education and life. The following extract provides all of the participants' responses during the interviews regarding this topic (Extract 4.8):

Researcher: What kinds of skill changes have you seen so far in the students after implementing cooperative teaching and learning?

Nosipho: They are boosted the level of confidence. Learners are free at class, the conducive environment…. their intelligence skills … critical thinking skills…

Chantel: I have seen them increasing their confidence also in their willingness to ask questions because very often….

Amanda: I think there is more intuition for learning … they enjoy it so there is more positive about learning…. they are excelling deeper learning.

Sifiso: The leaners start concentrating more on their work and the learners also cooperating more each other, which is resulting that the way of more understanding.

Furthermore, all of the focus sample participants indicated that the learners benefitted from participating in cooperative learning activities and became approachable, more active, and more creative during the completion of tasks. Furthermore, cooperative learning led them to recall information effortlessly and to understand the issues discussed in the activities easily. The responses of all four of the participants to question 21 of the questionnaire, which addresses this topic, are provided in the following extract (Extract 4.9).

Question (Q) 24: What kind of development have you seen after implementing cooperative teaching and learning instruction on your learners?

Nosipho's response: The rate of participation increased, and they become more creative in all task.

Chantel's response: They become friendlier, the rate of participation increased, they change their behaviour to good, and they become more creative in all tasks.

Amanda's response: The rate of participation increased, they change their behaviour to good, and they become more creative in all tasks.

Sifiso's response: They become friendlier than before, they change their behaviour to good, and they become more creative in all task.

Question 25 of the questionnaire, provided in Figure 4.4, lists alternative skills that are acquired by the learners through the involvement in CTLS experiences that are designed properly:

Questionnaire (Q) 25: Which of the following skills have been acquired by the learners after the implementation of cooperative teaching and learning?

A. The necessary social skills for learning and life
B. The development of learners' self-esteem
C. Being more interactive and engaged in classroom activities
D. Exposure to real life learning
E. Increased conceptual understanding
F. Improve communication skills

Figure 4.4: Contents of question 25 in the questionnaire

The learners' increased conceptual understanding of each lesson has been indicated by the four teachers in the focus sample, namely, Nosipho, Amanda, Sifiso, and Chantel. They also added the development of learners' self-esteem as one of the benefits obtained.

In addition, Nosipho, Chantel, and Amanda selected that learners acquire all of the necessary social skills for learning and life as an additional advantage for learners involved in CTLS. Sifiso, Chantel, and Amanda added that CTLS exposes learners to real-life learning. Only Sifiso and Amanda mentioned that CTLS changes low calibre learners to high calibre learners. The fact that learners become more interactive in class and enhance their communication skills was mentioned only by Nosipho and Chantel.

Many Natural Sciences teachers believe that being exposed to different opinions enables learners to consolidate their own understanding and knowledge. CTLS creates constructive group work amongst learners with different abilities and skills towards the accomplishment of a given task. Many of the educators in the full sample agreed that such exposure assists learners to develop their positive self-efficacy, ability to communicate, teamwork skills, and time management skills, which will help them in academic and professional environments. Three examples of responses to question 26 in the questionnaire are provided below (Extract 4.10).

Question (Q) 26: In your opinion, what do the learners gain from cooperative teaching and learning?

Teacher three: Interacting each other discipline.

Teacher seven: Self-confidence, respect and positive interdependency.

Teacher 17: Working together as team.

After executing CTLS, several teachers observed changes in learners such as involvement in class, development of respectable behaviour, and more innovation when completing tasks. The majority of teachers agreed that learners develop communication skills when they engage in CTLS. In addition, they agreed that learners' academic ability can improve and they can develop positive self- esteem. The percentage of teachers' responses on learners' benefits after being involved in CTLS are presented in Figure 4.5.
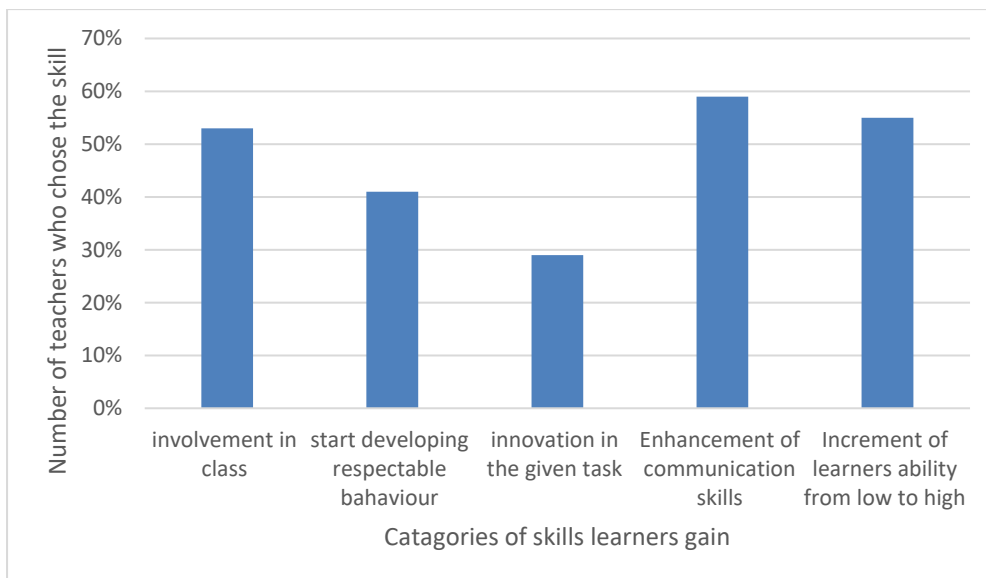
Figure 4.4: Skills that learners gain from CTLS

The participants' responses demonstrate that the Natural Sciences teachers are aware of the advantages of CTLS for learning. Enhancement of communication skills was the best-known skill amongst the science teachers as an advantage of CLTS. This indicates that most teachers are aware of the need for face-to face interaction within the group in order to enhance their communication abilities. Class participation

and enhancement of positive self-esteem are also highly valued by teachers as advantages of CTLS.

4.3.1.3. Possible disadvantages of CTLS

This sub-category addresses the possible limitations of cooperative teaching and learning instructional methodology.

According to Sifiso, CTLS is not a comfortable methodology when one introduces learners to a new concept or topic to work on. In such circumstances, learners will not collaborate and contribute fully to the given task. Sifiso describes the limitation of CTLS as follows (Extract 4.11):

> Researcher: What are the negative impacts of cooperative teaching and learning strategy?
>
> Sifiso: It is usually difficult to give learners on something which they do not know completely. They are not, it is hard to say, starting a new topic which, they do not know if they cannot cooperate. They become very noisy and again was take it as some they, which is not serious, as they are playing around during that activity …

Nosipho describes the constraints of CTLS as being time intensive and demanding. She cites the amount of effort required as CTLS requires many well-prepared tasks. The teacher needs to encourage and confirm the involvement of the learners, especially the weak learners, if he or she wants them to achieve the desired outcomes. Nosipho addresses the disadvantages in her response during the interview (Extract 4.12):

> Researcher: What are the negative impacts of cooperative teaching and learning?
>
> Nosipho: Time consuming, you must create different task, you have to move a round checking learners. … you pushed them to the level of those who are average or whatever even create more time after class you know sometimes 35 minutes it is not enough, so you must create extra lessons.

Chantel also agreed that CTLS is time consuming. She explained further that one requires ample time to prepare the tasks, however, one will use each of them several times after that. She added that there are times when poor performing learners might

not understand the content. Chantel's interview response illustrates her concerns (Extract 4.13):

Researcher: what are the negative impacts of cooperative teaching and learning strategy?

Chantel: …. some resources take quite a lot of time to prepare so it is time intensive…. you have got those resources for a few years, so you prepare it once that takes a lot of time … it as seriously so some of the weaker learners are a little bit lost in the fun and they do not get the content.

Amanda also expresses the limitation of CTLS as a teaching methodology that it does not allow teacher to sit at a desk as it demands a considerable number of activities. Furthermore, it requires well-prepared tasks in order to implement it according to expectations. Otherwise, learners will not be engaged and they might make a lot of noise.

Extract 4.14: Amanda's interview response

Researcher: What are the negative impacts of cooperative teaching and learning?

Amanda: A lot of work and you cannot sit behind your desk like a teacher… Let's say they do not have the plan and the table in the worksheet they knew what is aiming for it is not going to work they won't be learning it is just to be a chaotic. I think planning is the most important, which teachers do not like to do.

The three teachers, namely, Chantel, Amanda, and Nosipho, mentioned that CTLS is time intensive in nature and identified the effort and time needed to construct tasks as common disadvantages of CTLS. Only Sifiso cited that CTLS cannot be a good strategy to use for introducing new knowledge.

4.3.2. Methods to ensure that essential principles of CTLS are implemented

This category describes the techniques that teachers use to confirm the presence of the five principles of CTLS. The category has two main sub-categories: Confirming the presence of the principles of CTLS and creating awareness on how the groups work.

4.3.2.1. Confirming the presence of principles of CTLS

The techniques that Sifiso used to confirm the presence of positive interdependence, face-to-face interaction, individual accountability, social skills, and group processes were the following: choosing one learner from the group to report the group work to the rest of the class, giving small tests or formal tests, walking around between the groups and sitting amongst them to see how they are doing, and giving different materials to each member of the group to force them to share in the process of completing the given task.

Extract 4.15: Question 22 and Sifiso's response

> Question 22. Which one of the following methods do you usually use to ensure the presence of the aspects that you indicate in question 21?
>
> A. Random selection of learners to report their work to the rest of the class.
> B. Check their individual and group goals
> C. Formative and summative assessment
> D. Moving around and sitting with them at the time of their discussion
> E. Giving the necessary materials for the task to the individual learners in the group

Sifiso's response: Random selection of learners to report their work to the rest of the class, formative and summative assessment, moving around and sitting with them at the time of their discussion, and giving the necessary materials for the task to the individual learners in the group.

Nosipho's method to confirm the presence of the principles of CTLS, as stated in the extract (Extract 4.16), is choosing one learner from the group randomly so that he or she presents the group work on behalf of all of the group members.

Question (Q) 22: Which one of the following methods do you usually use to ensure the presence of the aspects that you indicate in question 21?

Nosipho's response: Random selection of learners to report their work to the rest of the class.

The practice that Amanda has for confirming the presence of the principles of CTLS are providing different materials to members of the group, constantly examining the goals that are established individually and as a group, and moving around between the groups. In addition, she sits with them at times to hear their group processes.

63

Extract 4.17: Item 22 questionnaire response by Amanda

Question (Q) 22: Which one of the following methods do you usually use to ensure the presence of the aspects that you indicate in question 21? Amanda's response: checking their individual and group goals, moving around and sitting with them at the time of their discussion, and giving the necessary materials for the task to the individual learners in the group.

Chantel gives different resources to each group member to complete the given task. They can share their resources to finish the task. Walking around between the groups during the group work to see how and what they are doing, giving small tests or formal tests after the group work, and choosing one learner from each group to present their work to the rest of the class were confirmed by Chantel as her methods.

Extract 4.18: Item 22 questionnaire response by Chantel

Question (Q) 22: Which one of the following methods do you usually use to ensure the presence of the aspects that you indicate in question 21?

Chantel's response: Random selection of learners to report their work to the rest of the class, formative and summative assessments, moving around and sitting with them at the time of their discussion, and giving the necessary materials for the task to the individual learners in the group.

Teachers should use different approaches to ensure the presence of the principles of CTLS. The use of these five methods enables learners and teachers to achieve the anticipated outcomes. Three of the focus sample participants, Sifiso, Amanda, and Chantel, used all of the methods as recommended. Nosipho, however, used only one technique.

64

Within the full sample of participants, many of the teachers reported moving around and sitting with and within the group as a major technique to confirm the presence of the principles of CTLS. Other than moving around within the group, some teachers use random selection of learners from the group to report their group work to the rest of the class. Very few of the teachers use the confirmation of individual and group goals, giving different resources to group members to promote accountability and interdependency, and formative and summative assessments as methods of confirming the presence of the principles of CTLS during cooperative learning. Figure 4.5 provides an overview of the methods which were selected by the full sample of teachers as techniques to ensure the presence of the fundamental principles of CTLS.
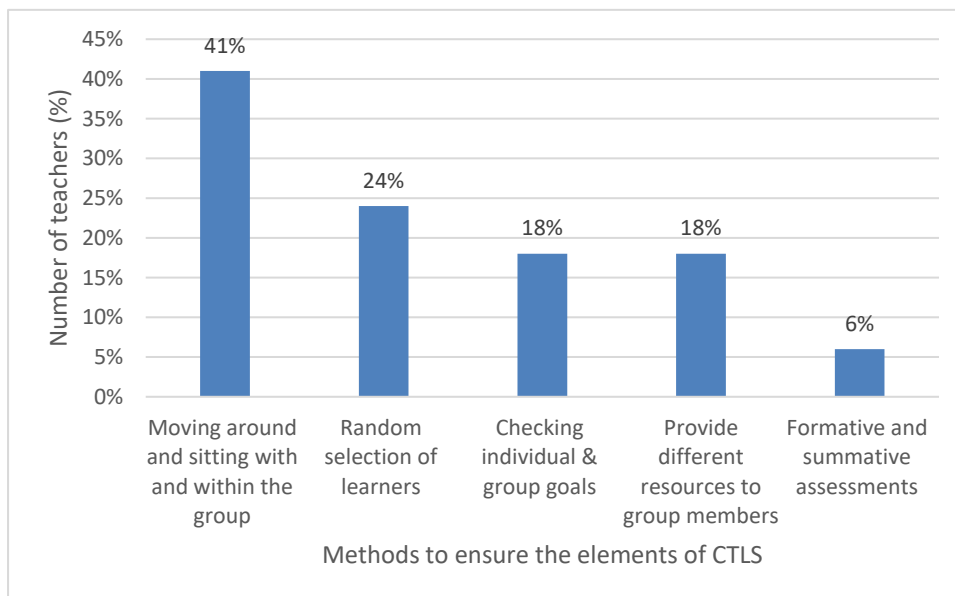
Figure 4.5: Methods to ensure the presence of the principles of CTLS

All of the methods listed in the questionnaire are required (Ifeoma, Ngozi & Nkem, 2015). Only a few of the science teachers chose all of them but many teachers indicated one or two of them. This signals that the majority of the science teachers do not know the proper methods of ensuring that the principles of CTLS are implemented.

4.3.2.2. Creating awareness on how the groups work

Chantel explained that her school has a culture that promotes learning through CTLS. She only has to remind the learners and explain to them why they are doing the activity and what is expected of them for the activity.

Extract 4.19: Chantel's interview and item 18 questionnaire responses

Researcher: Have you given an orientation to your students about cooperative teaching and learning strategy?

Chantel: I explain to them the reason why we are doing these activities in these ways… I want you guys to communicate … to interact… to share your knowledge… outcomes structure of activity itself.

Question (Q) 18:   How are the learners made aware?

Chantel's response: The school uses cooperative learning from lower grades, and we are encouraged to remind learners of the instruction before we start.

Sifiso's experience of orienting learners about how CTLS works is that each individual teacher provides training at the beginning of the term and teachers give a brief explanation of the method of instruction before they begin with their tasks. Learners are accustomed to some of the rules of CTLS as the school has this culture.

Extract 4.19: Sifiso's interview and item 18 questionnaire responses

Researcher: Have you given an orientation to your students about cooperative teaching and learning strategy? Like, how it is working, what kind of skill is needed?

Sifiso: In giving them instructions. They knew some instruction.

Questionnaire (Q) 18:   How are the learners made aware?

Sifiso's response: Each class teacher trains learners at the beginning of the first term.

Amanda's school does not have any culture of giving any orientation about CTLS to teach the learners what is expected of them and how the groups work. The reason she provided was that her school started cooperative learning in lower grades and she believes that orienting learners is similar to forcing them to follow the structure. It is rather formed spontaneously when the learners work in a group.

Extract 4.20: Amanda's interview and item 18 questionnaire responses

Researcher: Have you given an orientation to your student about cooperative teaching and learning strategy at the beginning of the year?

Amanda: No, we just do it.

Researcher: what is your reason behind it?

Amanda: I don't want to impose the structure on them I feel it they must just learn intuitively that if I cooperate with somebody else in a group it is going to be better for me and in the long run so know I don't for to me it is something that must develop from within the group…

Question (Q) 18:   How are the learners made aware?

Amanda's response: The school use cooperative learning from lower grades.

However, in the questionnaire, she said that the school has a culture of using CTLS in lower grades. Amanda does not agree with facilitating or guiding learners to know how the groups work. According to her, the learner should recognise it on his/her own. This indicates that the role of teachers as facilitators during the implementation of CTLS is misunderstood.

Nosipho's practice regarding creating awareness about cooperative learning is that the teachers explain to the learners at the beginning of each year to prevent any confusion when two classes merge for group work.

> **Extract 4.21: Nosipho's interview and item 18 questionnaire responses**
>
> Researcher: Have you given an orientation to your students about cooperative teaching and learning strategy?
>
> Nosipho: Yes, we explain to them from the beginning of year, they must not be shocked when we combine them every time. …
>
> **Question (Q) 18:** How are the learners made aware?
>
> Nosipho: Each grade twelve teacher tell the learners before each task.

There is a contradiction between Nosipho's answers during the interview and in the questionnaire. During the interview, she said that the teachers orient learners on what is expected of them at the beginning of the year. Yet, in the questionnaire, she mentioned that teachers brief learners before the beginning of the tasks.

According to the full sample that completed the questionnaire, many of the schools leave the responsibility to teachers to tell learners about what cooperative learning is, how it works, and what is expected of them. Very few schools use cooperative learning

often to ensure that learners are familiar with this method of learning by the time they reach high school. The rest of the schools orient the learners at the beginning of the year as a method of creating awareness. Figure 4.6 represents the number of teachers (full sample) who chose particular techniques which are used to make learners aware of CTLS and how it works.
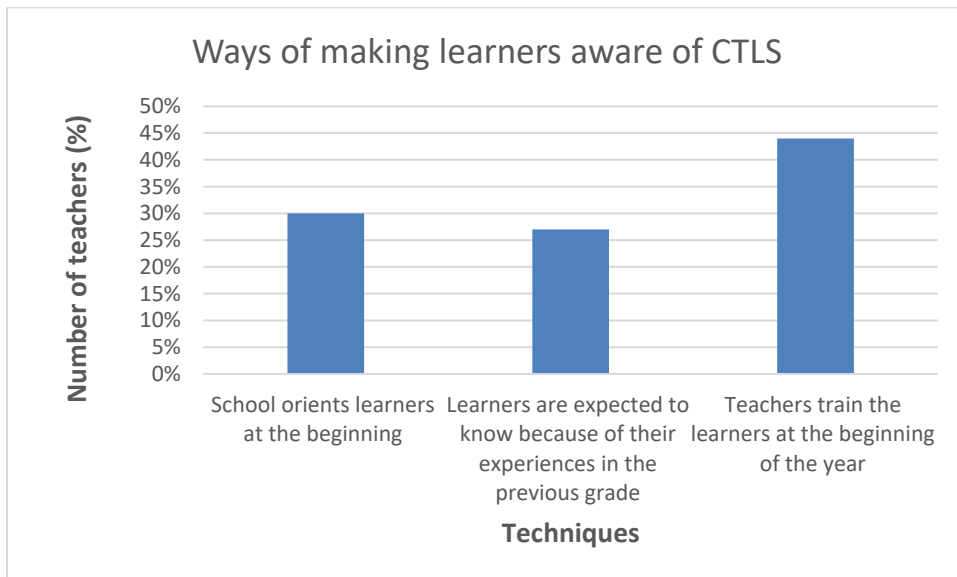
Figure 4.6: Ways of making learners aware of how CTLS works

4.4. THEME TWO: FACILITATING FACTORS

This theme describes the aspects that enable South African science teachers to frequently use CTLS as one of their teaching methodologies. The theme is organised into three categories which are school environment, training, and teacher attitude and collaborative teaching (Figure 4.7).
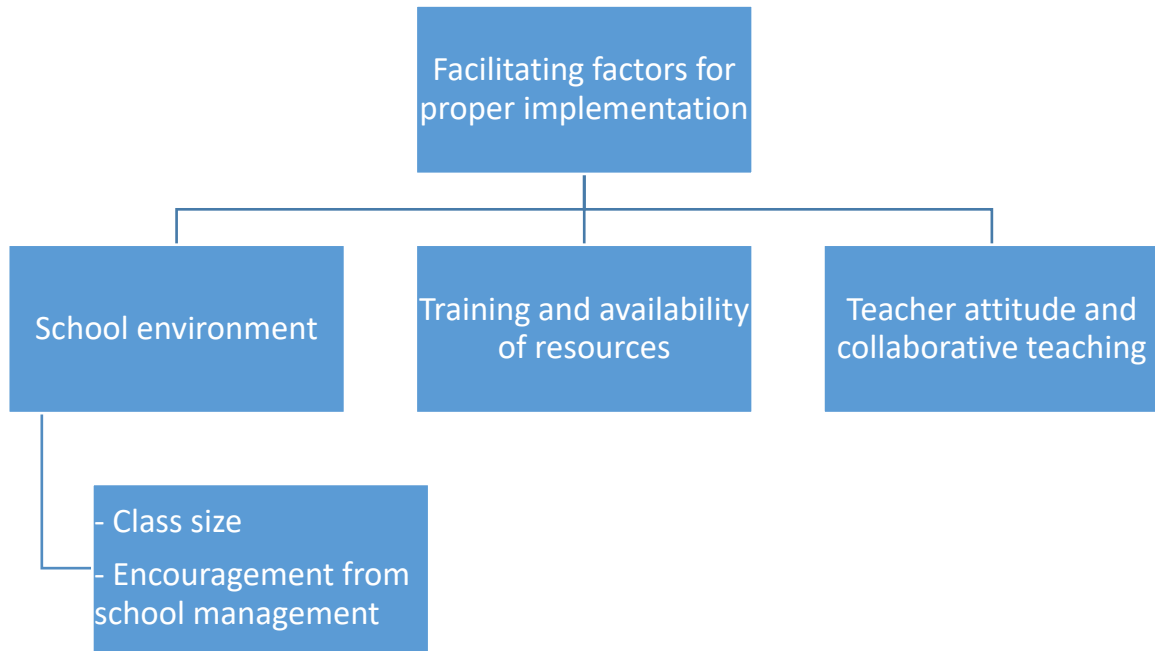
Figure 4.7: Categories of factors that facilitate the implementation of CTLS

4.4.1. School environment

This category emphasises the school context as a possible contributing facilitating factor for the implementation of CTLS with classroom setting and encouragement from school management as two sub-categories.

4.4.1.1. Class size

Nosipho's class of grade nine learners is quite big but the class size decreases with higher grade levels. She has one class of 60 learners and another of 56 learners, but her grade 12 class has only 36 learners. Sifiso's class sizes range between 36 and 41 learners per class. Chantel's biggest class has 36 learners and the other classes range between 27 and 31 learners.

Extract 4.22: Interview responses by Nosipho, Sifiso, and Chantel

Researcher: How many students do you have in a class?

Nosipho: In the lower grade is fifty something then …grade twelve I have got thirty-six students, grade eleven forty something in a class, and grade nine fifty-two – fifty-five sometimes it goes to sixty I have one a class with sixty students.

Sifiso: My biggest class is 41 and my smallest class is 36.

Chantel: That depends. My largest class has thirty-six, but on average most of the classes range between 27 and about 31.

Amanda's class sizes are quite small compared to those of the other participants. She has 28 learners in her largest class and the smallest class consists of 20 learners.

Extract 4.23: Interview responses by Amanda

Researcher: How many students do you have in a class?

Amanda: Between 20 to 28, the highest class is 28 and the lowest class is 20.

The full sample's teachers mentioned that the number of learners per class should be small for the proper implementation of CTLS as illustrated in the following examples of answers to question 29 (Extract 4.24).

Extract 4.24: examples of answers to question 29 in the questionnaire

Question (Q) 29: Which factors do you think facilitate the implementation of cooperative teaching and learning?

Teacher two: A well-disciplined class, Small class sizes, a greater amount of notional time

Teacher 15: Number of learners in a class

Despite the fact that the number of learners per class suggested by the CAPS is a maximum of 35, a large number of public schools are experiencing overcrowded classrooms. For CTLS, the class size is important when dividing learners into small groups. A manageable number of groups per class enable the proper facilitation of the implementation of CTLS. The responses of the teachers from the two public schools indicate that the proper class size is one of the components that facilitate the proper implementation of CTLS and a factor that contributes to using CTLS as frequently as teachers would like to.

4.4.1.2. Encouragement from School Management

Amanda believes that the HOD is the relevant person to assist and support the proper implementation of CTLS as the principals and the DBE do not know the details of the subject matter. However, she is not getting the support that she expects from the HOD.

70

In addition to this, she believes that cooperation between teachers is also one of the aspects that facilitate the implementation of CTLS.

Extract 4.25: Amanda's responses during the interview and to question 28

Researcher: In your opinion, in which aspects must the HOD or principal assist you for the proper implementation of cooperative teaching and learning strategy?

Amanda: I think the most important person is probably HOD, that is the person closest to you, but for say someone from the department or the principal and to come in and say do this… I think the HOD is probably the best person.

Researcher: In your context, do you think your HOD assist you on the way that you want to implement cooperative teaching and learning strategy?

Amanda: He does not stand in my way ... Yes let us say yes.

Question (Q) 28: In your opinion, which stakeholder (principal, HOD, district) is the most responsible for facilitating and encouraging teachers to use cooperative teaching and learning as one of their group work strategies? Why?

Amanda's response: I think other teachers must encourage and facilitate. You learn to manage co-operative learning by doing it.

Nosipho also thinks that the person who should motivate teachers to implement CTLS is the HOD. She explained further that, even though the HOD is the relevant person to assist, the situation can be challenging. She said that, if a teacher introduces a new technique of teaching, the HOD feels threatened. Thus, he or she does not support or encourage the teachers according to the expectations.

Extract 4.26: Interview and questionnaire responses by Nosipho

Researcher: In your opinion, in which aspects must the principal and the HOD assist you for the proper implementation cooperative teaching and learning strategy?

Nosipho: In the case of my HOD he must not feel like what I, feeling threatened like when you bring strategy when it takes away his job. He must feel good cooperative teaching and learning is for the benefit of learners' right, so that you must be prepared to…

Question (Q) 28: In your opinion, which stakeholder (principal, HOD, district) is the most responsible for facilitating and encouraging teachers to use cooperative teaching and learning as one of their group work strategies? Why?

Nosipho's response: HOD, because, the HOD is the one that mostly interact with teachers in daily bases and s/he knows the challenges encounters and will be assist.

Chantel believes that a suitable environment in terms of the availability of training and support from the HOD and principal is essential for the proper implementation of CTLS. She is grateful that her school encourages the implementation of CTLS by creating a conducive environment and training for teachers. The HOD encourages and the principal plays a vital role in supporting different training programmes.

Extract 4.27: Interview and questionnaire responses by Chantel

Researcher: In your opinion, in which aspect must the HOD or principal assist you for the proper implementation of cooperative teaching and learning strategy?

Chantel's response: We need encouragement by management and middle management to try cooperative learning strategies ……which we are very fortunate here … I think availability of training cooperative learning is not something that comes naturally, you need to be trained you need to be taught, you need to be shown how to do it...

Question (Q) 28:   In your opinion, which stakeholder (principal, HOD, district) is the most responsible for facilitating and encouraging teachers to use cooperative teaching and learning as one of their group work strategies? Why?

Chantel's response: The principal and HOD, because ultimately, we report our results to them, and they (especially the principal) have the right to make decisions regarding our future in the specific school environment. The district is more interested in results regardless of how these results are obtained

Sifiso thinks that principals play a significant role with respect to making cooperative learning a part of the school culture, supplying the essential materials, and inspiring teachers to use CTLS as one of their teaching methodologies. Furthermore, the principal is the one who is the most responsible person when it comes to discipline in the school. Unfortunately, Sifiso's principal is not playing his or her role.

Extract 4.28: Interview and questionnaire responses by Sifiso

Researcher: In your opinion, in which aspect must the HOD and the principal assist you for the proper implementation of cooperative teaching and learning strategy?

Sifiso: I think the principal might say cooperative in sense of school discipline, provide the resources, and encouraging cooperative teaching and learning strategy, encourage teachers to use cooperative teaching and learning strategy.

Researcher: Currently, is your principal do these things to encourage you?

Sifiso: No, not at all.

Question (Q) 28: In your opinion, which stakeholder (principal, HOD, district) is the most responsible for facilitating and encouraging teachers to use cooperative teaching and learning as one of their group work strategies? Why?

Sifiso's response: Principal is responsible for learners' discipline.

Many Natural Sciences teachers believe that the HOD is the right person to facilitate the implementation of cooperative learning since she or he has the subject specialisation. She or he is the relevant person in terms of knowing the subject content and classroom context. Only a few Natural Sciences teachers in the full sample identified three of the stakeholders (learners, teachers, and the school management) as responsible for the successful implementation of CTLS.

Extract 4.29: selected item 28 questionnaire responses by teachers in the full sample

Question (Q) 28: In your opinion, which stakeholder (principal, HOD, district) is the most responsible for facilitating and encouraging teachers to use cooperative teaching and learning as one of their group work strategies? Why?

Teacher three's response: HOD, since they are the curriculum drivers, and deputy to supervise as curriculum head.

Teacher six's response: HOD, he is the subject specialist.

Teacher seven's response: Everyone, because this supposed to be collective approachable, all the stakeholders must be aware on what is happing in a classroom.

Teacher eight's response: Everyone, support is vital for cooperative learning.

Figure 4.8 illustrates the various stakeholders who have been identified as responsible to facilitate the implementation of CTLS (Q 28) as well as the number of teachers who identified the particular stakeholders.
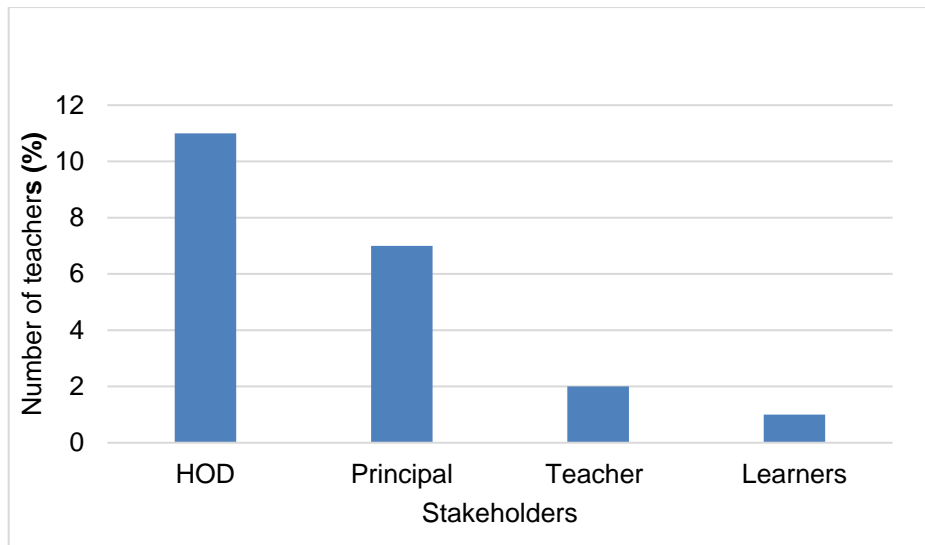
Figure 4.8: Responsible stakeholder for the implementation of CTLS

The majority of the responses state that the HODs play the most vital roles for the proper implementation of CTLS. They are considered to be the closest and most relevant persons for the subject and to the teachers as they are expected to comprehend the challenges the teachers encounter and what aspects are working appropriately for them. Therefore, the involvement of HODs in terms of facilitating the principals' assistance helps to implement CTLS sustainably.

4.4.2. Training and availability of resources

One of the focus sample participants mentioned that the training on CTLS for all teachers and principals is helpful for the proper and sustainable implementation of CTLS. In addition to this, he suggested that supplying resources is a vital factor that enables CTLS and other teaching strategies.

Extract 4.30: Item 29 questionnaire responses by one of the teachers in the focus sample

Question (Q) 29:   Which factors do you think facilitate the implementation of cooperative teaching and learning?

Participant's response: The training of all teachers and principals on cooperative teaching. Functionalized and providing resources for both general teaching and cooperative teaching of science.

74

Another teacher from the focus sample mentioned the accessibility of materials and training for teachers on CTLS as facilitating factors for the sustainable implementation of CTLS.

Extract 4.31: Item 29 questionnaire responses by one of the teachers in the focus sample

Question (Q) 29: Which factors do you think facilitate the implementation of cooperative teaching and learning?

Participant's response: Training and availability of resources that enable facilitation of cooperative strategies…

Many of the teachers recommended the availability of training for teachers on CTLS and resources for the successful and sustainable implementation of CTLS.

4.4.3 Teacher attitude and collaborative teaching

Nosipho specified that teachers will be encouraged to implement CTLS when they teach in teams by sharing experiences and best practices of implementing group work and class discussions.

Extract 4.32: Item 29 questionnaire responses by one of the teachers in the focus sample

Question (Q) 29: Which factors do you think facilitate the implementation of cooperative teaching and learning?
Nosipho's response: Team teaching, Group work, Class discussion.

Amanda described that, if less experienced teachers work with more experienced ones, this would facilitate and encourage the implementation of CTLS.

Extract 4.33: Item 29 questionnaire response by one of the teachers in the focus sample

Question (Q) 29: Which factors do you think facilitate the implementation of cooperative teaching and learning?
Amanda's response: Working with experienced colleagues.

In addition, science teachers mention that proper planning and assistance between teachers are helpful components for the successful application of CTLS.

Extract 4.34: Item 29 questionnaire responses by some of the teachers in the full sample

Question (Q) 29:   Which factors do you think facilitate the implementation of cooperative teaching and learning?

Teacher one's response: Preparation of task.

Teacher four's response: Planning, resource, and cooperation among educators

Two of the teachers indicated that teachers more experienced in using CTLS, communicating, and working with other teachers can be a great support for the continuous and proper enactment of CTLS.

4.4.4. Summary of Theme Two

Overall, availability of resources, development of skills to construct teaching and learning tasks, class size, continuous support for teachers from their HODs and principals, and sharing of experiences between teachers were found to be prominent facilitating factors for the proper implementation of CTLS.

4.5.   THEME THREE: HINDERING FACTORS

The theme discussed in this section describes the aspects that are constraints for the implementation of CTLS from teachers' experiences and perspectives. The theme, as outlined in Figure 4.9, has two categories. The first one focuses on teachers' exposure to CTLS regarding the training that they have received and their experience in using CTLS. The second category describes all of the features that are related to the curriculum and teachers' recommendations for the implementation of CTLS.

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┌─────────────────────────────┐
│   Hindering factors for     │
│   implementation of CTLS    │
└─────────────────────────────┘
        ┌──────────┴──────────┐
┌───────────────────┐  ┌─────────────────────────┐
│  Exposure to CTLS │  │ Curriculum implementation│
└───────────────────┘  └─────────────────────────┘
        │                        │
┌────────────────────────┐  ┌──────────────────────┐
│ - Training in CTLS      │  │ - Time available     │
│ - Exprience of using CTLS│  │ - Other challenges   │
└────────────────────────┘  └──────────────────────┘
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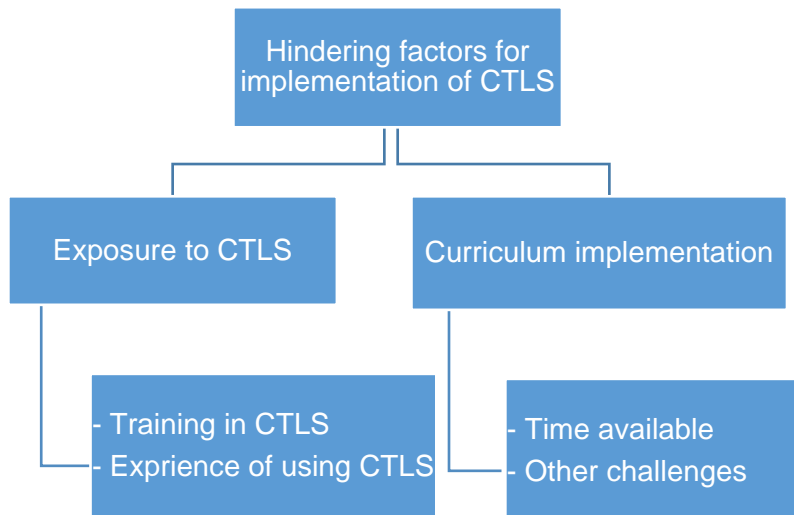
Figure 4.9: Hindering factors for execution of CTLS

4.5.1. Exposure to CTLS

This category consists of two sub-categories which are (i) training in CTLS, and (ii) years of executing CTLS.

4.5.1.1. Training on CTLS

Sifiso has not received any training in CTLS in his 22 years of teaching. The only exposure that he had was the introduction to CTLS theory during his senior undergraduate and honours degree programmes. He indicated that he was exposed to CTLS only when he was at university. After university, the school did not organise any training on CTLS and he did not receive training opportunities.

Extract 4.35: Interview and questionnaire responses by Sifiso

Researcher: Have you attended any training on cooperative teaching and learning strategy?

Sifiso: what I have attended is during my training as a teacher.

Researcher: But, after that does your school facilitate any kinds of trainings?

Sifiso: No

Question (Q) 11: How many in-service training sessions did you attend on the cooperative teaching and learning?

Sifiso's response: Not at all.

Similar to Sifiso, Nosipho reported no experience of receiving in-service training on CTLS. Her experience of learning about CTLS is in the form of theory lectures during her undergraduate and postgraduate degree.

Extract 4.35: Interview and questionnaire responses by Nosipho

Researcher: Have you attended any training on cooperative teaching and learning strategy?

Nosipho: No.

Researcher: Even when you were doing your undergraduate degree?

Nosipho: Just say it in person like we are not train in a literal sense, but we did have a course which has passed on learning, advantage of cooperative teaching and learning, modes of cooperative learning, but we did not do any practical learning

Researcher: Even from the department of basic education any kind of training?

Nosipho: No

Question (Q) 11:   How many in-service training sessions did you attend on the cooperative teaching and learning?

Nosipho's response: Not at all.

Chantel reported to have attended more than eight training sessions on CTLS. However, the training was not formal courses or offered by a company. Instead, two or more teachers from her school attended short term training and shared the lessons from the training with the rest of the school teachers. She views this informal training and sharing as helpful and motivational.

Extract 4.36: Interview and questionnaire responses by Chantel

Researcher: Have you attended any training on cooperative teaching and learning?

Chantel: I did not attend any formal training at like company or something but, we have internal staff training so what happens one or two teachers will go to a course and they bring back and present to the rest of the staff so I had informal training in that sense but I learned from my colleagues, but it had formal training.

Researcher: Did you get it helpful?

Chantel: Yes, I really do think it is helpful. I think also be encouraging to share if we experience something new to make sure that we share it with our colleagues it is very helpful…

78

Question (Q) 11: How many in-service training sessions did you attend on the cooperative teaching and learning?

Chantel's response: More than eight.

Figure 4.9 illustrates the number of teachers who have and haven't received in-service training on the CTLS
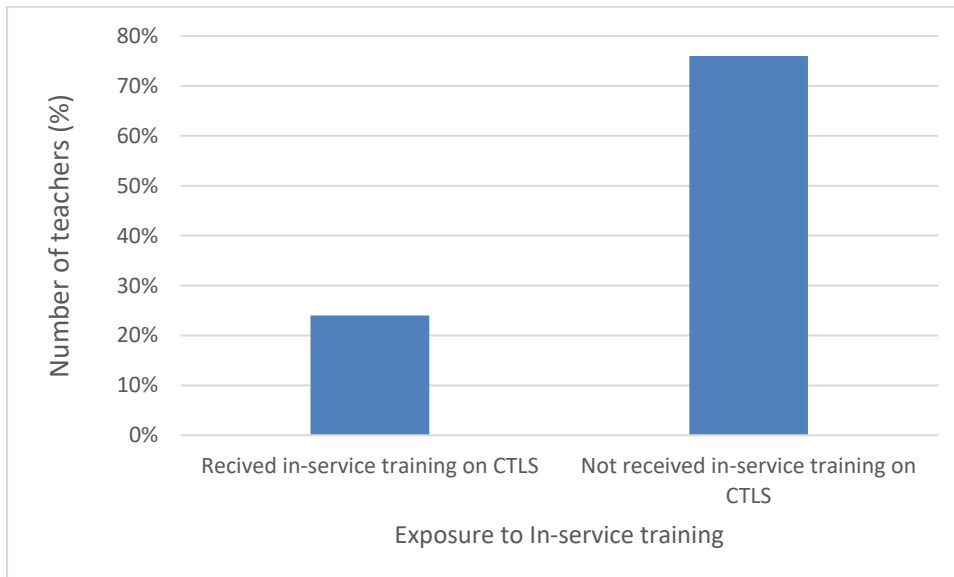
Figure 4.9: In-service training on CTLS

The questionnaire responses revealed that about a quarter (24%) of the full sample Natural Sciences teachers participating in the study have received between one and three in-service training sessions on cooperative teaching and learning. These training sessions were mostly in the form of formal training on CTLS.

Even though CTLS is prescribed as one of teaching strategies by the South African curriculum, it is surprising that there is inadequate training to empower teachers in utilising it. Some teachers, who are using CTLS, are doing so without having any exposure to training. They rely on the theory that they acquired in their postgraduate studies or through self-learning.

4.5.1.2. Experience in using CTLS

Chantel has fewer years of experience in teaching than the other focus group teachers. She has been using CTLS as her teaching methodology for the past two years. She said that she was teaching at that time at her first school in terms of

79

teaching in general as well as using CTLS. According to her explanation, at the beginning, she was somewhat unsatisfied but, once she started sharing her experiences with her colleagues, she realised that she was on the right track.

Extract 4.37: Interview and questionnaire responses by Chantel

Researcher: When do you use cooperative teaching and learning strategy?

Chantel: I was exposed to cooperative learning I tried a little bit of it in my first year… I did not know if I implement it correctly and then over time as I share my ideas with colleagues they give me their input then very often I found that I am on the right track … , speaking to my colleagues has built my confidence and we also received training quite often as a collective staff in cooperative learning and brain based education because the school truly believe in that…

Question (Q) 13:   How many years have you been implementing the cooperative teaching and strategy?

Chantel's response: 1-2 years

Sifiso's experience in using CTLS as one of his instruction methods is equal to his experience in teaching. He has been using it for the past 22 years. In the questionnaire, the last option provided is 18 years of experience and above, which includes 22 years of experience.

Extract 4.38: Interview and questionnaire responses by Sifiso

Researcher: When did you start using cooperative teaching and learning strategy?
Sifiso: 22 years ago

Question (Q) 13:   How many years have you been implementing the cooperative teaching and strategy?
Sifiso's response: More than eight years.

Amanda has 26 years of teaching experience, but she has been using CTLS as her teaching methodology for approximately ten years. She began using it after she read about the helpfulness of CTLS and noticed some of her colleagues using it.

Extract 4.39: Interview and questionnaire responses by Amanda

Researcher: When did you start using cooperative teaching and learning strategy?

Amanda: I suppose ten years ago. And I think I only start using it because maybe read about it, saw other people using it I never had formal training with it… I found it looked in interesting way I always like to try new things.

Questionnaire (Q) 13:   How many years have you been implementing the cooperative teaching and strategy?

Amanda's response: More than eight years.

Nosipho has the least experience of the focus group participants in using CTLS as her teaching methodology. She has been using it for the past three years, according to her interview responses.

Extract 4.40: Interview and questionnaire responses by Nosipho

Researcher: For how long have you been implementing it?
Nosipho: I think for the past three years and it did work for us like…

Question (Q) 13:   How many years have you been implementing the cooperative teaching and strategy?
Nosipho's response: One or two years.

In the full sample, many of the participants have between one and two years of experience in using CTLS as one of their teaching instructional methodologies. The minority has between three and five years of experience in the implementation of CTLS and only a few of them have eight and more than eight years of experience in using CTLS. Figure 4.10 represents the teachers' years of experience in using CTLS as one of their teaching methodologies.
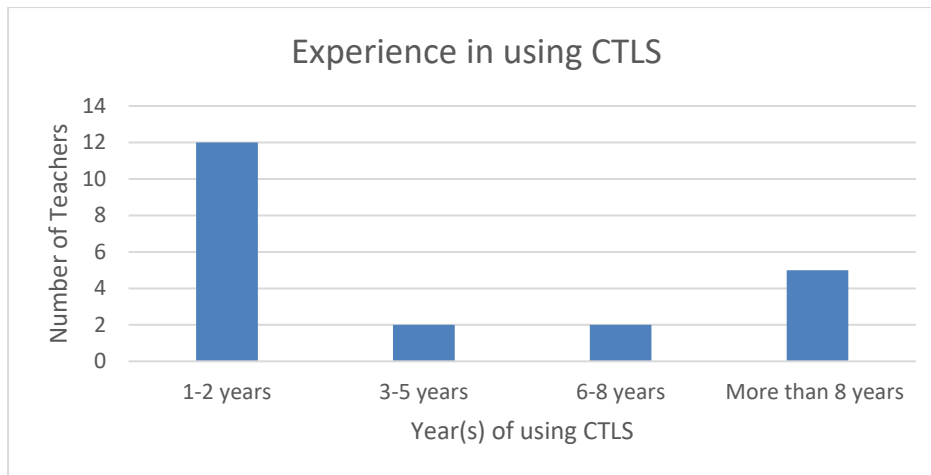
Figure 4.10: Teachers' experience of using CTLS

Based on the responses of most of the participants, one could conclude that using CTLS as a teaching methodology has become more common in the past ten years. This indicates that the Department of Basic Education needs to give attention to motivating schools to build the culture of using CTLS and assist them by providing continuous teacher professional development training on CTLS. Although the experience that teachers have in using CTLS influences the proper implementation of CTLS, it does not assist teachers to use CTLS according to the expectations without the appropriate culture of the school and continuous training on CTLS. Chantel is the least experienced one from the focus sample but she is using CTLS correctly due to the school culture and the training facilitation by the school.

4.5.2. Curriculum implementation

This category refers to subject content load in each grade and availability of resources to implement CTLS properly. The description is based on the perceptions of the participants. The category is organised into two sub-categories which are availability of time and other challenges for the proper implementation of CTLS.

4.5.2.1. Availability of time

Amanda does not remember exactly when and where, but in the questionnaire she reported that sometime in the past she attended one to three training sessions. It is not clear whether it was in the form of in-service training or within her educational path. However, during the interview, she indicated that she did not attend any training after her studies and cited her reason as not having time to do so. In fact, the school would

keenly cover the costs and send her for training should she indicate the need to attend to enhance her teaching skills.

Extract 4.40: Interview and questionnaire responses by Amanda

Researcher: Have you attained any training on cooperative teaching and learning strategy?

Amanda: I think possibly my study also come across it.

Researcher: What is your reason that you could not get any additional training after that?

Amanda: Maybe it was just a time constraint I felt that I could not cope with. There was not time. You know I did what I did what I could do

Researcher: but the school is willing to ….…...

Amanda: Yes, they would have if I want it to

Question (Q) 11: How many in-service training sessions did you attend on the cooperative teaching and learning?

Amanda's response: 1 - 3 times

Chantel thinks that revision of the curriculum is needed for the proper implementation of CTLS. Her idea is based on the fact that cooperative learning is time consuming while the curriculum prescribes specific content that should be covered in a year. She personally took the time to analyse the curriculum to calculate the time allocations. According to her findings, double the allocated time is needed for grade nine Mathematics and Natural Sciences to cover the content expected. She further explained that the other hindering factor is the attitude of some of the teachers.

Extract 4.41: Interview and questionnaire responses by Chantel

Researcher: What are the factors, which are affecting you during implementation of cooperative teaching and learning strategy?

Chantel: …   The biggest challenge that I have is the CAPS curriculum as a whole because the nature of the curriculum is in my opinion that the curriculum is very full… I found that for mathematics and natural sciences especially with grade nine the curriculum requirement in terms of time is literally double what is available. … it is very challenging to ensure that conceptual understanding, … let's say cooperative strategy can accelerate learning…bit time consuming …. I also think another thing need to change is perception of the teachers, educator perception is playing a big role …

83

Question (Q) 27: What are the challenges that you have encountered in the implementation of cooperative teaching and learning?

Chantel's response: It's difficult to think of creative ways to use collaborative strategies that are also topic related and will ensure efficiency in the learning environment. Often intense time constraints placed on the teaching and learning by the volumes (of) curriculum also make it difficult to incorporate collaborative learning because, once group work has been completed it is important to ensure that true learning has taken place. This can be time consuming at times.

Most of the participants in the full sample indicated the time intensive nature of CTLS and the content load of the syllabus as hindering factors for not using CTLS as regularly as they wish.

4.5.2.2. Other challenges

Chantel advises, for the proper implementation of CTLS, that the DBE revises the syllabus against the available time and provides affordable and accredited training on CTLS as part of the continuous professional development of teachers.

Extract 4.45: Interview and questionnaire responses by Chantel

Researcher: What must be done by the department of basic education to encourage the implementation of cooperative teaching and learning strategy sustainably?

Chantel: They should make sure that the courses are focusing on cooperative learning collaborative learning is probably advertised accessible in terms of time timing that is presented as well as cost … So if you are at school where you are expected to pay for your own training then it is not going to be possible for everyone to attend expensive course like that, so they need to make sure that a creditable courses are easily accessible both timely wise location wise and cost wise for all people.

Question (Q) 30: What are the possible steps that the department of education could take to resolve the challenges influencing you and your colleagues to use cooperative teaching and learning in your instruction?

Chantel's response: Revision of the syllabus is definitely an option, because there are a great many time constraints in the current syllabus… Current training can be quite expensive and if the school budget does not allow it places constraints on the teachers which will possibly result in non-attendance or non- compliance to cooperative learning strategies.

Sifiso mentioned the disproportion between classroom size and number of learners per class as a challenge as one must have a suitable setting for face-to-face interaction

84

for learners and space for the teacher to move around to control and support his or her learners. He added that the length of one period against the content to be addressed in a year is another factor. He explained that CTLS needs time. He pointed out that one will not be able to cover the content, if one uses CTLS, in 33 or 35 minutes. In addition, the noise level of learners, especially when it comes to a school with a quiet culture, makes it difficult to execute CTLS.

Extract 4.42: Interview and questionnaire responses by Sifiso

Researcher: What are the factors, which are affecting you during the implementation of cooperative teaching and learning strategy?

Sifiso: The factor that affect implementation that class sizes versus the size of the classrooms, and that is one of them and the length of the period that you should conduct.

Researcher: One period is how many minutes or hour is it?

Sifiso: Someday which works thirty minutes and the other days are thirty- five minutes. Another factor is the syllabus, the contents must be covered.it is very long so apply learner in that approach you will need more time so the syllabus will be completed. … so, you find out that the school might have a culture of having silence classrooms but if you implement cooperative teaching and learning strategy you have a noisy class, I think that is all.

Question (Q) 27:   What are the challenges that you have encountered in the implementation of cooperative teaching and learning?

Sifiso's response: Time consuming and noise levels too high.

Nosipho mentioned the learners' lack of interest to work in groups and the availability of space as challenges for the proper implementation of CTLS. She wishes to have a large space in order to combine two or more classes and ask one teacher to help with the discipline. By doing so, she can teach the learners at the same time in groups. However, some learners who do not prefer to work in groups might refuse to work collaboratively.

Extract 4.43: Interview and questionnaire responses by Nosipho

Researcher: What are the factors, which are affecting you during the implementation of cooperative learning?

Nosipho: I think the main problem that we have like space, the classrooms are becoming smaller …I cannot do cooperative teaching and learning in grade nine why? If I combine 56 and

85

56 that is a hundred and twelve, they cannot even sit in one class, but if there is accommodation like a big hall, I can combine even five class ….

Question (Q) 27:   What are the challenges that you have encountered in the implementation of cooperative teaching and learning?

Nosipho's response: Some learners' refusing to work within the same group.

Amanda said that the hindering factor is her because, in a school like the one she is working for, teachers are supported to pursue opportunities. Yet, the teacher's own personal interest may stand in the way. She explains further that CTLS, by it is nature, needs more time to structure the lesson and to apply it. Thus, it is time intensive.

Extract 4.44: Interview and questionnaire responses by Amanda

Researcher: What are the factors, which are affecting during implementation of cooperative learning?

Amanda: I knew limiting factor is myself, you know, how much I will put in work. I think in school like this you get all the support in it, it is not a problem. Because we are very lucky, if I want to do something in my classroom I will get all the full support with whatever I need so, … this from top down the teacher has got feel for it and they have to engage to cooperative learning them self. That's why I think the only way to teach cooperative learning techniques for more experience teachers to work with less experienced teachers, so that they can get it. You cannot impose it I do not think.

Question (Q) 27:   What are the challenges that you have encountered in the implementation of cooperative teaching and learning?

Amanda's response: Very time consuming.

Sifiso suggested that the DBE must train all teachers on CTLS. This will lead to the successful implementation of CTLS and learners will acquire the necessary skills for their education and lives.

Extract 4.46: Interview and questionnaire responses by Sifiso

Researcher: What must be done by the department of basic education to encourage the implementation of cooperative teaching and learning strategy sustainably?

Sifiso: I think the department can train, can do in-service training for teachers and also even for principal in cooperative teaching and learning strategy.

Question (Q) 30: What are the possible steps that the department of education could take to resolve the challenges influencing you and your colleagues to use cooperative teaching and learning in your instruction?

Sifiso's response: In-service training on cooperative teaching.

Nosipho's suggestion is that the DBE needs to organise workshops which would allow schools to learn from the experiences of the schools that have fared well in terms of academic performance and teaching strategy. In addition to this, the department should organise training for teachers to enable them to implement CTLS properly and provide the required materials for the application of CTLS either in the form of spacious classrooms or printed teaching and learning materials.

Extract 4.47: Interview and questionnaire responses by Nosipho

Researcher: What must be done by the department of education to encourage the implementation of cooperative teaching and learning?

Nosipho: So that I think is ignorance, there is no training, like workshops, like introducing this kind of thing where we see videos other countries or how they were improving their results, where implemented cooperative teaching and learning strategy, teach us the skills to implement it properly and they must make sure that there is enough space to do that, ….

Question (Q) 30: What are the possible steps that the department of education could take to resolve the challenges influencing you and your colleagues to use cooperative teaching and learning in your instruction?

Nosipho's response: They should assist in materials that are needed for us to conduct the activities.

Amanda suggested that the DBE should organise opportunities for teachers who are more experienced in using CTLS to work with less experienced ones to allow the less experienced teachers to acquire new skills.

Extract 4.48: Interview and questionnaire responses by Amanda

Researcher: What must be done by the department of basic education to encourage the implementation of cooperative teaching and learning strategy sustainably throughout science classroom?

Amanda: They need to identify teachers who use it that properly and let them teach others it is cooperative learning

Question (Q) 30: What are the possible steps that the department of education could take to resolve the challenges influencing you and your colleagues to use cooperative teaching and learning in your instruction?

Amanda's response: Let experienced teachers work alongside less experienced ones.

The other two factors that are indicated by the participants are the overcrowding in their classes which prevents the effective creation of groups and the active engagement of low performing learners within the group. Only a few participants mentioned inadequate resources as a challenge. Figure 4.11 presents the challenges that teachers encounter that make it difficult for them to use CTLS often (Q. 28).
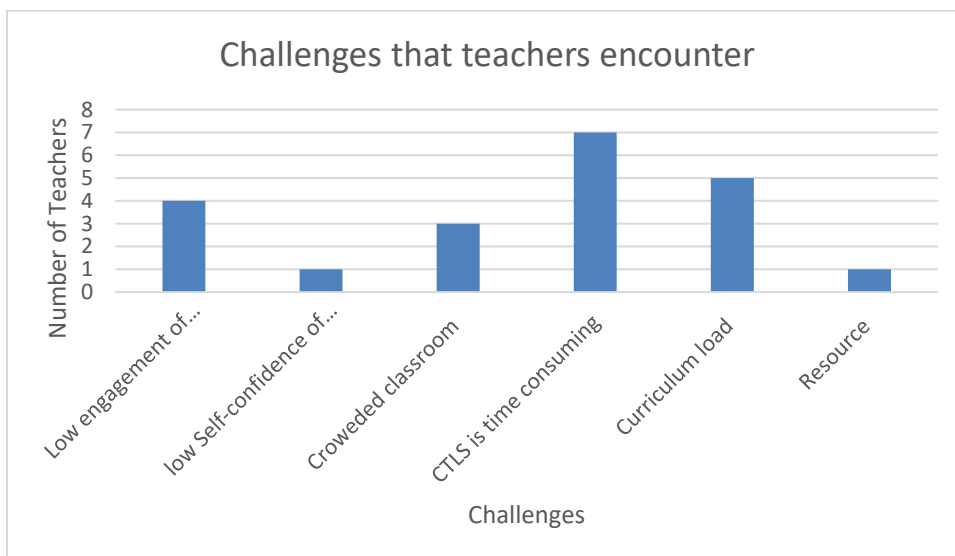
Figure 4.11: Challenges that teachers encounter

Most Natural Sciences teachers in the full sample have concerns about student behaviour. They are concerned that they may not be focusing on the activity and rather engage with their phones or personal activities. In addition to this, they mentioned as a limitation the content load as CTLS needs time to implement properly and the content has to be covered in the time specified in the annual teaching plans. Therefore, they prefer to use the traditional techniques rather than CTLS. Secondly, the classroom size and the number of learners per class are not proportional and it is not suitable to form groups and apply CTLS according to the pedagogic structural requirements.

Thus, the teachers suggested that the DBE should work on the proportionality between classroom size and the number of learners allocated per class, workshops and continuous training on CTLS, encourage experience sharing, and provide the necessary resources for CTLS.

4.6.   THEME FOUR: IMPLEMENTATION OF CTLS

The questionnaire alone was not enough to provide a deeper sense of the teachers' understanding of CTLS. It became necessary to compare the responses given by the teachers to their actual implementation of the teaching technique in real classroom settings. All the consenting participants were observed and interviewed in natural classroom contexts. Theme four addresses how science teachers execute CTLS.

Figure 4.12 illustrates how the theme is sub-divided into five categories, namely, classroom size and learners' arrangement, resources, teachers' approaches, teachers as facilitators, and assessment methods.
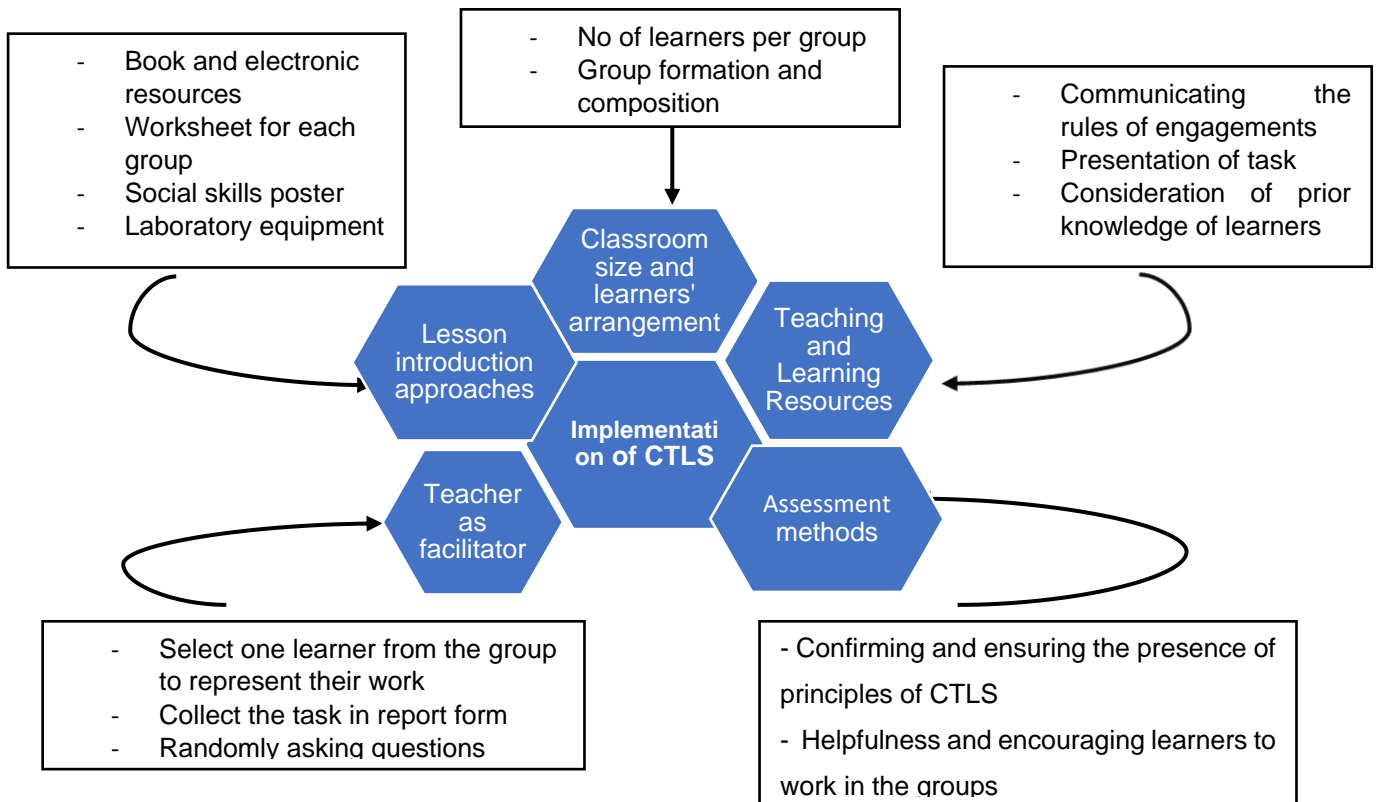
Figure 4.12: Implementation of cooperative teaching and learning strategy

4.6.1. Classroom size and learners' arrangement

This category represents the contextual setting of each teacher's classroom in terms of size and learners' arrangement which were captured in natural class settings in the schools. The category is structured in the following two sub-categories: (i) Number of learners per group, and (ii) Group formation.

4.6.1.1. Number of learners per group

Two of the teachers, Nosipho and Sifiso, had large numbers of learners per class which restricted the regular use of CTLS as the classroom was not spacious enough to arrange the learners into small groups.

> **Extract 4.49: Interview response by Nosipho**
>
> Nosipho: The classrooms are becoming smaller I would have wished if it is a hall, so you can put all your learners.

Chantel explained that the number of learners in a group depends on the class size.. She said*:* "Depending on class size, between four and five or if I have a smaller class some groups may have three learners… so it depends on the number of learners."

Amanda believes that the number of learners should be very small so that they can easily interact with each other. It might not work as expected if the number of students in a group increase.

> **Extract 4.50: Interview response by Amanda**
>
> Amanda: Three or four, I do not like, three to me is the best, but just depends on class size. Bigger than four, depends, I do not think it works.

Sifiso also believes that a small number of learners in a group makes the group work more effectively. Four learners are the best size for one group, but it relies on the numbers of learners in a class.

> **Extract 4.51: Interview response by Sifiso**
>
> Sifiso: I put four but, if you cannot make group of four, there are extra learners then I can make five in one group or two groups, just to cover the learners.

Nosipho thinks that, if learners sit in a group which includes learners with varying levels of academic performance and a teacher is able to control the discipline and interaction, many learners in a group is not a problem. What she expressed does not agree with CTLS as she indicated that grouping 28 learners in one group is a correct technique of group formation.

Extract 4.52: Interview response by Nosipho

Nosipho: Like for grade 12, we combine 28 and 28 which makes 56. It is going to be two groups with low, medium and high performance but both of us (the teachers) will be in one class where one stands in the back to observe the discipline, assist, write, teach and summarize. This is how we do it.

4.6.1.2. Group formation and composition

The teachers believe that a group must incorporate mixed academic ability. Yet, learners can choose where to sit or who to work with. If the learners are forced to be in a group, they might not work effectively. In the beginning of the year, this may work and give teachers time to determine the performance of the learners.

Extract 4.53: Interview response by Chantel

Chantel: Especially at the beginning of the year I allow the learners to group them self because I want to see they must be comfortable in my class, so I allow them to sit where they want to sit until I know them a little bit better also until we had a bit more contact time.

Sifiso feels that groups must be formed based on friendship since learners know each other regarding their performance. He said:

Extract 4.54: Interview response by Sifiso

Sifiso: I usually want them to be in their friendship groups. I do, very occasionally, put them according to their ability to identify that where bright students will be going to at least one group. That is very rare.

In Amanda's school, learners know each other since childhood. They have been learning at the same school and working in groups since the early stages of their education. Each learner knows the performance of others in specific subjects. The

learners, therefore, know with whom to form a group to perform well. Sometimes it is beneficial to respect the learners' feelings, as stated by Amanda.

Extract 4.55: Interview response by Amanda

Amanda: I let them choose I really do maybe because of the situation the kids know each other so well and they know each other abilities and all them are trying to get the best marks. They will choose their groups; they will choose they work best with. Occasionally, you have there is someone who no one else want to work with and you just must be diplomatic and put them into a group where you think they will be comfortable.

Nosipho presumes that the group should not be formed haphazardly. This is because group work is aimed at strengthening the low ability learners while at the same time empowering the students with high ability to retain knowledge through peer teaching.

Extract 4.56: Interview conversation with Nosipho

Nosipho: I do not just put them randomly they must be someone who strong in group, they must be weakest link so that they can be able to pull that learners up and there also average learners who are able to benefit from the one from the top and also help the one who is struggling.

Chantel thinks that once the teacher determines the academic ability and interest of his or her learners, it is essential to form the groups based on diverse ability and the learners' interest towards the subject. Hence, students with high ability can assist the low ability ones and the middle achievers also try to identify, through the process, which activities lead them to develop their own understanding about the lesson.

Extract 4.57: Chantel's Interview response

Researcher: How do you make the group?

Chantel: I try to keep it like one weak one strong and kind of middle one as well so that if there is any problem you know the strong learner can help the very weak one and the other can still talk and figure out by themselves when they really do thorough group discussion they can really share knowledge based.

4.6.2. Teaching and learning resources

This category refers to the availability of materials that are important for each task. Thus, the sub-division of the category is organised into the following sub-categories:

(i) books and electronic resources, (ii) a worksheet for each group, (iii) a social skills poster, and (iv) laboratory equipment.

4.6.2.1. Books and electronic resources

The availability of printed resources is not a problem for any of the teachers from the focus sample. Every learner has his or her own text and exercise books.

Extract 4.58: Interview response by Nosipho

Nosipho: No, we even have smart boards, we have got laptops for using in class. No, resources are perfect.

Nosipho's classroom has a typical classroom arrangement of one desk for two learners. When she enters the class after greeting the learners, everyone starts taking out their textbooks and exercise books. Every desk has more than one textbook. She explained that printed resources are not a problem at all and that the resources are "perfect".

In Chantel's classroom, which is arranged in groups of eight, once the leaners are there, they start greeting her and sit in their places and take out materials for the subject such as textbooks, exercise books, and tablets. Afterwards, they started writing what the teacher asked them to write (Chantel lesson observation video 00:04:45). Chantel also explained that the materials they need for teaching are provided by the school or the teacher buys them and asks for a refund (Extract 4.59):

Chantel: Because we are strongly encouraged to use cooperative learning strategies if you plan well enough in advance and you know I am going to need this, this, and this you can request it. If it is not immediately available, they would ask you may be if postpone that lesson until they have resource……. if we need to buy stuff then just go and buy it and then you bring the receipt to school and they reverse the money for you.

Sifiso's learners, after entering the class, sit in groups and start talking about the necessary materials to do the given task. Each desk has enough textbooks and other printing materials. (Sifiso lesson observation video 00: 03:54). He also stated during the interview that it is usually not a problem for cooperative learning "unless you speak in terms of doing practical work".

In Amanda's class, learners were busy with a plastic project. Learners sat in their groups after the teacher's explanation. Every group has the necessary material to complete the task as well as internet connectivity to conduct searches. There are laptops and tablets in each group. (Amanda lesson observation video 00:04:36). She explained the availability of resources during the interview (Extract 4.60):

> Amanda: I think in school like this you get all the support in it, it is not a problem. Because we are very lucky, if I want to do something in my classroom, I will get all the full support with whatever I need so.

4.6.2.2. Worksheet for each group

Three of the focus sample teachers, Sifiso, Amanda, and Chantel, used additional resources in addition to the textbooks. Every group member had printed activities, report sheets, and game cards. Sifiso was doing revision using past exam papers. Each group had a printed copy of the questions. In addition, he displayed it via liquid crystal display (LCD) (Sifiso lesson observation video 00:02:00).

Chantel's class was a revision lesson using a game. After the learners revised the lesson from their textbooks, she gave the learners game cards which had the questions and answers. Each of the eight groups had one game card (Chantel lesson observation video 00:30:23).

Amanda's class was project work. Every group needed the internet, textbooks, and to do an experiment in order to complete the project. Every group had a report sheet (Amanda lesson observation video 00:04:36).

4.6.2.3. Social skills poster

A social skills board refers to a board which includes the rules of engagement for a group and social life. Two of the classrooms, Sifiso's and Nosipho's, do not have any educational or social posters on the walls and both were in public schools. Amanda's lesson took place in the laboratory which had scientific posters on each side of the wall such as the periodic table, facts about planets, and the properties of light. None

94

of the side walls held a poster that encourages or guides learners in terms of life skills or behaviour when working together in a group.

Chantel's class wall had many educational posters and her learners' projects on heart disease. On the door of the class there are two big posters that inform learners about what is expected in terms of behaviour:

> **Extract 4.61: Contents of poster behind Chantel's classroom door**
>
> WELCOME: W- when you, E-enter this classroom, L-learning happens, C-cooperation is expected, O-to, C-cooperation is expected, M- mutual respect is part of, E- everything we do and say.
>
> When you enter this class: - be ready to learn, - be respectful, -raise your hands, -take risks and -make mistakes, -do your best, -work hard and DREAM BIG!

4.6.2.4. Laboratory equipment

One of the teachers, Amanda, used CTLS for laboratory project work. However, the availability of laboratory equipment and enough space in the laboratory was still a big problem. Sifiso explained that the school has a laboratory without the essential laboratory material, as science posters, equipment, and chemicals, to perform experiments or to do classroom demonstrations.

Amanda's class was project work on polymers and learners conducted experiments on density, melting points, and the strength of different plastics. Each group had balance, density measure, spatula, and Bunsen burner (Amanda lesson observation second video, 00:00:02)

Nosipho also is reluctant to do experiments with the learners. Even though there is enough material, there is not enough space to form groups, explain the tasks, and follow up. She explained this during the interview

> **Extract 4.62: Nosipho's Interview responses**
>
> Nosipho: We cannot do experiment because at the end of the day what if they can use acid and burn them because they are not aware, but if there is only a lot of them you can be seen them at the one group and you can be able to give them on instruction the learners start the experiment and then you observe them. But if I say this learner do the practical go to that

95

corner go to this corner I go and call other learners which I again explain to them, it is quite hassle for teachers.

Chantel explained that, if you have a plan and ask the school to provide the materials, it is very easy to get what is needed. Even though the material is expensive, the school plans and will buy it. As she said:

Extract 4.63: Interview response by Chantel

Chantel:　　　　I think it was digital thermometers that you connect with your app and your phone then you can monitor temperature gradient within time, that is expensive item and he did not have it available one year and they used traditional thermometers and budget it for next year and they bought it and now it is available for anyone to use…

4.6.3. Lesson introduction approach

This section captures findings made on the teachers' approaches towards setting the scene and explaining how the cooperative learning works as well as how the teachers considered the prior knowledge of learners in their lessons.

4.6.3.1. Communicating the rules of engagements

Chantel's class had two activities. The first one helped with inter-group interactions and the second activity was to foster within-group interactions. Chantel explained how the first activity would be done:

Chantel:　　　　It is an activity get one give one take out paper and fold it or divided into two then on one side write get one and the other side write one.

In the second activity, the learners were expected to play a game using the given cards and their responsibilities in the group rotated after five minutes. She assigned numbers to each group member in all of the groups and explained to them how their responsibilities rotate. Chantel explained to the learners as follows (Extract 4.64):

Chantel:　　　　If you are three in a group, person one fence the card, person two ask the question and person three answer the question and person one check the answer if it is correct or not, if not just discuss and get the correct answer. If there are four in a group, the first person fence the card the second person ask the question the third person answer the question and the forth one check the correctness of the answer and once you done then pass the card to the

96

next person so that that person two become person one and so on your responsibility will be circulated.

Afterwards, she assigned the numbering to each group by asking learners to raise their hands and assigning a number to each learner. She mentioned to the groups the importance of accountability, face-to-face interaction and positive interdependence in the group.

Sifiso's learners were engaged with past papers for exam preparation. Sifiso clarified to them how the groups work by telling them that they should all contribute to the task and be cognisant of their individual accountability.

> Sifiso: One person must be a writer, who is writing in this group……….. we discuss, we agree, we check them as a group we will have one answer.

Amanda's lesson was about a plastic project. The work consisted of questions and required the learners to perform an experiment. The group would answer the questions and collect their plastic for the next section. They usually do experiments during double periods. Thus, she told them to sit in their groups without adding any new rules of engagement.

Nosipho's lesson used cooperative learning for classwork purposes. The learners started by arranging their chairs into groups. Afterwards, Nosipho gave the page and question number following the explanation of how the groups should work. She mentioned the rules of engagement to the learners, focussing on face-to-face interaction and positive interdependence, which was followed by clarifying the activity for the learners for the purpose of achieving a common understanding of the task.

> Nosipho: What we are going to do, we discuss first, we agree, we balance the chemical equation using different strategies following that present the work as a team to our classroom.

4.6.3.2. Presentation of the task

Sifiso explained to the learners the activity that they were going to do, which was the past examination paper, to prepare for the upcoming September exam. He indicated the numbers of questions that they had to complete for the day. However, he did not say anything about how they needed to solve the problems and how they would do it.

97

Besides giving the reason why they were doing the past paper, there was no further explanation about what they needed to do to answer each question or to revise the basic content knowledge.

Amanda's learners were supposed to do project work using what they had learnt in class and internet sources to answer the questions. Amanda explained what question one was about, what they had to do, and where they would get the necessary information. She said:

Extract 4.65: Instructions given to learners in Amanda's class

Amanda: You are going to look at what plastic (is) made of… In question one, you have to find out what the monomer of each one of those six plastics you looked at, second you draw the molecules… You can get all the information from google class drive in my slide.

Chantel explained to the learners how the first activity works. She mentioned, in her explanation, that they need to divide the paper into two columns: one labelled '*give one*' and the other '*get one*'. She also explained how they were to exchange with their partners. She explained the task as follows (Extract 4.66):

Chantel: I will give you two minutes; in those two minutes you need to be quiet and think about which minerals are necessary for plants and animals to function? You are going to list your minerals that you remember, …. Write down the name of the mineral that you remember…then you are going to pair up with two different people, you move hands up (give) them high five you tell them one mineral to your partner from your list and they must give you in response a different one then moves (to) the next one.

Nosipho did not explain how the task should be done except giving the question numbers for the classwork.

4.6.3.3. Consideration of prior knowledge of the learners

Two of the teachers, Nosipho and Chantel, took into consideration the learners' prior knowledge before they engaged them with the task. The other two teachers, Sifiso and Amanda, directly engaged learners with the activity after explaining what the task was about. Neither of them used any means to establish the previous knowledge of learners on specific topics.

Chantel gave learners two minutes to think and write the type of mineral that they know helps plants and animals to function. The learners wrote what they knew. The second activity was a game which incorporates questions and answers. Chantel told the learners to revise from their textbooks the deficiencies and functions of the eight minerals for both plants and animals cells to function. She told them:

Extract 4.67: Instructions given to learners in Chantel's class

Chantel: In your textbook page 42, quickly just for a very brief two minutes revise deficiency and function of these minerals so that you can know what the different function of these minerals and the deficiency is associated with them.

Nosipho's class was busy with redox reactions and balancing equations. Thus, she started the class with an oral revision question. Learners did not respond to the question and Nosipho asked the question again by rephrasing it. The learners responded to the question. This was followed by corrections of their homework. She selected three students to do the answer and asked the rest of the class whether they were correct or not. Lastly, she gave them the classwork to complete in ordinary group work format.

4.6.4. Teacher as a facilitator

This category describes the teacher's actions and the techniques used to facilitate the implementation of CTLS. This category has two sub-categories which are: confirming and ensuring the presence of the primary principles of CTLS, helpfulness, and encouraging learners to work in a group effectively.

4.6.4.1. Confirming and ensuring the presence of the primary principles of CTLS

The primary principles of CTLS have been reported as positive interdependence, individual accountability, face-to-face interaction, social skills, and group process.

Sifiso told the learners that everyone in the group should contribute to the task and be informed about the individual accountability as roles would be allocated to each group member, such as a scribe. All the learners were expected to contribute to the task through discussion to ensure positive interdependence. During the reporting stage,

Sifiso selected the group members randomly to provide an answer to establish the level of contribution by each member in the group.

Sifiso used several of the main principles of CTLS. He used the random selection of learners and encouraged interaction during the learners' work. Sifiso moved around and in one of the groups asked them who the writer is to establish if the learners were functioning according to their assigned roles. He paused between groups to confirm whether they were engaged in task-related discussions or not and whether they were moving in the right direction. He guided them and stopped to listen to their conversations.

During the post-classroom observation interview, Sifiso also mentioned that the only technique he used for ensuring and confirming the presence of all of the principles of cooperative learning was by informing the learners about the task they were expected to perform and moving around to inspect that the task was being done. Neither in the class nor in the interview conversation did he mention other techniques like giving different material to different learners in a group, formulating a task that needs the participation of each member, developing a format to sign in, having posters in a class that help to develop interpersonal skills, and evaluating personal and group goals. However, to ensure face-to-face interaction, he managed to form smaller number of learners per group. During the class observation, there were four learners in each group. Concerning the confirmation of other principles Sifiso mentioned the following in the conversation (Extract 4.68):

> Researcher: What are your methods of checking the presence of presence of: positive interdependency, face-to-face interaction, social skills, individual accountability and group process in a group?
>
> Sifiso: All that I just see it, but do not record of it because I do not need it… I do not know about that one because my learners already know that they do not do any other thing during my, when I have given them work to do, this is like part of the rules…….

Chantel used different and innovative techniques to ensure and confirm the presence of the principles of CTLS. She gave different materials and resources to enable each of the members to develop a sense of responsibility towards the successful completion

of the task. As a reminder of the importance of interaction, she frequently reminded them how the groups work and the skills they needed to have. She determined how they were doing by moving around and listening to their conversations. A social board is displayed detailing how social interaction works. Learners read the displayed social board before they enter class and the school has a programme that helps learners to develop their social personal interaction skills. In our conversation Chantel shared the following insights:

Extract 4.69: Chantel's Interview responses

Researcher: How do you facilitate the group activity?

Chantel: It depends on the topic & nature of the work …. for instance, with these hearts … I gave them Prestik label he diagram, help each other, make sure that you checked refer to your text book, refer to the knowledge we spoken about, help each other out, if someone put label somewhere and you do not agree with him and then that is the point of your discussion and you will saying I do not agree with him and then that because this is my reason why…

Researcher: What are your methods of checking the presence of positive interdependency, face-to-face interaction, social skill, individual accountability, and group process within a group?

Chantel: I facilitate these group works …… walk around, I will check, kind of make sure everyone just listen to the conversation if I see there is something that really not happening I check in of them remember this, do not do that…..I pass by group someone withdraw itself,…..then I can say to them why are not participating? what is going on with you? …. trying to sort that out so I can give them individual attention to that learner ……. when you give them, a group work they do tend to take after their responsibility and realize I am going to do my part, so they do like their interdependence nature of group work.

Concerning personal skills, Chantel's school has a Monday assembly programme which incorporates personal values and her class also has a welcome poster which determines the values that should be present in the class within group work. She told me in the conversation about the school assembly duty (Extract 4.70):

Researcher: Do you perhaps do something like to develop their social skill, we know that group work, and it needs tolerance, respect one another, like you have to explain in good manner to the group member and if you want to reject something there is a way to reject that idea? Did you teach them like how to develop these things?

Chantel: I do not teach it personally because the school value system, which is every Monday, we have an assembly where the learners are reminded of the school value system…….

Amanda's class had different educational posters. However, none of them are helpful for developing social interaction skills of the learners. Amanda, as other teachers, used interaction, interference, and guiding learners to ensure the presence of the principles of CTLS. At some point, she told them to sit in their groups and start working. All of the group members were not involved in the task and she informed them that there much to do. She encouraged them to engage in their work. She told the learners, *"Gentlemen, please be aware that everything must be handed in next week Friday, and we do not have time and a lot of stuffs, you need to be working today."*

During the interview, Amanda said that encouraging social interaction, informing, and motivating learners to talk to her are her methods she uses to ensure positive interdependency, face-to-face interaction and individual accountability.

Extract 4.71: Interview responses by Amanda

Researcher: What are your methods to check the presence of positive interdependency between your students?

Amanda: I think, by just interacting with the groups all the time.

Researcher: even face-to-face interaction?

Amanda: Yes and I encourage them to talk to me all the time to sort of things.

Researcher: How do you also check shouldering responsibility or their accountability?

Amanda: I think, if I see one doing nothing if s/he is in her/his phone or on something, I just tell him to be engaged.

Having a small number of learners per group is one of the techniques to ensure face-to face interaction within the group. Amanda believes that if the number of students is small in a group, you can achieve the proper outcomes of using CTLS.

Extract 4.72: Interview responses by Amanda

Researcher: How many students do you usually put in one group?

Amanda: Three or four, I do not like, three to me the best, but just depends on class size. Bigger than four I do not think it works.

Nosipho sat on her desk during the group work until students started presenting their answers to the class and there was no evident academic engagement and social interaction inside the classroom. During our conversation, she confirmed the five principles of CTLS by randomly selecting learners to report their answers to the rest of the class (Extract 4.73):

> Researcher: What are your methods of checking the presence of interdependency, face-to-face interaction, social skill, individual accountability and group process in a group?
>
> Nosipho: When they present, I can see the level of confidence you know you look at the learners, are they able to express them self in explain? How they arrive on the answer? ………. So, through presentation of work you can check if there is selfishness in the group, you can check if those who are just sitting and not presenting because they feel like inferior, so I think when they present, today, if this one present, tomorrow another one because they are fix groups and make sure that I give everyone opportunity.

In the class work, there were learners in a group of four and five and there were seven groups in the class in total. At times, Nosipho's school also combines two classes and divides them into two groups and each group consists of 28 learners. In her understanding, the number of learners per group does not matter. To Nosipho, 28 learners in one group is fine as long as the teacher is there to facilitate. This indicates that she does not have a clear understanding of small group formation as a requirement of CTLS.

4.6.4.2. Helpfulness and encouraging learners to work in a group

This sub-category discusses how teachers ensured and encouraged the learners to stay motivated and engaged in the given group activities.

Sifiso facilitated the group work by moving around and pausing to listen to the conversations of the learners. When he found that the groups were not working in the right direction, he helped them to solve the problem.

Sifiso timed them:

Extract 4.74: Instructions given to learners in Sifiso's class

Sifiso: How many minutes are left?

Leaners: Eleven minutes

Sifiso: Are you sure?

Learners: Yes Sir.(Sifiso wrote you will finish by 08:50.)

Sifiso does not stand or sit in one place. He continued moving around while the learners were busy with their activity. He motivated them by saying "let's go!" and he confirmed whether each group member took responsibility by asking who fulfilled certain roles.

When the whole group struggled with some questions, Sifiso interrupted and explained to all of the group members. After that, he moved to the other group, asked the group members how they reached their answer, and one learner explained. Sifiso found that the answer was wrong and started guiding the group using probing questions to help them arrive at an answer on their own.

Extract 4.75: Examples of probing questions posed in Sifiso's class

Sifiso: How many in this side… and in this side?

Sifiso: Calculate the percentage of potassium.

He constantly reminded them of the time left. Sifiso facilitated the group work by confirming constantly whether they were writing or not. If the students did not understand, instead of moving to the answer, he guided them to see their mistake(s) and posed leading questions which helped them to finalise the answers. He explained during the interview (Extract 4.76):

Researcher: How do you facilitate the group activity?

Sifiso: I check what they are writing and then if there are any mistakes, I give them until they see where their mistakes are, I give them leading questions and I move around from group to group checking that and also under the question from the group and assisting them with difficult questions.

Amanda's learners were doing two activities in one project. The first group of learners were completing open-ended questions on the project. During this session, she moved from group to group to confirm whether they had started with their work or not. She

found some learners had not engaged with the work and she informed them that they had much to do on the project. Because of this, every learner continued with the work.

She moved from group to group and paused to answer their questions. She realised that most groups were not sure about the distinction between polymers and monomers. Thus, she clarified for the class the using proper definitions and the chain structure. (Amanda lesson observation second video 00:00:10).

In the second group, learners were doing an experiment on melting, burning, and the density of different plastics. Learners started by collecting their laboratory material and went to their working stations and started cutting plastics from different types. Amanda moved around and talked to each group. Amanda realised that one group had a yellow flame and she went there and adjusted the burner to a blue flame. Afterwards, she told the rest of the class that, while they use the Bunsen burner, it should have a blue flame. Once, the learners were done with the experiment, they started capturing their observations. Amanda called all the learners to sit in their groups and asked them to present their observations. She asked all groups' members about their observations.

Amanda's way of facilitating group work is that of moving around and frequently talking to the group. She said that, especially if you know the behaviour of your learners, interacting with them very often helps you to identify who is doing well and who is not.

Extract 4.77: Interview response by Amanda

Researcher: How do you facilitate your group activity?

Amanda: I think, it is just by constantly interacting with the group and keeping track on them and going around and round and you know, if you know your people well that is the best way to do it, we can immediately see who is not doing or who is not pulling the weight.

Nosipho sat at her table until the time of reflection. Not all of the learners were involved in the activity. Most learners did the class work on their own and two or three of the members interacted with one another. Nosipho's facilitation method is timing the learners and identifying their understanding and participation in the group during the reporting stage. She selected learners randomly to present their work to the rest of the class.

105

Extract 4.76: Interview response by Nosipho

Researcher: How do you facilitate group activity?

Nosipho**:** I give them work, I time them, if I say 15 minutes you have to attend to this, after then they present, I gave them different questions in the class. After the presentation I now look at some misconceptions they are not understanding well. I even ask the weakest link to present so that I can see they are not just copying from others…

Chantel had two activities for her learners in the form of a game. The first activity was to identify minerals which are helpful for plants and animals cell function. Chantel gave the learners two minutes to write the minerals that they remember on their own. Afterwards, they exchanged their answers amongst themselves via a '*give one, get one*' game. During this time, she gave them time to think and discuss, and constantly reminded them of the remaining minutes. She also guided some learners when they started talking before the expected time.

After allowing them to discuss it, she noticed that they were talking with loud voices. She asked them to consider their environment and use their "conversation voices". The second activity was about the deficiency and functions of those minerals. Half of the class were given question and answer cards on the deficiency and the rest on the functions. After she explained how the game works and assigned the numbers one to four to each group, she handed out the cards. She started moving between the groups. She paused at some groups and guided, helped, and encouraged them to be more interactive with their team members.

The learners had been on school holiday and Chantel encouraged them, indicating that it had been three months since they had done the work.

Chantel: You have not done this in a while guys, please do not feel bad or too hard on yourself. If you get much of it wrong, because we have not done this like more than three months let's face it.

After the lunch break, Chantel told them to exchange their cards with other groups.. She also told them to exchange their roles*.*

106

After assigning the new number one for each group and explaining how it rotates, Chantel moved around and started confirming the involvement of each learner in his or her group. When she noticed that all of the group members did not get the correct answer, she intervened and explained the work to them.

Chantel's group facilitation techniques vary from lesson to lesson. At times, she uses a formal way of telling the learners how they should do the task, the resources they need, and what is expected of them. In other classes, timing is her technique to make each member focus on the task.

Extract 4.77: Interview response by Chantel

Researcher: How do you facilitate the group activity?

Chantel: It depends, it depends on the topic, it depends on the nature of the work …. I said to them within your groups you have to make sure that you level these diagrams so use press stick and I gave them press sticks, level the diagram, help each other, make sure that you checked refer to your text book, refers to the knowledge we were spoken about, help each other out, if someone put level somewhere and you do not agree with him and then that is the point of your discussion and you will saying I do not agree with that because these is my reason why, so sometimes a bit more informal in terms of structure…….. I almost say a little bit less time would normally been required, because they have limited time then it is kind of force them to finish in time everyone has to do a bit…

The facilitation skills of the four educators can be described as formative (Sifiso), interactive (Amanda), passive (Nosipho), and Innovative (Chantel). Sifiso felt the need to inform and remind the learners of the task at hand as well as to limit their activities within a set time. He walked around and intervened when he noticed the learners were heading in the wrong direction. Sifiso was the only teacher who used probing questions to lead learners to the solution. This is a facilitation technique which is more constructivist in nature. Amanda values interacting with the learners as a way of staying updated on their progress and ensuring that they focus on the task. Nosipho was passive while Chantel proved to be innovative in her facilitation of CTLS.

4.6.5. Assessment methods

This category describes the techniques which the participants used to evaluate the learners after and during the execution of CTLS. This category has three sub-

categories which are: *select one learner from the group to present the group's work, collect the task in report form,* and *randomly asking questions.*

One of my participants used randomly asking questions, the other three selected one learner to report the group's work to the whole class and the other collected the completed task in a written report format. Thus, under each sub-category, I will explain only the participants that used the specific method.

4.6.5.1. Select one learner from the group to present their work

Nosipho started assessing learners seven minutes before the end of the class. She told them to present their answers to the rest of the class. She selected one learner randomly from each group to explain the group's answer and asked the rest of the class whether they agreed with the answer or not. If there was any discrepancy, she explained the answer before she moved to the next question. In this way, every group reported an answer to a question which was evaluated by the class and the teacher.

During the consolidation of the activity, most groups were still engaged with their own work, which was an indication that they had not used the group work effectively and the task was not suitable for the available time. Team members did not arrive at the same answer during the group work which led to the group representative still seeking guidance from the team members while writing the answer on the board. (Nosipho lesson observation video 00:18:00). Nosipho asked the class whether they agreed with answers or not. Once she realised that the whole class agreed with the answer, she asked whether there was any confusion in the group. No one responded so she moved on to the next group.

Sifiso chose each group to answer one question and write the answer on the smart board. One learner went to the board and wrote the answer and Sifiso asked the rest of the class to confirm the correctness of the answer. This process kept continuing until all the questions were answered by individual groups. When he noticed mistakes in the written answers, he asked the learners some leading questions to show them their mistakes and give them an opportunity to correct their errors.

Sifiso asked the class which group they would start with before he selected one group. He encouraged them with "Hurry up! Fast! Fast!" Once the learners wrote the definition of electrolyte on the board, Sifiso confirmed the correctness of the answer by saying "Good!"

Sifiso looked at two other groups and he called the name of a learner from the second group. Sifiso wanted to make sure that the whole class was following the lesson and asked them to confirm the number of the question being discussed. Once the learners wrote the balanced equation of decomposition of potassium oxide, Sifiso asked the class whether the answer was right or not and the learners said "Yes".

The learners from the third group started doing question 3.4 instead of 3.3. Sifiso noticed that and assigned 3.3 to another group. Sifiso noticed that the group's answer was not correct, and he asked the whole class about the accuracy of the answer. The whole class responded that it was not. He chose a learner from the other group to write the correct answer.

The next question needed a very simple answer: it either increases or decreases. He asked the whole class and once they answered that it increases, he asked them to explain why it did so.

Learners gave different answers for the question. Sifiso realised that there was a misunderstanding and decided to explain to the whole class about the relationship between concentration in a solution and conductivity. As he clarified for the class, he confirmed their understanding by asking them to repeat what he had said.

Sifiso continued selecting groups to answer the rest of the questions. When all the questions were answered, he instructed the class to copy the correct answers for each question to their exercise books. To confirm this, he asked learners whether they were copying.

After everything was done, Sifiso distributed a formal test for each learner to complete during class time as a way of evaluating their understanding of the content.

4.6.5.2. Collecting tasks in report form

Amanda's technique of assessing group work was the collection of written reports of the project work one per group. The project activity consisted of ten pages which included instructions, questions, useful websites related to the given task, and a rubric and mark allocation for each question.

The task was planned to be completed in two sessions (classes). During the first class, learners were working on the pre-activity questions before conducting the experiment. Amanda merely facilitated and intervened when it was necessary. However, in the second class, learners did the experiment and at the end, she did an informal assessment of what they had observed by asking different questions.

Amanda clarified the difference between recyclable and biodegradable materials once the learners were done with the experiment. Following this, she started asking each group about their findings regarding the density of different plastics and explained how plastics stay in the ocean for a long time. Finally, she instructed learners to hand in the report during their next session before they commence with the teaching and learning.

> **Extract 4.78: Instructions given to the learners in Amanda's class (Amanda lesson observation video 00:00:10 – 00:02:45)**
>
> Amanda: That group there, can you tell me the range of the density that you had? What was the density of that?
>
> Amanda: Do all your plastics melt or not? Which one did not melt? … Do you agree?

Following the discussion, she explained to them how they should complete the project as well as the mark allocation.

4.6.5.3. Randomly asking questions

Chantel had two activities. In the first one, learners had to identify the names of the minerals which are helpful for plant and animal cells to function. When the time ran out, she used her sticks that have the learners' names on them. She drew one stick and asked the learner what mineral they got from whom. This process continued until all the minerals were listed.

110

Extract 4.79: Instructions given to the learners in Chantel's class (Chantel lesson observation video 00:19:04)

Chantel: Tabange, who did you get what from?

Learner: Magnesium.

Chantel: Check if you get it on your list, if you do not, add it,,, Cigo, what did you get? From whom?

Learner: Sodium from Nathi.

The second activity was a game of questions and answers after all of the groups and each group member had a chance to play all of the roles. Chantel started with the assessment. She used her sticks in the jar to select learners randomly. This time, she asked the learners what they had learned and what they perceived as the benefits ofthe game.

Extract 4.80: Assessment strategy used in Chantel's class (Chantel lesson observation video 00:12:55, 2nd video)

Chantel: what word you remember off, what do you know better now than you did before, and what did you learn from the activity... Bonale, what did you get?

This conversation continued until they discussed all of the deficiencies and the functions of each mineral in plants and animal cells.

Table 4.1 provides an overview of how the participating teachers in the focus sample facilitated CTLS in their respective classrooms across the pre-determined categories and sub-categories of implementation.

Table 4.1: Summary of Implementation of CTLS

Category	Sub-categories	Sifiso	Amanda	Nosipho	Chantel
Classroom size and learners' arrangement	**Number of learners per group**	4 and 5 learners	3 learners	4 to 5 learners / 28 learners	3 to 4 learners
	Group formation and composition	Friendship based	Friendship based	Mixed ability based	Friendship and mixed ability based
Teaching and Learning Resources	**Books and electronic resources**	Yes	Yes	Yes	Yes
	Worksheet per desk/ game card etc.	Yes	Yes	No	Yes
	Rule of engagement	No	No	No	Yes
	LCD, Projector, Laptop	Yes	Yes	Yes	Yes
	Laboratory equipment	No	Yes	No	Yes
Lesson introduction approach	**Communicating the rules of engagement**	Communicated	Communicated	Communicated	Communicated.
Lesson introduction approach	**Presentation of the task**	It is not explained	It is presented	It is not explained.	It is explained
	Considering prior knowledge of learners	It is not considered	It is not considered.	It is considered.	It is considered
Facilitation of CTLS		Formative	Interactive	Passive	Innovative
Assessment method	**Selection of one learner from the group to present their work**	Yes	Yes	Yes	Yes
	Formative and summative assessments	Yes	No	No	Yes
	Collecting task in report form	No	Yes	No	Yes
	Group representative presents the task	No	No	No	Yes

112

4.7.   CHAPTER SUMMARY

This chapter presented the findings obtained from the analysis of the data collected for the purposes of the study according to the following themes: *description of CTLS, facilitating factors for implementation of CTLS, hindering factors for proper implementation of CTLS, and implementation of CTLS.* Thus, it focused on the obtained data comprehensively. The first three themes were discussed based on the information from the full sample and the last theme was discussed based on the information obtained through the class observations and interviews of the focus sample.

Theme one, *description of CTLS*, discussed the definition of CTLS and methods to ensure the presence of the fundamental principles of CTLS. In the definition of CTLS sub-category, explanations of CTLS and its principles as well as the benefits and limitations of CTLS were discussed. CTLS was described as a learner-centred teaching and learning methodology by the full sample of participants. However, Chantel and Amanda from the focus group were the only participants who selected all of the aspects of CTLS. The rest of the participants chose two or three of the principles of CTLS. The majority of the participants acknowledged the advantages of CTLS despite viewing it as a time intensive teaching methodology.

Facilitating factors for (the proper) implementation of CTLS were discussed in the second theme and these entailed a substantial number of sub-categories, namely, school environment, training and availability of resources, teachers' attitudes, and collaboration. In this discussion, appropriate class sizes, as mentioned in the South African curriculum, is suggested as one of the aspects needed for the proper implementation of CTLS in the school environment sub-category. In addition, in the same sub-category, the majority of participants reflected on the role of the HOD in facilitating the implementation of CTLS by encouraging teachers and providing training and resources. Only a few of the participants indicated the role of the school principal as a facilitating aspect for the proper implementation of CTLS.

The second sub-category discussed the availability of training and resources as facilitating factors. The majority of the participants mentioned that continuous training

on CTLS is needed for the proper implementation of CTLS. Few of the participants added the sharing of experiences and exchanging of ideas regarding CTLS by highly experienced teachers with beginner teachers as an aspect for the effective implementation of CTLS.

In the third theme, *hindering factors for the proper implementation of CTLS,* the factors such as curriculum implementation and exposure to CTLS were discussed. In the *exposure to CTLS* sub-category, lack of training on CTLS and experience in using CTLS were discussed as major obstacles for using CTLS as often as possible. Curriculum load, overcrowded classrooms, and inadequate resources were mentioned as obstacles to the proper implementation of CTLS in the *curriculum implementation* sub-category.

The fourth theme, *implementation of CTLS*, discussed classroom sizes and learners' arrangement, teaching and learning resources, lesson introduction approaches, teachers as facilitators, and assessment methods as categories of the theme.

Classroom size and learners' arrangement were validated by the number of learners per group as well as group formation and composition. Two focus sample participants experienced large class sizes and the rest had suitable class sizes to implement CTLS effectively. Three of the focus sample participants allocated four to five learners in a group. However, one participant indicated that having 28 learners in a group also allowed her to apply CTLS. For group formation, two of the teachers used friendship-based group allocation and two of them formed the groups based on the academic ability of the learners.

Concerning the teaching and learning resources, textbooks were available for all focus sample participants' classes and other resources were also available for all sample participants, except for posters communicating the rules of engagement. A poster was present in only one teacher's lesson. Regarding the introduction of the lesson, three teachers managed to explain the rules of engagement and explained the desired method for completing the task. Only one teacher considered the prior knowledge of learners before commencing with the task. For the consolidation of the lesson, only two of the participating teachers used the random selection of learners and report

114

submission. The other two teachers used only the random selection of learners to reflect on the task.

In the final chapter, a conclusion delineating the main findings of the research and the implications for future research will be presented.

5. CHAPTER FIVE: DISCUSSION AND CONCLUSION

5.1 INTRODUCTION

This chapter presents a critical discussion of the findings which culminate into the conclusions of the study. The chapter discusses the following:

- Research questions, mainly on their purposes
- Research processes followed to arrive at key findings
- Findings of the research
- Hindering and facilitating factors for the implementation of CTLS
- Contributions of the research towards CTLS
- Limitations of the research
- Recommendations for further study

5.2 A REVIEW OF THE RESEARCH QUESTIONS AND THEIR PURPOSES

The current study intends to explore the implementation of CTLS in South African science classrooms. To do so, the classes of four science teachers, as focus sample, were observed and interviews were conducted with these teachers. Additionally, these teachers as well as an additional 17 teachers completed a questionnaire and constituted the full sample. All of the captured information was analysed. The current study is guided by the following main research question and sub-questions:

Main research question:

How can the implementation of CTLS in South African classrooms be understood?

Sub-questions:

- How do south African science teachers describe CTLS?
- What factors facilitate the implementation of CTLS in south African science classrooms?
- What factors impede the implementation of CTLS in south African science classrooms?

116

- How do the participating science teachers (focus sample) implement CTLS in their classrooms?

Through sub-question one, the researcher aimed to determine how the participating teachers understood CTLS in relation to group work often used in classrooms. Sub-questions two and three enabled the researcher to determine what the participants perceived as facilitating and impeding factors to the successful implementation of CTLS in South African science classroom contexts. By investigating sub-question four, the researcher was able to determine how the focus sample participants operationalised CTLS as well as whether the implementation confirmed their understanding as demonstrated in their responses in the CTLS questionnaire and the observation from the focus group classes.

Sub-question one is answered based on the interview and questionnaire information that was obtained from the full sample who, in the questionnaire, claimed to use CTLS. This questionnaire was used to determine their understanding and perceptions regarding CTLS.

Sub-question two and three aimed to identify factors or aspects that facilitate and hinder the implementation of CTLS from empirical evidence. Thus, the questions were answered based on the data obtained from the interviews and questionnaires completed by both the full and focus sample participants.

Sub-question four was answered based on the classroom observation conducted with the focus sample and their responses to the interview and the questionnaire. The following section constitutes a reflection of the research processes followed to answer the research questions.

5.3   REFLECTION ON THE RESEARCH PROCESS FOLLOWED

This section provides a brief reflection on the process of data collection and analysis. It begins with a description of the data collection system followed by the data analysis process.

This research aimed to investigate the implementation of CTLS through the main themes of a description of CTLS, hindering and facilitating factors of the implementation of CTLS, and the execution of CTLS in real classroom contexts. Each main theme has categories and codes embedded in it based on the implementation principles of CTLS.

5.3.1 Data collection

The process was started by constructing a protocol for observation, semi-structured interview questions, and a questionnaire that incorporates cooperative learning principles and their application. All aspects are supported by the work of Davis (1999), Jolliffe (2007), Gillies (2008, 2010 & 2014), and Johnson et. al (2013) to understand the basic principles of CTLS and the strategies and requirements for the implementation of CTLS. Davis (1999) and Miller (2017) describe the presence of the basic principles of CTLS in group work which contribute to the effective execution of cooperative learning and lead to the achievement of the possible outcomes of CTLS.

The data collection process followed two phases. In the first phase, a questionnaire (Appendix III) was administered to 30 secondary school science teachers to identify those who are using CTLS in their classes. In the second phase, 21 (full sample) science teachers who claimed that they are using CTLS completed the second part of the questionnaire that explores more detailed knowledge and the implementation principles of CTLS. However, only four science teachers were willing to be observed in their classrooms while implementing CTLS. Therefore, the four teachers constituted the focus sample and the 21 teachers the full sample of the study.

The second data collection phase was conducted inside natural classroom settings. The research aimed to use different data collection strategies to obtain rich information. One of the data collection instruments used in the second phase of data collection was a classroom observation protocol (Appendix I). Four participants' lessons were observed and video recorded for further video analysis. The second instrument was an interview schedule (Appendix II) which took an average of 35 to 40 minutes per teacher. The conversations with the researcher were audiotaped with the

teachers' permission. Following data collection, all of the information was transcribed, which was the first step towards the data analysis described below.

5.3.2 Data analysis

Qualitative content analysis was employed as a data analysis technique. Renz et al. (2018) describe content analysis as a process of ascertaining key terms from textual data that assist to interpret and understand the proposed study through the examination of different methods and interactive and inductive systems.

The data analysis followed three stages. The first stage was the transcription of all verbal and nonverbal information gathered. The process of data analysis started with the transcription of the interview data and organisation of the open-ended questions of the CTLS questionnaires. Afterwards, the four videotapes of the observed lessons were transcribed using the classroom observation checklist which was prepared according to the principles that inform the implementation of CTLS. All of the data mentioned above is stored on a separate storage device.

The second stage was the coding of the transcribed data. In this research, since the themes were drawn and pre-formulated from the literature, the codes and categories were identified from the data under each identified theme. The codes were assigned to specific pieces of textual data and organised into categories within each theme. For instance, for the theme of implementation of CTLS, there are five categories: classroom size and learners' arrangement, resources, teachers' approaches, teacher as facilitator, and assessment methods. Each category has two or more codes according to the nature of the data, for example, the number of textbooks per desk, social board, laboratory equipment, and worksheet per learner are the codes that were assigned to the category resources.

The third stage of the analysis is interpretation. The transcription process was time-consuming and demanding. Furthermore, participants used different class settings. The recordings had to be examined repeatedly in order to identify the teachers' critical incidents and to ensure the transcriptions' correctness. Appropriate software for the transcription and analysis of data was unavailable and a considerable part of the

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process was done by the researcher. Since the study is qualitative and uses many methods to gather data in order to answer the research questions, organising, categorising, and frequently reviewing the information to ensure that it is free from bias became a tedious process. Yet, it emphasised the importance of being constructive and objective during the analysis.

5.4   FINDINGS: PARTICIPANTS' DESCRIPTIONS OF CTLS

In this section, brief descriptions are presented to illustrate the full sample's understanding of CTLS and its associated benefits as inferred from their responses in the CTLS questionnaire, as well as the classroom observations and interviews of the focus sample.

5.4.1 Participants' descriptions of CTLS

Many participants described CTLS as small group work formed with groups consisting of learners with heterogeneous academic backgrounds and different levels of capability. Few of the full sample participants further described CTLS as requiring positive interdependence, face-to-face interaction, individual accountability, social skills, and teamwork within the group. However, they understood that CTLS is a learner-centred teaching and learning approach. However, many of them failed to state the unique features of CTLS which make it different from other forms of group work. For the proper implementation of CTLS, a vital aspect is that teachers have a deep understanding of it (Serafin, 2016).

Three of the focus sample participants, Sifiso, Alta, and Chantel, had an adequate theoretical understanding of CTLS and constituted the only three of the participants from the full sample who described CTLS by incorporating its unique elements. According to literature, this is a mark of a teacher who understands CTLS (Baker & Clark, 2010; Miller, 2017).

The research also reveals that experienced teachers amongst the full sample failed to mention the basic principles of CTLS as the primary features that distinguish it from other forms of group work. In addition to this, the teachers were unable to describe the importance of the unique features of CTLS which are necessary for achieving the

120

desired learning outcomes. This finding contradicts the existing research since implementing CTLS often increases teachers' understanding of the structure of CTLS and leads them to use it more frequently (Johnson et al., 2013: Laguador, 2014).

Being in the teaching profession for a long time (Sifiso and Nosipho), knowing CTLS in theory (Sifiso), and using CTLS for quite a number of years (Sifiso) did not ensure the proper implementation of the principles of CTLS. This contradicts theories from previous research regarding the role of experience in implementing the principles of CTLS (Millis, 2010; Raja et al., 2017).

The current research found that teachers' practical exposure to different types of CTLS training enables them to understand and distinguish CTLS from other forms of group work and use CTLS as often as possible. For example, Chantel had the least teaching experience but more exposure in terms of training on CTLS. This enabled her to refer to the main aspects of CTLS in her responses and to describe what makes it distinct from other forms of group work. Nurhayati & Hartone (2017) report that teachers' exposure to training on CTLS might be a necessary exercise to assist teachers in understanding and identifying the differences between CTLS and other forms of group work.

5.4.2 Participants' description of the benefits of CTLS

Many of the participants confirmed that the implementation of CTLS encourages learners' understanding of the lesson, communication skills, and social skills. CTLS requires face-to-face interaction, understanding of each member's views about the lesson, and the contribution of each group member for the successful completion of the task. According to the focus sample participants, all of these requirements encourage learners to take responsibility for their learning, be creative in their task execution, demonstrate positive interdependence, communicate their ideas more effectively, and learn to work with fellow learners in teams. This is supported by many studies which report that CTLS helps to enhance interpersonal skills such as communication, tolerance, confidence in public speaking, accepting critique, reaching a decision based on a logical argument, accelerated learning, and a high level of

critical thinking (Baghechogi, Koohestani & Razaei, 2011; Johnson et al, 2013; Meena, 2020; Miller, 2017; Millis, 2010; Gillier,2014; Nurhayati & Hartono, 2017).

5.5   FINDINGS: PARTICIPANTS' DESCRIPTIONS OF FACTORS

Despite the advantages of CTLS for the development of academic performance, cognitive development, and enhancement of positive personal skills, many hindering factors discourage teachers from using CTLS.

The teacher's beliefs about CTLS may influence the decision to attend training or benefit from it, as seen in the case of Amanda who believed that CTLS creates more work for the teachers. It may also affect how often the teacher chooses to use CTLS in the classroom. This finding is supported by many studies which indicate that the nature of CTLS is a challenge since it needs teachers to be positive about CTLS and the skills to implement it (Baloche & Brody, 2017; Buch, Filippous, Palfrey, & Valpe, 2017; Alias et al., 2018).

There is no training or in-service training organised by the DBE on CTLS and the culture of the majority of schools fosters a teacher-centred, rather than a learner-centred, approach of teaching. Teachers' understanding of CTLS is insufficient without the support of first-hand experimentation with CTLS in authentic classroom contexts. The support of the DBE, school management, and the school culture impact teachers' use of the various teaching approaches that foster effective learning. These are the same disadvantages that Sifiso and Nosipho encountered as discouraging them from using CTLS as frequently as possible.

The time-intensive nature of CTLS and the curriculum load, as also alluded to by Sifiso and Chantel, were some of the barriers impeding the implementation of CTLS. Other impeding factors identified were classroom settings, including, physical space, number of learners in a class, and class time length. The findings are in agreement with existing studies (Millis, 2010; Gillies & Nichols, 2015; Baloche & Brody, 2017; Buchs et al., 2017; Alias et al., 2018). The accessibility of resources such as laboratory equipment or printed resources also plays a vital role in the implementation of CTLS. Thus, the lack of laboratory materials and equipment in Sifiso's case and small class

122

space in Nosipho's case were identified as hindrances to the proper implementation of CTLS. These findings are supported by the research of Baloche & Brody (2017) which report that the implementation of CTLS requires sufficient resources and space as each group should have a maximum of four learners.

Using CTLS as a teaching methodology requires the pedagogical knowledge of the teacher, a suitable school environment, sufficient length of the session, a supportive and good relationship between HOD and subject teacher, and the teacher's positive perception of CTLS (Laguador, 2014; Gillier, 2016; Nurhayati & Hartono, 2017).

Many of the respondents also mentioned the contribution of training and time in addition to the abovementioned factors. A conducive school environment in terms of the provision of training on CTLS (according to Chantel and Sifiso), accessibility of materials (according to Nosipho, Sifiso, and Chantel), class size, and the sharing of experiences implementing CTLS between more experienced teachers and new teachers (according to Amanda and Nosipho) are essential for the proper implementation of CTLS. The findings support the existing literature such as Jolliffe and Snaith (2017) and several other studies (Robyn & Boyle, 2006; Baker & Clack, 2010; Mendez-Gimenez & Aloso, 2016; Buchs, et, al, 2017).

5.6   FINDINGS: IMPLEMENTATION OF CTLS

This section presents what was found in terms of how each of the four teachers in the focus sample implemented CTLS in their classrooms. The findings are presented in terms of how each of their classes was set up in terms of spatial arrangement, groups formed, resources made available for learning, teaching approach, the role played as facilitator of learning, and the assessment methods employed. The findings in each case are then critically evaluated against existing literature.

5.6.1 Class space, learners' arrangement, and group formation

Before using cooperative learning, conducive conditions such as class size, group formation, printed materials, and laboratory equipment in addition to well-structured tasks are needed to properly implement CTLS (Jolliffe, 2007; Tadesse & Gillier, 2015).

CTLS is one of the learner-centred teaching methodologies that require embedding the five principles, namely, positive interdependence, individual accountability, face-to face interaction, social skills, and group process in the group activity. Therefore, ensuring the presence of all of the principles of CTLS is essential to achieve the desired learning goals (Gillier, 2014; Jolliffe & Snaith, 2017; Buchs et al., 2017).

Three of the focus sample members, Amanda, Sifiso, and Chantel, reported during the interviews that they arrange their learners into groups of small numbers whilst considering the background and calibre of learners. However, this was only observed as being implemented practically in Chantel's class. During Amanda's and Sifiso's classes, it was observed that learners were grouped based on friendship rather than mixed academic ability or background. However, arranging learners in a group with no restriction in the number of group members, as was observed in the case of Nosipho, was contrary to the requirements of CTLS and did not assist in achieving the desired learning goals. Therefore, the findings of this study reveal, in Nosipho's case, that an inadequate understanding and misinterpretation of the methodology results in learners sitting in groups, regardless of the number of learners per group, being perceived as sufficient to be called CTLS. In the case of Amanda and Sifiso, though friendship-related grouping is not recommended for the effective implementation of CTLS, they reported to prefer this method which indicates that more training and follow-up training may be required to train teachers to explore the use of more effective and diverse groupings when they implement CTLS in their classrooms (Raja et al., 2017).

5.6.2 Resources made available to learners to support the implementation of CTLS

Resources (printed, electronic, and laboratory equipment) are vital for implementing CTLS. This research found that printed materials were not obstacles to the implementation of CTLS in this sample as every learner had textbooks, exercise books, and worksheets. Instead, laboratory equipment, as reported by Sifiso, may have been a hindrance to using CTLS in a science laboratory setting. Posters may be used as a constant reminder to enhance learners' social skills and remind them to stay on-task, which eventually contributes to the effective implementation of cooperative

learning. Nonetheless, only Chantel used the social skills boards in the class and the other three focus sample participants did not.

Alias et al. (2018) also support this finding by reporting that the accessibility of materials for the successful application of CTLS is vital. In addition to this, the findings support the studies of Yi & Luxi (2012) and Sharan (2014) which report that printed resources like worksheets, printed activities, other resources that learners need to complete their work, as well as laboratory materials are needed to facilitate learning and to implement CTLS in science classroom contexts especially. One of the methods teachers employ to ensure positive interdependence is by giving different resources to group members. Fortunately, the findings of this study reveal that there were sufficient printed materials to implement CTLS correctly.

5.6.3 Teaching approaches and teachers as facilitators

The teacher's responsibility as a facilitator during the execution of CTLS begins by briefing learners about the given task. This research found that three members of the focus sample, Chantel, Amanda, and Sifiso, briefed the learners about their responsibilities in the groups and the desired methods of completing the tasks. This finding supports the many studies which found that learners should be oriented about CTLS, about how it works, and about what is expected from them. This must be done at the beginning of the year (Robyn & Boyle, 2009) and before starting each task. Other than explaining how the groups work, teachers should explain the tasks to the learners and consider the learners' prior knowledge about the lessons. These are essential for the proper implementation of CTLS (Baker & Clark, 2010). The findings show that most of the teachers from the focus group met the requirements regarding the briefing of learners, including, how the groups work and what the tasks are about.

Orienting learners includes sharing with the learners how their responsibilities contribute towards the completion of each task and how the roles should be rotated from task to task to ensure that learners get the chance to develop skills such as time management, productive discussion, and the ability to work effectively in a team (Sharan, 2014). The finding shows that three of the focus group members, Chantel,

Amanda, and Sifiso, orient their learners about their responsibilities and how the process works.

The second finding of the research under this section is that learners who were briefed about the task, such as those of Sifiso, Chantel, and Amanda, and who revised the necessary prior knowledge were observed to perform well in the task. This finding supports the study of Miller (2017) which indicates that teachers as facilitators of learning need to introduce the tasks to the learners and clarify each task's instructions in order to avoid learners spending too much of the task's time on the incorrect or unnecessary aspects of it.

This research also found that teachers who have proper training on CTLS, like Chantel, and who had ample exposure to the theory through their postgraduate study, such as Amanda and Sifiso, ensured the presence of positive interdependence, individual accountability, face-to-face interaction, communication skills, and group process as the fundamental principles of CTLS and, in addition, motivated learners to be involved more through intervention. Such skills are developed through hands-on experiments and training. If the teachers do not get this exposure, like Nosipho, they fail to effectively implement CTLS in their classrooms. They facilitate without giving much consideration to how the groups are formed and fail to ensure the presence of the five principles of CTLS. The comparison of, what Nosipho described as constituting CTLS and implementing it in class revealed a big divide between being aware of CTLS and implementing CTLS correctly in class contexts.

This study found that ways of ensuring the five principles (positive interdependence, individual accountability, face-to-face interaction, communication skills, and group process) of CTLS by Amanda, Sifiso, and Chantel support the Jolliffe (2007) and (2014) studies which suggest that ensuring the presence of the five main principles of CTLS and encouraging and motivating learners to involve themselves and complete the task are teachers' responsibilities as facilitators. Providing different materials to group members, forming a group with three to four learners, moving around and pausing in between to listen and intervene if necessary are some of the techniques that are recommended for ensuring the principles of CTLS are present during group work.

The findings of this study regarding the impact of insufficient exposure to training, as in Nosipho's case, are supported by the study of Gisbert, Sevba & Coll (2017) which indicate that the lack of hands-on training on the fundamental concepts of CTLS leads teachers to implement CTLS incorrectly.

5.6.4 Assessment methods

The findings of this study reveal that the focus sample used different techniques to assess the outcomes of the task, for example, Chantel, Nosipho, and Sifiso selected learners randomly from the group to present the answer to the question to the rest of the class. Additionally, findings concur that one of the suitable evaluation techniques for CTLS is a random selection of learners per group to present the answer to the rest of the class members (Sharan, 2010; Jollifee, 2007; Miller, 2017).

In Amanda's case, once the learners were done with the group task, the answer was submitted in the form of a report for assessment and each learner obtained a group mark. This assessment method is recommended to evaluate learners' understanding and contributions during CTLS (Jolliffe, 2007).

Another method of assessing learners, which is not observed in this research, is to assign the role of presenter to one learner at the beginning of the task to report the outcome to the rest of the class. This responsibility is rotated among the learners to enable each learner to develop his/her presentation skills (Johnson et al., 2013; Jolliffe, 2014). The findings show that all focus group members used assessment methods which are recommended for CTLS.

5.7 CONCLUSIONS: HOW THE DATA ANSWERS THE RESEARCH QUESTIONS

The current research aimed to answer the following sub-questions:

- How do South African science teachers describe CTLS?
- What factors facilitate the implementation of CTLS in South African science classrooms?
- What factors impede the implementation of CTLS in South African science classrooms?
- How do the participating science teachers implement CTLS in their classrooms?

To answer the first sub-question, the findings in terms of the description of CTLS as expressed by the respondents were shared (Chapter four and Section 5.4). The majority of the full sample participants did not provide accurate descriptions or demonstrate an understanding of CTLS. They had no knowledge of the basic principles of CTLS and the necessary teaching and learning aspects that need to be present to ensure the effective implementation of CTLS. Yet, evidently and reassuringly, all of the participants understood CTLS to be a learner-centred teaching methodology. However, the fundamental features and the proper descriptions were not explicitly mentioned.

To answer sub-questions two and three;
- The lack of exposure to CTLS and experience in using CTLS,
- Availability of training, curriculum load, and school culture, as well as the lack of encouragement from the HOD and the principal, were identified as impeding factors.
- It was observed that the time-intensive nature of CTLS and the curriculum load,
- The demand of skill and experience in using CTLS,
- Accessibility of laboratory equipment, and the imbalance between teacher and class size ratio were deterring factors for using CTLS frequently.

This research also found that continuous teacher professional development on CTLS, revision of the syllabus, diverse change of school culture to encourage the use of CTLS, continuous support of HODs and principals, and increasing the teacher-to-learners ratio per class may facilitate the effective implementation of CTLS.

Considering sub-question four, it was found that;

- The class space,
- How learners are formed and arranged into groups,
- Resources, teachers' approaches, and
- How teachers assume the roles of facilitators, as well as the assessment methods they employ, were key distinguishing features of whether or not CTLS was implemented properly.

This research found that teaching experience does not correlate with proper implementation of CTLS. Teachers' exposure to training on CTLS and a school culture which encourages and organises such training for teachers allow the novice teachers to implement CTLS innovatively. In addition to this, knowledge of CTLS theory is not adequate to implement CTLS. Ultimately, the teacher who reported to have continuous exposure to training was the one observed to implement CTLS innovatively.

In conclusion, this research found that CTLS was adequately implemented by the teachers at schools that encouraged the implementation of CTLS and provided continuous training and support on CTLS. The major obstacles to using cooperative learning properly were the absence of training, class sizes, curriculum load, and resources. The research also found that the facilitating aspects for the proper implementation of CTLS were the knowledge and skills of teachers regarding CTLS, the classroom sizes, and the school environments.

The principals of the specific schools should organise small-scale training on CTLS for teachers on a continuous basis and create a balance between the number of learners and teachers per class. Additionally, they should liaise with the Department of Basic Education to revise the syllabus and make laboratory resources accessible. Science teachers also need to develop their pedagogy knowledge and skills that allow them to adjust to changes in the education system. For proper implementation of CTLS in the future, the Department of Basic Education should facilitate opportunities for teachers to attend continuous training on CTLS, create conducive school environments, and revise the syllabus to allow for more varied teaching approaches that influence learning outcomes positively.

5.8 LIMITATIONS OF THE STUDY AND RECOMMENDATIONS FOR FURTHER RESEARCH

This study aimed to determine the status quo in terms of teachers' understanding and implementation of CTLS in South Africa, particularly in the selected science classrooms in the Pretoria area. Pretoria is only one city representative of other large cities of South Africa. Thus, the findings of this study are restricted to the science teachers in high schools in and around the Pretoria area.

The objectives of the study were to explore the implementation of CTLS in South African science classrooms. This study did not examine the content knowledge of the participating teachers and other pedagogical knowledge aspects of the teachers. This research planned to obtain information through observation, interviews, a questionnaire, and document analysis. However, due to the lack of documents to be evaluated submitted by the participants, a document evaluation strategy to validate the findings was not employed.

This research was conducted on a small scale with a full sample of 21 science teachers to obtain a deep understanding of the implementation of CTLS in natural classroom settings. Thus, the findings of this research cannot represent how science teachers are implementing CTLS across the country. A large scale research study needs to be conducted to determine the status and implementation of CTLS across South Africa.

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132

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136

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138

139

7. APPENDICES

7.1 APPENDIX I: OBSERVATION CHECKLIST

Aspects	What should be observed?
Classroom size and learners arrangement	❖ the number of student in the class ❖ the number of students in one group ❖ the total group numbers in class ❖ over all arrangement of the class
Resources	❖ text book number in each group ❖ worksheet for each group ❖ laboratory equipment ❖ technological equipment ❖ social skills note boards in the wall
Teachers approaches	❖ explaining to learners how the group is working ❖ well presentation of the task to the learners ❖ taking in to account learners prior knowledge ❖ friendly conversation between teacher and learners
Student engagement and interaction	❖ active participation and contribution to the given task ❖ sharing their material with the rest group members(positive interdependence) ❖ interaction, communicative skills ❖ tolerating others member behaviours ❖ reaching to same decision through logical reasoning ❖ allocation of individual work , rotation of responsibility ,and helping each other (individual accountability)
Teachers as facilitator	❖ Is the teacher checking the presence of positive interdependence, face-to-face interaction, individual accountability, social skills, and shoulder responsible? ❖ Techniques employed to ensure the presence of the above aspects in the group ❖ Helpfulness ❖ Encouraging learners to work in a group
Assessment methods	❖ Select one learner from the group to present their work ❖ Collect the task in report form ❖ Randomly asking question ❖ Group presentation

140

7.2   APPENDIX II: SEMI-STRUCTURED INTERVIEW PROTOCOL

Introduction of interviewer

Good morning / afternoon / evening,

My name is Mrs Belay

During our conversation, I would like to discuss with you about cooperative teaching and learning and its implementation in your science lessons. I also want to know the factors that are facilitating and hindering the implementation of cooperative teaching and learning instruction in your context.

I thank you very much for your time in advance!

1. How long have you been teaching?
2. What is your highest qualification?
3. Which grade(s) are you teaching currently?
4. How many students do you have in a class?
5. Are you satisfied with your learners' performances?
   - If yes, how do you describe their performances?
   - If no, what makes you unsatisfied?
6. Are you using cooperative (group work) teaching and learning instruction?
   If yes, since when?

   If no, have you ever used cooperative teaching and learning instruction before?

   If yes. For how long? ,

   If I have never used it. What are your reasons for not using it?

7. How often do you use cooperative teaching and learning instruction?
Week/ month/ year

8. What does cooperative teaching and learning instruction means to you?
9. When did you start using cooperative teaching and learning strategy?
10. How many students do you usually put in one group?
    - How do you make the group?
    - Do your students know about group work?
    - If no, what do you think is the reason?
11. Have you given an orientation to your students about cooperative teaching and learning strategy?
    If no, what is the reason behind it?

12. Have you attended any training on cooperative teaching and learning strategy?
    - If yes, for how long and on which types of cooperative teaching and learning methods?
    - If no, why?
13. How do you facilitate group activity?
14. What are your methods of checking the presence of;
      - Interdependency
      - face-to-face interaction
      - social skills

141

- individual accountability
- Shouldering responsibilities: within the group?

15. What kinds of skill changes have you seen so far in the students after implementing cooperative teaching and learning?
16. What are the negative impacts of cooperative teaching and learning?
17. What are the factors, which are affecting you during implementation cooperative learning?
18. In your opinion, in which aspects must the principal assist you for the proper implementation of cooperative teaching and learning strategy?
19. What must be done by the department of education to encourage the implementation of cooperative teaching and learning strategy?

Exploring the Implementation of the Cooperative Teaching and Learning Strategy in South African Science Classrooms

Date:

Dear Teachers

Thank you very much for your willingness to be part of my research. I am a Master's student in the Department of Science, Mathematics and Technology Education at the University of Pretoria. I am conducting qualitative research on the implementation of cooperative teaching and learning as a group work strategy in science classrooms. The purpose of the study is to understand how and to what extent South African science teachers implement the cooperative teaching and learning strategy in their science classrooms. I also want to identify the factors that impede or facilitate the implementation of cooperative teaching and learning in South African classrooms.

This questionnaire is going to be collected by the researcher (me). This study is aimed to help the Department of Basic Education and policy makers of South Africa to understand and take into account teachers' challenges in implementing the cooperative teaching and learning strategy. It will also provide possible remedies that must be taken by the pertinent bodies to alleviate the existing challenges. Moreover, it will create an opportunity for teachers to share their experiences with their colleagues regarding this matter.

I would greatly appreciate it if you could take the time to complete the questionnaire. Your participation in this study is voluntary and you are free to discontinue at any time, without any consequences. This research has been approved by the University of Pretoria's Ethical Clearance Committee and the Department of Basic Education. If you have any questions about your rights as a participant in this study, or are dissatisfied at any time with any aspect of the questionnaire, you may contact me on 061 992

5678. Your individual responses will be kept strictly confidential. I sincerely appreciate your cooperation in completing this questionnaire.

Sincerely,

Mrs MZ Belay (zerumekidela@yahoo.com)

This questionnaire has two sections. The first section asks about your personal information and the second section queries your perception of cooperative teaching and learning as a group-work strategy and the challenges you are facing during the implementation process. This questionnaire consists of four types of questions, which you must respond to by: ticking inside the box, circling the suitable choice, placing an "X" next to the idea that you agree with, and writing your opinion in the space provided.

I. These questions are about you, your education and the time you have spent in the teaching profession. In responding to these questions, please put an "X" in the appropriate box for Question 1 and 2, and circle your chosen option in Questions 3 to 8.

1. Gender: Male ☐   Female ☐   Others ☐

2. Number of years in teaching: 1-5 ☐   6-10 ☐   11-24 ☐   25+ ☐

3. Highest educational qualification obtained:

   A. Higher certificate and Advanced National Certificate.
   B. National diploma and Advanced Certificate.
   C. Bachelor's degree.
   D. Honours degree. E. Master's degree.
   F. Doctoral degree.
   G. Other: _____

4. Which grade do you teach?

   A. Grade 8 and 9.
   B. Grade 10-12.
   C. Grade 11 and 12.

144

D. Other _____

5. Number of students per class in the school where you teach:

    A. Less than 20 students.

    B. 21-35 students. C. 36-48 students.

    D. More than 48 students.

6. The performance of the learners in your class:

    A. Mostly above average performing learners.

    B. Mostly average performing learners.

    C. Mostly medium average performing learners.

    D. Mostly below average performing learners.

    E. Mixed levels of learners' performance (low, medium, and top achievers).

Cooperative teaching and learning is a group work instructional strategy that consists of four to five learners in one group who are working towards a common goal. The group work is structured in such a way that each member of the group is responsible for a portion of the work to create interdependence and a sense of accountability.

7. Do you use cooperative teaching and learning instruction?

    A. Yes, I do.
    B. No, I do not.

8. If you are not using cooperative the teaching and learning strategy, what is your reason for not using it?

II. The next part of the questionnaire is about the cooperative teaching and learning strategy. All of the answers depend on your teaching experiences and personal opinions.

10. If your answer is "yes I do" in **Question 7**, how often do you use cooperative learning per year?

A. 1-3 times. B. 4-7 times.

C. 8-12 times.

D. More than 13 times.

E. In every class.

11. What does cooperative learning mean to you?

12. How many in-service training sessions did you attend on the cooperative
teaching and learning strategy?

A. 1-3 times. B. 4-7 times.

C. More than 8 times.

D. Not at all.

13. Which cooperative teaching and learning strategy method(s) have you been
trained to use?
You can choose more than one alternative as per the training you received.

A. Complex learning.

B. Student teams (STAD).

C. Group investigation.

D. Jigsaw.

E. The structure approach.

F. Learning together.

G. Strategic cooperative learning.

H. None.

14. How many years have you been implementing the cooperative teaching and
learning strategy?

A. 1-2 years.

B. 3-5 years. C. 6-8 years.

D. More than 8 years.

E. So far, never.

15. How many students do you usually put in one group?

    A. 4-5.

    B. 6-10.

    C. More than 10.

16. Does the group consist of students with different levels of performance, and with different heterogonous backgrounds?

    A. Yes.

    B. No.

17. Are the students aware of how the group will work?

    A. Yes.

    B. No.

18. If your answer in Question 16 is "**No**", what is the reason for this? You can circle more than one reason as an answer.

    A. It is not necessary to inform them about how it works.

    B. The school does not provide the necessary training for students.

    C. I do not know how to teach students about their future activity.

    D. I used to form the group, but did not tell them the purpose of the group work.

    E. There are time limitations to perform the necessary training with them.

    F. The students have had experience with this in their previous grade level.

19. If your answer in Question 16 is **"Yes"**, how are the learners made aware?

    A. The school uses cooperative learning from lower grades.

    B. There is orientation and small term training for learners at the beginning of every year.

    C. Each classroom teacher trains learners at the beginning of the first term.

    D. Other

    _____

20. Do you constantly check that all of the group members actively participate in the activity?

    A. Yes.

    B. No.

21. Based on your opinion, when the students sit in a group, which of the following aspects should be present during group work? Please circle your chosen options (you may circle more than one option).

   A. Face-to-face interaction.

   B. Positive interdependence.

   C. Shouldering responsibilities.

   D. Individual accountability.

   E. Communication skills.

   F. Sociability.

   G. Decision making abilities.

   H. Ability to criticise.

   I. Ability to accept criticism.

   J. Set group and individual goals.

   K. Evaluate group effectiveness and accept weaknesses.

   L. Set new goals after completing each task.

22. Do you check the presence of all the above elements in each group?

   A. Yes.
   B. No.

23. If your answer to Question 21 is "**Yes**" , which one of the following methods do you usually use to ensure the presence of the aspects that you have indicated in Question 21? Place "**X**" in the provided boxes (you may indicate more than one).

   A. Random selection of learners to report their work to the rest of the class ☐

   B. Checking their individual and group goals ☐

   C. Formative and summative assessments ☐

   D. Moving around and sitting with them at the time of their discussion ☐

   E. Giving the necessary materials for the task to the individual learners in the group ☐

24. If your answer in Question number 21 is "**No**" what is your reason for this?

A. I do not know how to check the principles.

B. There is not enough time to crosscheck all the procedures of cooperative learning.

C. Even though I took the training, I do not have experience using it.

D. Other
_____.

25. What kind of development have you seen after implementing cooperative teaching and learning instruction with your learners? please put " **X**" in the applicable box:

A. They have become friendlier ☐

B. The rate of participation increased ☐

C. They changed their behaviour ☐

D. They asked to work in groups ☐

E. They refused to work in a group ☐

F. F. They become more creative in all tasks ☐

26. Which of the following skills do learners acquire from participating in cooperative teaching and learning activities?

A. The necessary social skills for learning and life.

B. The development of learners' self-esteem.

C. Being more interactive and engaged in classroom activities.

D. Exposure to real life learning.

E. Increased conceptual understanding.

F. Improved communication skills.

27. In your opinion, what do the learners gain from cooperative teaching and learning?

28. What are the challenges that you have encountered in the implementation of cooperative teaching and learning?

29. In your opinion, which stakeholder (principal, HOD, district) is the most responsible for facilitating and encouraging teachers to use cooperative teaching and learning as one of their group work strategies? Why?

30. Which factors do you think facilitate the implementation of cooperative teaching and learning?

31. What are the possible steps that the Department of Education could take to resolve the challenges influencing you and your colleagues to use cooperative teaching and learning in your instruction?

Thank you very much for your cooperation!

7.4   APPENDIX IV: DOCUMENT ANALYSIS CHECKLIST

Types of document	What should be analysed?
Lesson plan	❖ Are the objectives of the lesson achievable and measurable? ❖ Is there correlation between the annual plan and the curriculum goals? ❖ Are the five aspects of CLTS included? ❖ Is the allocated for time appropriate? ❖ Are lesson objectives related to the outcomes of cooperative instruction? ❖ The alignment of the task and the available resources.
Annual plan	❖ Number of cooperative instruction planned to be used ❖ Number of group assignments ❖ Number of classroom tasks
Instructional task	❖ Consideration of calibre of all learners ❖ Aspects which are forcing learners to work in-group ❖ Alignment with the five aspects of cooperative instruction ❖ Consideration of the resources and time allocation
Assessment method	❖ Formative (classroom participation , randomly assign to present the group work) ❖ Summative (marking the group work)
Portfolio of learners Which kept by teacher	❖ Individual and group goals ❖ Student performance progress checklist ❖ Social skill development list ❖ Result of each task ❖ Evidence that all learners in group to understand each lessons which were instructed via cooperative ❖ Rotation of allocated responsibilities (leader, writer, timekeeper, presenter…)

7.5   APPENDIX V: LETTER REQUESTING TEACHER CONSENT

<div align="right">

School name:

Tel:

 Postal address:

Date:

</div>

Dear Sir/ Madam,

My name is Mrs MZ Belay and I am doing my Master's degree at the University of Pretoria on the research topic: Implementation of cooperative teaching and learning strategies in South African science classrooms. The purpose of this study is to explore and understand how and to what extent science teachers are implementing cooperative teaching and learning as a group-work strategy in their classrooms. I will, in addition, investigate the factors that impede and/or facilitate the implementation of cooperative teaching and learning strategies.

I request your participation in the study which will entail allowing me to observe and video record your lesson. I also wish to go through your lesson plans, assessment tasks, and learner portfolios. As part of the study, you will also need to complete a questionnaire at a time that is convenient for you. The purpose of the questionnaire is to provide me with insights into your teaching practices and background. I will also need you to participate in a short interview regarding your teaching practice.

There are no expected risks or anxieties related to participation in this research. Participation is voluntary, therefore, if you feel uncomfortable with any part of this study, kindly be advised that you have the right to withdraw participation without any consequence. Pseudonyms will be used to protect your identity during the dissemination of this study.

This study is supervised by Dr. K. Mathabathe and co-supervised by Prof. E. Gaigher. If you have any queries regarding this study please be free to contact me (061 992 5678 or zerumekidela@yahoo.com) or my supervisor (012 420 2758 0r kgadi.mathabathe@up.ac.za).

Please confirm your consent by signing below.

_____   _____
                 Name   Date

_____   _____
              Signature   Date

Truthfully,

_____   _____
        M.Z Belay (Student)   KC Mathabathe (supervisor)

7.6 APPENDIX VI: UP ETHICS COMMITTEE LETTER OF APPROVAL

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Education

Ethics Committee
4 May 2018

Ms Mekideka Belay

Dear Ms Belay

REFERENCE: SM 18/02/03

We received proof that you have met the conditions outlined. Your application is thus **approved**, and you may start with your fieldwork. The decision covers the entire research process, until completion of the study report, and not only the days that data will be collected. The approval is valid for two years for a Masters and three for Doctorate.

The approval by the Ethics Committee is subject to the following conditions being met:

1. The research will be conducted as stipulated on the application form submitted to the Ethics Committee with the supporting documents.
2. Proof of how you adhered to the Department of Basic Education (DBE) policy for research must be submitted where relevant.
3. In the event that the research protocol changed for whatever reason the Ethics Committee must be notified thereof by submitting an amendment to the application (Section E), together with all the supporting documentation that will be used for data collection namely; questionnaires, interview schedules and observation schedules, for further approval before data can be collected. Non-compliance implies that the Committee's approval is null and void. The changes may include the following but are not limited to:
    - Change of investigator,
    - Research methods any other aspect therefore and,
    - Participants.

The Ethics Committee of the Faculty of Education does not accept any liability for research misconduct, of whatsoever nature, committed by the researcher(s) in the implementation of the approved protocol.

Upon completion of your research you will need to submit the following documentations to the Ethics Committee for your

Clearance Certificate:

- Integrated Declaration Form (Form D08),
- Initial Ethics Approval letter and,
- Approval of Title.

Please quote the reference number **SM 18/02/03** in any communication with the Ethics Committee.

Best wishes

Prof Liesel Ebersöhn
Chair: Ethics Committee
Faculty of Education

Room 3-3, Level 3, Building 10
University of Pretoria, Private Bag X20
Hatfield 0028, South Africa
Tel +27 (0)12 420 1234
Fax +27 (0)12 420 5656
Email marisa.leask@up.ac.za
www.up.ac.za

Faculty of Education
Fakulteit Opvoedkunde
Lefapha la Thuto

154

GAUTENG PROVINCE

Department: Education
REPUBLIC OF SOUTH AFRICA

| 6/4/4/1/2 |

GDE RESEARCH APPROVAL LETTER

Date:	16 May 2018
Validity of Research Approval:	05 February 2018 – 28 September 2018 2018/66
Name of Researcher:	Belay MZ
Address of Researcher:	Albatross 223, Stead Avenue
	Queens wood
	Gauteng Pretoria, 0186
Telephone Number:	061 992 5879
Email address:	zerumekidela@yahoo.com
Research Topic:	Exploring the Implementation of Cooperative Teaching and Learning in South African Science Classrooms.
Type of qualification	Masters
Number and type of schools:	Thirty Secondary Schools
District/s/HO	Tshwane North, Tshwane West, Tshwane South.

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

17/05/2018   1

Making education a societal priority

Office of the Director: Education Research and Knowledge Management
7⁰ Floor 17 Simmonds Street, Johannesburg, 2001
Tel (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gog.gov.za

155

7.8 APPENDIX VIII: LETTER REQUESTING PRINCIPAL CONSENT

School name:

Tel:

Postal address:

Date:

Dear Sir/ Madam,

I am a Masters' student in the Department of Science, Mathematics and Technology Education at the University of Pretoria. I am currently planning to conduct a study that will involve the physical science teachers of your school. I kindly request your permission to undertake the research.

The purpose of the study is to explore and understand the implementation of cooperative teaching and learning as a group-work strategy in science classrooms. I also want to identify the factors that hinder and/or facilitate the execution of cooperative teaching and learning strategies. The information collected from the teachers through observations, interviews, questionnaires, and document analysis will be kept in strict confidence. This research is supervised by Dr. K. Mathabathe and co-supervised by Prof. E. Gaigher. If you have any questions please do not hesitate to contact me (061 992 5678 or zerumekidela@yahoo.com) or my supervisor (012 420 2758 or kgadi.mathabathe@up.ac.za).

Thank you in advance for your cooperation and support!

Please confirm your consent by signing below.

_____   _____

Name   Date

_____   _____

Signature   Date

Truthfully,

_____   _____

MZ Belay (student)   KC Mathabathe (supervisor)

156

School name:

Tel:

Postal address:

Date:

Dear Sir/ Madam,

My name is Mrs MZ Belay and I am doing my Master's degree at the University of Pretoria on the research topic: Implementation of cooperative teaching and learning strategies in South African science classrooms. The purpose of this study is to explore and understand how and to what extent science teachers are implementing cooperative teaching and learning as a group-work strategy in their classrooms. I will, in addition, investigate the factors that impede and/or facilitate the implementation of cooperative teaching and learning strategies.

I request your participation in the study which will entail allowing me to observe and video record your lesson. I also wish to go through your lesson plans, assessment tasks, and learner portfolios. As part of the study, you will also need to complete a questionnaire at a time that is convenient for you. The purpose of the questionnaire is to provide me with insights into your teaching practices and background. I will also need you to participate in a short interview regarding your teaching practice.

There are no expected risks or anxieties related to participation in this research. Participation is voluntary, therefore, if you feel uncomfortable with any part of this study, kindly be advised that you have the right to withdraw participation without any consequence. Pseudonyms will be used to protect your identity during the dissemination of this study.

This study is supervised by Dr. K. Mathabathe and co-supervised by Prof. E. Gaigher. If you have any queries regarding this study please be free to contact me (061 992 5678 or zerumekidela@yahoo.com) or my supervisor (012 420 2758 0r kgadi.mathabathe@up.ac.za).

Please confirm your consent by signing below.

_____   _____
                Name   Date

_____   _____
              Signature   Date

Truthfully,

_____   _____
       M.Z Belay (Student)   KC Mathabathe (supervisor)

7.10   APPENDIX X: LETTER OF INFORMED ASSENT (LEARNERS)

School name:

Tel:

 Postal address:

Date:

Dear learner,

REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN YOUR CLASSROOM

I am a Master's student in the Department of Science, Mathematics and Technology Education at the University of Pretoria. I am doing a research entitled "**Exploring the Implementation of Cooperative Teaching and Learning Strategies in South African Science Classrooms**". I am requesting your permission to collect data during a lesson that you will be attending at your school. In the study, I wish to determine how your science teacher implements cooperative teaching and learning as a group-work strategy in the lesson.

As part of the study, I would like to sit in one of the lessons attended by you and observe the teacher while he/she delivers the lesson. I will video record the lesson to capture the teacher's activities accurately. However, I wish to assure you that the recorder will be focused on the teacher at all times. Clips will be deleted and only the audio will be used to jog the memory of the researcher about the actual occurrences of the day if there are instances where you are captured because of the teacher engaging with you during the lesson.

This data will assist me to answer the research questions related to my research title. The findings of this study have the potential to inform the design of better and more engaging science lessons for future presentations. This study is supervised by Dr. K. Mathabathe and co-supervised by Prof. E. Gaigher. If you have any questions about this research project, please contact Mrs MZ Belay (researcher) at 061 992 5678 or email zerumekidela@yahoo.com.

159

Should you agree, please read and sign the attached consent form. Thank you very much for considering this request.

Sincerely,

_____   _____

MZ Belay (student)   KC Mathabathe (supervisor)

Informed consent form for data collection

Please read the conditions below and sign if you agree to participate.

With reference to the request for permission to conduct research entitled: **Exploring the Implementation of Cooperative Teaching and Learning Strategies in South African Science Classrooms** I understand and agree that:

My physical science teacher will participate in the study.

The teacher will be video recorded as he/she presents a lesson.

The data collected will only be used for research purposes.

The identity of the school, educators and learners will be held in the strictest of confidence.

My participation in the project is voluntary, and I may withdraw at any stage of the research.

I am not waiving any human or legal rights by agreeing to participate in this study.

I verify by signing below that I have read and understood the conditions listed above.

Learner's name and surname: ....

Signature................................... Place and date: ....