THE INFLUENCE OF PRACTICAL ACTIVITIES ON THE ACQUISITION OF AGRICULTURAL SCIENCES FARMING SKILLS AMONG GRADE 12 LEARNERS AT MANKWENG CIRCUIT IN LIMPOPO PROVINCE.

BY

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SUPERVISOR: DR MF MASHA

CO-SUPERVISOR: MR KJ CHUENE

CO-SUPERVISOR: PROF MS MTSHALI

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ABSTRACT

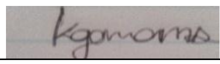
The acquisition of farming skills by Agricultural Sciences learners seem to be lacking because of several factors. The study sought to analyse the influence of practical activities on the acquisition of Agricultural Sciences farming skills by Grade 12 learners in the Mankweng Circuit in the province of Limpopo. This was achieved by answering the main research question: 'How do practical activities influence the acquisition of farming skills by Grade 12 Agricultural Sciences learners at selected secondary schools in the Mankweng Circuit?' This question was further divided into three sub-research questions. The first sub-question was: 'How do Grade 12 Agricultural Sciences learners acquire farming skills from practical activities?' Following on from this was the second sub-question: 'What are the implications of practical activities on the acquisition of farming skills by Grade 12 Agricultural Sciences learners?' While the last sub-question was: 'What are the learners' perceptions of the practical activities of Agricultural Sciences?' A qualitative multiple case study research design was used to answer these questions. Kolb's experiential learning theory was used as a framework to guide the study.

Three secondary schools were selected in the Mankweng Circuit using purposive and convenience sampling. Data collection was done using lesson observations and individual semi-structured interviews. Analysis of data was done using codes thematic data analysis. Three themes were used for analyses and discussion of data namely; the acquisition of Agricultural Sciences farming skills, the implications of the practical activities, and the learners' perceptions of the practical activities. Findings from this study show that learners acquire different agricultural farming skills when engaged in practical activities. In addition, learners perceived agricultural as an interesting and motivating subject when practical activities are included in their learning. Therefore, the study recommends that teachers, curriculum advisors and the Limpopo Department of Education must ensure that Grade 12 Agricultural Sciences practical activities are delivered as outlined in the Curriculum Assessment Policy Statements (CAPS) document. Moreover, learners must engage more often in practical activities since each type of practical activity determines the types of Agricultural Sciences farming skills to be acquired by learners.

KEYWORDS: Practical activity, Farming skills, Agricultural Sciences, Learners

DECLARATION

I, MASENELO DINAH KGOMO, hereby declare that this research report submitted to the University of Limpopo, for a Master's degree in science education has not been previously submitted for a certification by anyone at any institution of higher learning. Also, this is my work in planning and in implementation, and related resources used here have consequently been acknowledged.



MD KGOMO (Ms)

[redacted]

DEDICATION

This work is dedicated to my late father, Jeremiah Kgomo, and my family

ACKNOWLEDGEMENTS

Psalm 27:1

To the Lord God Almighty, for giving me the light, strength and determination throughout my studies, making it easier to complete this project successfully.

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ABBREVIATIONS AND ACRONYMS

C2005:	Curriculum 2005
CAPS:	Curriculum and Assessment Policy Statement
DBE:	Department of Basic Education
DoE:	Department of Education
ELT:	experiential learning theory
FET:	Further Education and Training
FRN:	Federal Republic of Nigeria
GOK:	Government of Kenya
LDoE:	Limpopo Department of Education
NAS:	National Academy of Sciences
NCS:	National Curriculum Statement
NIFA:	National Institute of Food and Agriculture
NPE:	National Policy on Education
NRC:	National Research Council
OBE:	outcomes-based education
RNCS:	Revised National Curriculum Statement
SCORE:	Science Community Representing Education
TREC:	Turfloop Research Ethics Committee
WAEC:	West African Examination Council

CHAPTER ONE: INTRODUCTION

1.1. Background

Agriculture involves practical activities and therefore it needs hands-on actions and field practices. Practical activity is regarded as a physical activity that a person participates in to master a certain skill or an objective (Aggarwal, 2014). This includes the training of learners to work with their hands and minds for the acquisition of improved farming skills. In addition, the Agricultural Sciences Curriculum and Assessment Policy Statement (CAPS) document stipulates the specific learning outcomes that Agricultural Sciences learners need to attain at the end of their studies at secondary level (CAPS, 2011). In summary, the learners need to create awareness of the management and care of natural resources, and they must also acquire problem-solving mechanisms within the context of Agricultural Sciences. The learners are also required to be conscious of the socioeconomic development of society, and must be well-versed and responsible citizens in the production of agricultural commodities. Furthermore, being able to solve social injustices and being mindful of agricultural indigenous knowledge and practices are also some of the requirements that the Agricultural Sciences learners need to meet (CAPS, 2011).

With regard to the practical activities, the CAPS document states that schools should be furnished with an Agricultural Sciences laboratory where several practical activities or experiments can be implemented (CAPS, 2011). A practical investigation, for example, should be given to learners with the purpose of acquiring and assessing the learners' science investigative skills. This could be implemented in the form of hands-on activities or hypothesis testing (CAPS, 2011). Learner's skill acquisition can be enriched by teacher involvement and by indulging learners in continuous practical activities. According to an observation made by Kidd, Ogwo and Oranu (2016), the acquisition of skills proceeds routine creation, meaning that continued practice of an activity becomes a habit, hence leading to perfection. Teachers are required to engage learners vigorously in the farm and laboratory activities; go to field trips; and assign tasks and specific parts in the farm for their own practice. Learners ought to be educated about their experiences and environments, according to Navarro (2014), to enable them to be equipped to compete in an environment such as an agricultural farm. Companies increasingly demand graduates with multicultural experiences (Bruening & Frick, 2014), and agricultural farms are no exception.

The problem is that when those learning outcomes are not thoroughly accomplished after indulging in Agricultural Sciences studies at secondary level (Department of Basic Education [DBE], 2019). Even though the learning outcomes may seem attainable, it is not easy to fulfil them with the current operational teacher-centred approach of instruction (Ofoegbu, 2015). The method of teaching that is used by the teachers at any grade will determine the nature of learners produced after an academic programme (Ofoegbu, 2015). According to Okoro (2017), if assessment measures disclose that learners have not completely acquired what they were trained to acquire, the issue could be with the adopted methods of instruction. Generally, the unsatisfactory performance of learners in examinations calls for a cautious evaluation of the methods of instruction that are implemented by the teachers.

The Chief Examiners Report of the West African Examination Council (2014) highlighted that the inadequate acquaintance with hands-on agricultural activities affects the learners' progression. The report further advised the teachers to implement a more investigative and hands-on approach to the education of agricultural values and ethics, and not use the outdated approaches of teacher-centred learning. Furthermore, the DBE (2020) has noted a significant decline in the overall pass rate in science subjects between the years 2019 and 2020. Thus, to deliver a solution to this educational risk, a reliable instructional strategy to correct the present context must be employed.

Olaniyan and Ojo (2008) noted that the rise in the learners' registrations at secondary schools leads to congested classrooms. This congestion makes it hard for a single teacher to accomplish all the practical aspects of the course. Various studies have shown that school farms do not exist at secondary level at many schools (Shimave, 2017; Olaniyan & Ojo, 2008; Aggarwal, 2014). These studies further found that, in schools where farms exist, they are poorly equipped and the learners failed to attain the necessary learning outcomes as stipulated in the Agricultural Sciences CAPS document. According to Darko, Yuan, Okyere, Ansah and Liu (2016), Agricultural

Sciences learners mostly lack the mandatory practical skills after completing Grade 12 and fail to participate in basic agricultural practices at higher learning institutions. In addition, they are often unable to successfully engage themselves in agricultural enterprises. This may lead to the long-term effects of the ineffective acquisition of practical skills, and a general lack of technical and employable skills (Amuriyaga, Hudu, & Abujaja, 2018). The evidence collected from reliable educational sources has accredited the unskilled existence of agricultural alumnae to the ineffective training of learners in practical activities and the lack of fundamental instructional materials, at the secondary level, among other factors (Alkali, 2015; Darko *et al*., 2016).

Research articles have shown that this topic has frequently been studied mostly internationally and outside of this specific area of study (Millar, 2004; Deegan & Wims, 2015; Amadi & Aleru, 2016). Therefore, little or no research have been conducted in the Mankweng Circuit (Maicibi, 2013; Samikwo, 2013; Rammala, 2019). Their findings indicate that this topic was not properly investigated, as it continues to disadvantage the learners in this specific study area (Kibirige, Maake & Mavhunga, 2014). This indicates that more research needs to be done to fill in the missing gaps and to generate new solutions to alleviate this issue. It is, therefore, the purpose of this research project to analyse how practical activities influence the acquisition of farming skills by Agricultural Sciences learners and to supply guidelines for the solutions to this issue.

1.2. Research Problem

According to the CAPS document (DBE, 2011), the best way to teach Agricultural Sciences is to actively involve the learners in their own learning, rather than using rote learning. The CAPS document for Agricultural Sciences further stipulates that an activity-based strategy should be used to carry out curriculum goals. According to (Kalogiannakis *et al.,* (2021) scientific education is essential in the 21st-century education and should begin at a young age (Tavares *et al*., 2021). Gayle and Carolyn (2013) also notes that direct and indirect instruction, experiential learning, independent study and interactive instruction may be incorporated in the classroom for active participation. This will depend on the type of topic that is being taught during a particular lesson. Moreover, the practical activities that help to develop advanced farming skills in the Agricultural Sciences learners include, but are not limited to, practical demonstrations and investigations, field trips and experiments (Olajide *et al*., 2015).

The reality may be that the schools are not adequately engaging the learners in practical activities. This may be attributed to factors such as the lack of resources, poor funding of practical agriculture and the lack of physical infrastructure (Muzah, 2015; Mutai, 2016). The afore-mentioned factors may lead to the lack of acquisition of essential farming skills, such as critical thinking, problem solving, collaborative initiatives, time management and organisational skills (Richa, 2014). This is corroborated by Olowu (2023) who asserts that scientific education may cultivate critical thinking, fundamental scientific skills, practical steps, creativity, and originality in scientific explorations amongst learners.

This means that learners may fail to comprehend and recollect the taught content if it was not implemented practically, as required by the CAPS document. This may affect the learners' performance and contributes to the lack of interest in studying Agricultural Sciences. Moreover, may lead to poorly trained farmers at the secondary level with lack of farming skills. Hence, the influence of practical activities on the acquisition of farming skills by learners still needs to be researched, as it continues to disadvantage the agricultural industry, and the production of quality crops and livestock (Navarro, 2014).

1.3. Purpose of the Study

The purpose of this research project was to analyse the influence of practical activities on the acquisition of Agricultural Science farming skills by the learners at secondary schools in the Mankweng Circuit.

1.4. Research Questions, Aims and Objectives

1.4.1 Aim and Main research question

Aim

To analyse the influence of practical activities on the acquisition of farming skills by Grade 12 Agricultural Sciences learners

Main research question

How do practical activities influence the acquisition of farming skills by Grade 12 Agricultural Sciences learners at selected secondary schools in the Mankweng Circuit?

1.4.2 Objectives and Sub-questions

Objectives

- To analyse how Grade 12 Agricultural Sciences learners acquire farming skills from practical activities
- To explore the implications of practical activities on the acquisition of farming skills by Grade 12 Agricultural Sciences learners
- To explore learner's perceptions on the practical activities of Agricultural Sciences

Sub-questions

- How do Grade 12 Agricultural Sciences learners acquire farming skills from practical activities?
- What are the implications of practical activities on the acquisition of farming skills by Grade 12 Agricultural Sciences learners?
- What are the learners' perceptions on the practical activities of Agricultural Sciences?

1.5 Significance of the Study

This study aimed to investigate the influence of practical activities on the development of farming skills by Agricultural Sciences learners at selected secondary schools in the Mankweng Circuit. Therefore, the research results could be beneficial to several educational institutions that are involved in policy development and in the implementation of practical activities during lesson presentation at schools. The study may increase the available literature on the practical activities that influence the development of farming skills by Agricultural Sciences learners. Moreover, it may guide educational evaluators in generating ongoing educational quality, monitoring systems and development procedures to direct teachers and improve the use of instructional strategies and teaching methods. The findings and recommendations from this study could also be used to form the basis for further studies that are involved in the planning and development of the practical activities that are implemented at schools.

1.6 Ethical Considerations

Ethical considerations are of significance, particularly when animals and people are involved in a study (Dooly, Moore and Vallejo, 2017). The authors defined ethical considerations as ethics that protect an individual's behaviour during data collection. The confidentiality of research participant's was ensured by not revealing the names of the schools and that of the research participants. Moreover, informed consent forms were signed by research participants to get their permission for data collection. Permission was also granted by obtaining a clearance certificate from the Turfloop Research Ethics Committee (TREC) of the University of Limpopo (Appendix G). A detailed description of this section is given in Chapter 3.

1.7 Organisational Structure of the Study

This research report consists of five chapters; the first chapter of which is an overall introduction to this research, which comprises of the background, motivation of the study, research problem and the purpose of the study, and which includes the main research question along with three sub-questions, significance of the study and ethical considerations. The second chapter is the review of previous literature; it includes an introduction, and research studies conducted internationally, continentally and within South Africa in relation to the study topic. In addition, this chapter also includes the theoretical framework of the study and, lastly, a conclusion. The third chapter covers a detailed description of the research methodology; including an introduction, research design, sampling and data collection, data analysis and, lastly, quality criteria. The fourth chapter deals with analysis of results and a discussion thereof. The fifth chapter is the conclusion to and recommendations from the study.

1.8 Chapter Conclusion

In this chapter, a brief background of what this research entails was given. The real motivation for conducting this research and the problems that the researcher wants to address through this study were briefly discussed. The main purpose and the significance of this study were thoroughly discussed. The next chapter will take us through a literature review pertinent to this study. In this chapter we will look at how previous studies are related to this study, looking at their research methodology, results and discussions, and also at their conclusion and recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.1 Chapter Introduction

In the previous chapter, a brief background, the motivation for conducting this research and the problems that the researcher wants to address through this study were briefly discussed. In addition, the purpose and significance of this study were discussed. In this chapter, the researcher emphasises the educational constituents and, therefore, explains the role of practical activities in a science classroom, and the link between practical activities and the acquisition of agricultural farming skills. The analysis of previous literature focuses on the assessment of the implementation of practical activities in the existing learning programme and studies conducted in the past are acknowledged since reference is made to them. The link between previous studies, along with their findings and recommendations, is thoroughly discussed in this chapter**.**

2.2 Review of Previous Literature

2.2.1 Description of practical activities

In an analysis of a study on practical activities in science subjects conducted by Dillon, (2008), the researcher showed that scientists and teachers provide diverse denotations for scientific practical activities. The author used different terminologies to define scientific practical activities, which includes regularly used terminologies such as ‘practical’ and ‘investigation skills’, ‘practical and enquiry activities’, ‘independent analysis’ and ‘experiential activities’. The author then gave a broad explanation to simplify the misconception, namely that practical activities consist of any ‘learning experiences whereby learners interrelate with tools or with data generated from secondary sources to discover and comprehend the physical world’ (p. 5).

According to Millar (2004), practical activity denotes ‘an educative activity that involves the learners in discovering or operating entities and tools that they are studying’ (p. 2). The author chose the term ‘practical activity’ rather than ‘laboratory activity’, ‘since a setting is not the main factor in describing this type of activity. The operation of entities might occur in a laboratory, but could also take place in an out of school context, for example, at home or inside the field (e.g. when studying field identification of soils in Agricultural sciences)' (p. 2).

A study undertaken by Science Community Representing Education (SCORE) (2008), described practical activity in science schooling as 'learning activities whereby learners observe, investigate and develop an understanding of the world around them. This can be in the form of a direct or hands-on experience of a phenomenon' (p. 4). In a previous study, SCORE separated practical activities into three wide classes, namely fundamental activities, complementary activities and paired activities. Fundamental activities include inquiries, laboratory techniques and practices, and field activities. Complementary activities include planning and formulating investigations, analysing data through technology, analysing findings, classroom corroborations and real life experiences. Paired activities include scientific trips, site inspections, classroom debates, presentations, role play, imitations and collaborative activities.

According to Needham (2014), science learning frequently includes generating contexts whereby learners are able to experience objects, events or scientific ideas. An imperative factor in any practical activity is when learners are able make observations and reflections, and handle tools and apparatus. Practical activities in some studies has been described in diverse ways, for example, 'experimental activity; scientific inquiries' (Ramnarain, 2011); and 'laboratory inquiries' (Kibirige & Tsamago, 2013). The wider perception of 'learning from experience' was used in this study to cater for the varied definitions of practical activities.

This study adopts the description of practical activities by Needham (2014) and SCORE (2008). This is because through practical activities learners are able to experience different tools and apparatus, make observations and reflections as stated by Needman, (2014). In addition, learners from this study were given a hands-on experience of dissecting chickens to observe its alimentary canal, to extract DNA from onions and also to conduct Monohybrid and Dihybrid crosses. Therefore, those practical activities provided learners with a direct and hands-on experience of tools and apparatus. Hence, learners were able to make reflections from the experiences as stated by SCORE (2008)

2.2.2 The role of practical activities in the acquisition of Agricultural sciences farming skills

Learning in Agricultural Sciences is the attainment of skills and knowledge in Agricultural Sciences with the purpose of conveying them to potential agriculturalists for enhanced production (Woodley, 2019). Practical activities involve learners, assists them to cultivate vital skills, improves their understanding and solves agricultural issues (Woodley, 2019). An efficient practical task attains its objective of successfully communicating a clear and distinct set of concepts. If executed efficiently, practical activities can motivate and involve learners to higher learning levels, and stimulate them psychologically and physically in several ways that certain scientific practices cannot (SCORE, 2009).

Practical activities may enable learners to make accurate observations and predictions through the execution of experimentation (DBE, 2011). When learners make accurate observations, they may be able to identify differences and similarities between objects and processes, and also identify problems given in specific situations (DBE, 2011). This implies that learners may identify and solve problems encountered in different farming enterprises when they engage thoroughly in practical activities. The role of practical activities is to develop learners' knowledge and advance their skills in solving scientific problems by imitating scientific activities. According to Sotiriou, Bybee and Bogner (2017), learners would be like scientists and follow scientific procedures when resolving scientific problems.

Referring to Dillon (2008), several factors support learners' engagement in practical activities when it comes to scientific subjects. These include the stimulation of precise observations and explanations, conversion of theory into a real-life context, retaining the learners' interest in scientific lessons and stimulating a sound and cognitive way of thinking. This implies that accurate observations and measurements may enable learners to apply what they have learnt to real-life situations. According to the Tech team (2019), problem-solving skills are essential in the agricultural industry. For instance, a farmer often looks for effective ways to manage and handle their livestock. When unexpected diseases occur, farmers need to come up with new ways to protect their livestock. Thus, animal feeding and handling are included in the Grade 12 Agricultural Sciences curriculum in order for learners to acquire such skills.

Active practical activities permit learners to form a gap between what can be seen and handled and scientific concepts that justify their observations. Creating those links is challenging, thus practical activities that create these connections are expected to be fruitful (Millar, 2004). According to Okorie, (2011), practical activities in Agricultural Sciences incorporate farming and agri-industries comprising additional services and sales in agriculture. This is because practical activities in agriculture aim to train existing and potential farmers in expertise in farming (Phipps & Clarke, 2014). Moreover, practical activities have continued to be an imperative component of school science education (Said, Friesen & Al-Ezzah, 2014). For this purpose, the practical aspect of a theoretical topic is an imperative feature that distinguishes science from other subjects. This means that science subjects are better understood through engaging in practical activities as opposed to other subjects.

According to Skamp (2011) and Hartley (2014), the inclusion of practical activities generates a conducive environment for science education, which may improve learning outcomes. However, there is a heated debate about the impact that practical activities have on learners and their education (Abrahams & Millar, 2018; Abrahams, 2019). Referring to Abrahams and Millar (2018), most teachers believe that practical participation is essential in science education and it is effective. Millar and Driver (2013), on the other hand, note that engaging in practical activities does not always lead to innovation in science learning. According to Woodley (2019), teachers consider practical activities to be a form of behaviour management to grasp the learners' attention and interest, rather than being a major contributor to the acquirement of skills in science learning. Therefore, this study stands with the perception that practical activities are essential and effective in science education and also contributes to the acquisition of skills.

Tsakeni (2018) discovered effective ways of conducting practical activities in Agricultural Sciences at two South African secondary schools. The author suggested supporting practical activities in the form of assessments and apparatus for instructional guidance. Practical activities conveyed with skills and understanding can help learners comprehend scientific theories and trigger their interest in science subjects (Tsakeni, 2018). Practical activities are also a significant portion of scientific concepts and engagement in them trains learners on the experiential origin of scientific investigations (DBE, 2011). Teaching and learning approach of science organisations share the same sentiments, namely that practical activities serve as a vital aspect of the newly introduced curriculum (Curriculum and Assessment Policy Statement [CAPS]). This is mainly because practical activities provide the learning of scientific theories, trains learners in respect of the world of science and also inspires them.

The researcher agrees with Tsakeni (2018), in that practical activities conveyed with skills and understanding can help learners comprehend scientific theories and trigger their interest in science subjects. This is because learners seemed very interested and motivated to engage in practical activities and showed an understanding of concepts. This indicated that practical activities have the ability to cultivate vital skills and enable learners to solve agricultural issues, in line with the views held by (Woodley, 2019).

2.2.3 Teaching methods adopted in Agricultural Sciences

Merlot (2015) described teaching methods as an idea of action intended to attain a curriculum plan for a learner. According to Heinrich, Molende and Russel (2013), teaching methods are techniques of teaching designated to help learners accomplish the purposes of instruction; meaning that teaching methods can be described as measures implemented by the teacher to assist learners to acquire understanding, attitudes and skills to control agricultural yield for independence. Instructional approaches were classified by Osinem (2008) into field and non-field instructions. Field instructions constitute teaching done out of the school context. For instance, this may be a field trip, an experiment, a laboratory activity, a demonstration of ideas or any other outdoor instruction. In this teaching approach, learners are actively included, thus the acquisition of skills is highlighted. The non-field instructions are those approaches offered to learners that comprise of theories and are mainly done in the classroom (Osinem, 2008). These instructions include classroom discussions, debates, group work, role play and textbooks.

Ogwo and Oranu (2016), argued that using textbooks helps learners find raw data and significant information with vital processes relevant to the subject matter. On the other hand, classroom discussions allow learners to understand and comprehend theories better. Utilisation of old-fashioned instructional methods leads to the poor acquisition of skills in the science discipline in a straightforward manner (Makgato & Mji, 2016). In their research encounters, Makgato and Mji (2016) postulate that deprived instructional approaches affect the performance of pupils in the science discipline. The deprived instructional strategies result from a lack of facilities. Furthermore, the principle that 'one trains in the manner which one is educated' (Thomas & Pedersen, 2003, p. 319) basically means that teachers utilise the methods that were used to educate them and not the methods that are in line with the content to be taught (Makgato & Mji, 2016).

They further suggest that teachers ought to occasionally attend short courses introduced by various individuals. Thus, they can fuse various techniques of learning in order for them to utilise innovative approaches to training (Makgato, 2017). Then again, discoveries by Mwenda, Gitaari, Nyaga, Muthaa and Reche (2013) showed that the most utilised instructional technique was demonstrations and, thereafter, classroom interactions. Although these strategies were utilised, learners continued to perform badly. These discoveries do not highlight poor teaching strategies as adding to a lack of Agricultural Sciences skills. In any case, suggestions by Mwenda *et al*. (2013) are similar to those of Makgato and Mji (2016), namely that there ought to be sessions to furnish the teachers with different techniques or approaches for teaching (Mwenda *et al*., 2013).

This study views practical methods of teaching and learning as the best methods to cultivate Agricultural farming skills amongst learners. In line with Osinem (2008), the author agrees that field trips, experiments, laboratory activities and demonstrations actively involve learners and enhances their acquisition of skills. This is shown by Makgato and Mji (2016), who postulates that theoretical methods of learning affects the performance of learners and leads to poor acquisition of skills in science subjects. The same sentiments were also shared by Mwenda *et al*. (2013). Hence, the researcher suggests that teachers must be well trained with different instructions and approaches so as to engage learners in their learning, for them to acquire different farming skills.

2.2.4 The significance of quality school-based Agricultural Sciences practical activities

In the United Kingdom, there is a wide choice of better practical activities that concentrate on the excellence of the practical activity rather than on the quantity only (SCORE, 2008). According to SCORE (2008), high-value practical activities have a long-term positive impact on Agricultural Sciences education. Farm-based practical activities allow learners to acquire skills, understanding and capabilities of on-farm processes. They demonstrate farming processes and practices to learners and convey field experiments that are difficult to conduct in the laboratory (Onanuga, 2015). The intention of Agricultural Sciences education in schools is to ensure that learners are exposed to the significant values of agricultural production. Learners participate in several practical activities that help them improve their essential skills and the capabilities needed in agricultural production. Practical classes are planned to ensure that learners obtain practical skills and become independent, creative and beneficial to society.

The Federal Republic of Nigeria (2004) noted that secondary schools can instil practical skills, knowledge and standards that help Grade 12 learners to resolve realistic problems. Learners acquire skills better when they observe, sense and touch; this is the basics of learning by doing, which is best accomplished by actively involving learners in practical activities. School farm activities improve learners' awareness of the production and selling of agricultural produce in society. This implies that scientific observations and making predictions from such activities may have an effect on learners’ acquisition of farm management, problem-solving and interpersonal and organisational skills (Tech team, 2019). These are imperative skills in the agricultural industry; for instance, a farmer needs to ensure that raw materials are properly transported, stored and delivered to wholesalers and consumers. In addition, farm management skills may enable learners to become subsistence farmers at young age.

The intent of science education should be to shape a self-governing, incorporated and independent national economy. This simply means that teaching and learning can be practically focused on the improvement of creative skills and the development of knowledge through experience, innovative technology and on-going lifelong learning (Osinem, 2008; Alexander, Christianah & Gana, 2014). Therefore, practical activities in schools have to be stressed by imparting manipulative skills to the learners to make them more useful to society. According to Whyte (2005), practical activities deliver awareness to the learners of how to operate using their hands and to cultivate crops. If accurately executed, practical activities may benefit learners directly (Amadi & Aleru, 2016). According to Olowu (2023), the basic process skills such as classifying, predicting, measuring, observing, and communicating provides a foundation for scientific learning. Whilst the more complex skills such as interpreting, experimenting, hypothesizing, formulating methods, and identifying variables describe improved scientific knowledge and skills Romadona *et al*., 2021).

According to Acker (2019), scientific learning can incorporate the growth of critical thinking skills to complement problem-solving skills, which incorporate socio-biological and physical organisations. In addition, full engagement in precise practices, a reflection on those practices and energetic roles in experimenting with those experiences are all cornerstones of practical learning (Kolb, 2004; Joplin, 2010; Andreasen, 2019). Moreover, practical activities enable learners to cultivate creative skills, form a background for upcoming farmers and have knowledge of farms and their benefits, (Modebelu & Nwakpadolu, 2013). Practical activities also support the learners with the proof needed to defend their thoughts and to incorporate scientific values (Jormanainen, 2006). Hence, learners are subjected to fundamental practises of science using practical activities which are essential in the 21^{st} Century (Kalogiannakis *et al.,* 2021).

Practical activities have customarily been used as 'recipe-like' tasks, with little intellectual involvement and did not motivate creativity in learners (Bigelow, 2012). This implies that practical activities might not have been conducted in line with the curriculum, since the acquisition of creative thinking skills is barely considered. Research carried out by National Research Council (2003) and the National Academy of Sciences (2010) suggested that, during practical activities, learners ought to be investigative, plan experiments, and write down, examine and discover their answers. Driver (2013), recommended that, instead of learners working with previously given answers, they should examine new problems. Therefore, practical activities provide for the improvement of scientific and conceptual skills in this way. Practical activities are underestimated in South Africa (Hartley, 2014), notably among teachers from historically underprivileged schools. Nonetheless, the Agricultural Sciences CAPS document places solid emphasis on 'hands-on activities' rather than being taught about scientific theories (DBE, 2011).

The above literature has indicated that quality school-based practical activities are significant in helping Agricultural Science learners to acquire basic and fundamental skills (SCORE, 2008; FRN, 2004). This indicates that quality school-based practical activities must be implemented by teachers on an on-going basis. Suggestions by NRC (2003) and NAS (2010) are concurred by the researcher since learners may solve, examine and discover new information through practical activities and this are very essential life skills. Hence, this study asserts that practical activities must not be underestimated in the science disciplines as shown by Hartley (2014) and must be implemented as stated in the CAPS document.

2.2.5 Proper ways to conduct practical activities

Williams, Lawrence, Grartin and Smith (2012) recognised the significance of practical learning, stating that the prospects of practical activities might expose learners to experiences that may help to form and cultivate the necessary skills. Bruening and Shao (2015) agreed that practical learning is valuable because it provides, but is not limited to, the prospects for collaboration with specialists and the development of reminiscent links. This is because much of the content that is covered in schools is theoretical and has little relevance to the learners' activity area and reality. Hence, learner acquisition of creative thinking and problem-solving skills may be negatively affected since they are not taking an active role in their learning. According to Henze (2014), learners were typically skilled tentatively and intently in the subject of Agricultural Sciences by the implementation of practical activities. As a result, the traditional classroom rote learning systems provided limited opportunities for acquiring the essential skills and practice to discover professional opportunities (Nikolova-Eddins, Williams, Bushek, Porter & Kineke, 2017).

Hodson (2010), highlighted the notion that the main emphasis of laboratory activities may not be restricted to learning precise scientific approaches or exact laboratory procedures. Alternately, learners can use the approaches and techniques of science to examine phenomena, resolve problems and follow investigations (Hodson, 2010). The author further asserted that the laboratory context symbolises an essential change from a teacher-centred approach to a purposeful analysis that is more learner-centred. In addition, a study by Hodson (2013), disapproved of the outdated conduct of poorly equipped laboratory classrooms and asserted that they are not productive and unclear. This is because a poorly equipped laboratory is often used with indefinite objectives. Furthermore, Hodson (2013) stressed that more emphasis should be placed on what learners are doing in the laboratory. De Jong, Linn and Zacharias (2013) asserted that inquiries provide an opportunity for learners to collaborate directly with physical objects using equipment, data collection instruments, simulations and scientific theories. In addition, learners can acquire laboratory skills, including the operation of equipment and pieces of machinery, thereby experiencing the challenges faced by various scientists when designing practical activities that need a cautious setup of apparatus and observation over long periods of (Romadona *et al*., 2021).

The instruction of Agricultural Sciences at schools needs a thorough contextual theory and practical knowledge by teachers. The new curriculum needs agriculture to be trained as a vocational subject at the secondary school level (Ndem & Akubue, 2016). According to Olaitan (2018), the main goal of the National Policy on Education in India is to create learning that is both practical and effective. Moreover, the Federal Ministry of Education in Nigeria states that the intention of Agricultural Sciences should include stimulating and sustaining learners' interest, thus enabling them to acquire useful knowledge and the practical skills needed in the agricultural industry.

Investigations carried out in the UK demonstrated that real-world inquiries are difficult to conduct in overcrowded classrooms (Akinsolu & Fadokun, 2015). This might be because of the absence of sufficient scientific resources and the limited movement of teachers to cater to all the learners (Bakasa, 2011; Yelkpieri *et al*., 2012); meaning that the different learning abilities of learners are not catered for since they acquire skills and learn differently. This alternately leads to poor acquisition of Agricultural Sciences skills since the Agricultural Sciences discipline requires a great deal of training. Theoretical and practical work should be linked in order to close the knowledge gap between theory and pragmatic knowledge. Real-world experience improves knowledge of the curriculum content. Investigations by Ornstein (2012) in Nigeria, demonstrated that the absence of practical activities in science education offers restricted scientific knowledge in instruction. This could be the same situation for Agricultural Sciences as a subject in secondary schools in the Mankweng Circuit of Limpopo.

The above literature has shown different ways of conducting practical activities properly in Agricultural Sciences. Based on the researcher's experience in learning Agricultural Sciences, the best ways to engage learners in practical activities is to expose them different objects and to allow them to interact with those objects. The same views are shared by Williams *et al*., (2012) in that exposing learners to real-life experiences may help them to cultivate the necessary skills. The researcher shares the same sentiments with Porter & Kineke (2017), and believes that teacher-centred learning approaches provide limited opportunities for acquiring essential skills. This is shown by Hodson, (2010) who asserts that the practical activities symbolises an essential change from a teacher-centred approach to a purposeful analysis that is more learner-centred. Therefore, this study approves that well-equipped laboratories and real-world experiences and demonstrations are some of the proper ways to conduct practical activities.

2.2.6 The effect of school laboratories for science learning

Learners attain skills for welfare, risk and safety measures against pressures in the laboratory (SCORE, 2008). According to Kriek and Grayson (2019), once teachers utilise the equipment to conduct practicals, they enhance their theoretical grasp and their experimental skills. Furthermore, they increase both their teaching skills and their learners' comprehension when they deploy scientific kits in their laboratories to determine the phenomena and to clarify these ideas to their pupils. According to Shulman *et al*., (2017), manipulative, inquiry, investigative, organisational and communicative skills may be acquired through participation in laboratory activities. Moreover, learners may be able to test hypothesis and theoretical models, and advance their cognitive abilities, such as critical thinking, problem solving and application. This implies that schools without laboratories may produce learners who lack the skills and knowledge required in the agricultural farming industry. Consequently, these learners may lack the prerequisite requirements for tertiary qualifications, such as plant science, soil science, animal science, agricultural economics, food sciences and veterinary science (Shulman *et al*., 2017).

Laboratory activities, according to Hofstein and Lunetta (2013), have the potential to improve constructive social relationships, foster good attitudes and stimulate intellectual growth. According to Johnstone and Al-Shuaili (2011), activities in an institution's science laboratory can provide the learners with an opportunity to play an active role in their activities, increase their sense of possession and motivate them. These advantages are in line with the CAPS, which inspires learners to take an active role in their education and choose how they wish to study. According to Hofstein and Kind (2011), practical activities have a distinct and vital role in learning science content and science teachers have claimed that participating in science laboratory activities with learners has several benefits. The laboratories at a school are also a vital instrument for enhancing intellectual skills, in line with Kolb's experiential learning theory. According to Grussendorff *et al*., (2014), most (approximately 95%) of the schools in South Africa might not be able to conduct the recommended practical activities of the CAPS because of inadequate laboratory facilities. The lack of scientific laboratories in many low-income schools has impacted on, not only the adoption of the CAPS, but also on the teacher's ability to teach in a traditional manner (teacher-centred approach).

This section showed the effects or importance of having school laboratories for science learning. The researcher views a school laboratory as one of the essential facilities that are needed in the learning of Agricultural Sciences. This is because it offers learners an opportunity to attain skills for welfare, risk and safety measures when operating different tools, apparatus and solutions in the laboratory and this is also shown by SCORE, (2008). The researcher shares the same views with Kriek and Grayson (2019); Shulman *et al*., (2017), and Hofstein and Kind (2011), that science laboratories helps learners to test hypothesis, advance their cognitive abilities, such as critical thinking, problem solving and enhances intellectual skills.

2.2.7 South African curriculum policies in respect to practical activities

According to Erduran and Msimanga (2014), the policy statement in South Africa after apartheid was first presented as Curriculum 2005 (C2005) in 1997. The policy was revised in 2002 to become the Revised National Curriculum Statement (RNCS). In addition, it was incorporated into education at the junior grades (Erduran & Msimanga, 2014). The National Curriculum Statement (NCS) was then introduced in 2007 at the further education and training (FET) phase (DoE, 2003). The NCS defined subjects according to learning outcomes (LOs) and a frame of content. The LOs described the knowledge, skills and ethics that learners would acquire when finishing the FET training phase (DoE, 2003). This prerequisite was a key change from prior curricula, which mainly highlighted the acquisition of theory (Chisholm, 2005). The CAPS was introduced in 2011. Although the fundamental ideas and curriculum content continued, the basic values of outcomes-based education (OBE) and assessment were removed. The CAPS curriculum was then implemented after observing that teachers because of challenges (DBE, 2011; Grussendorff, Booysen & Burroughs, 2014) had opposed the implementation of the prior NCS. Thus, CAPS was more content-based and moved towards traditional school science (DBE, 2011). However, continuous practical investigations and activities are emphasised in this curriculum.

Alterations in the practical components for Agricultural Sciences are some of the most clearly perceived amendments to the existing curriculum phase. The current curriculum offers a list of recommended practical activities for formal and informal assessment. According to DoE (2003), for grades 10–12 Agricultural Sciences, practical-based assessment techniques intend to determine whether learners can apply their skills in different contexts or outside the learning area. Furthermore, practically-based assessments also incorporate the practical constituents of subjects by investigating how learners place theory into practice (DoE, 2003). In addition, the Agricultural Sciences CAPS document (2011) states that each learner should be given a textbook and that the school should be equipped with a laboratory where various practical activities can be implemented. The curriculum further states that practical investigation; research projects or a practical report should be given to learners as both formal and informal assessment tasks in each term. These practical activities contribute 25 per cent to the formal assessment tasks, while controlled tests contribute 75 per cent. Practical activities can also be assessed informally using observations, discussions and practical demonstrations.

The main aim of practical activities, according to DBE (2011), is to cultivate and measure the learners' science investigative skills. Practical activities can take the form of hands-on activities or theory testing. To measure and improve these different skills, learners should be given several opportunities to accomplish all the potential practical activities in groups, individually or as part of a demonstration. At least one practical activity must be evaluated formally and recorded in grades 10 and 11. In addition, two practical activities in Grade 12 must be given to learners (DBE, 2011). Possible practical tasks that may be given to Grade 12 Agricultural Sciences learners are dissecting a chicken, and identifying various structures and functions, and extracting DNA from wheat, onions or bananas. Thus, this study looked at how the practical activities influence the acquisition of farming skills by Grade 12 learners in selected secondary schools in the Mankweng Circuit.

2.2.8 Challenges facing the proper ways of conducting practical activities at schools

Several studies have revealed that as creditable as the learning outcomes of Agricultural Sciences are, it may be difficult to attain them because of poor teaching techniques of the subject and incorrect instructions (Ikeoji, 2017, 2018). Martin and Odubiya (2011), Obi (2015), Egbule (2018) and Olaitan (2018) all stated that the curriculum learning outcomes are too wide; there is also a failure of the policy to specify the overall aim of Agricultural Sciences. Certain gaps consist of the failure to detect topics in which practical skills are to be established; poor subject delivery; and a lack of teaching aids and apparatus for incorporating practical skills (Obi, 2015; Egbule, 2018; Ikeoji, 2018; Olaitan, 2018). Egbule (2018) noted that practical agricultural activities at secondary schools are inadequate to promote the preferred level of creativity and inspiration in learners.

In addition, Giva (2006) asserted that the quality of Agricultural Sciences instruction in secondary schools was poor in Mozambique. Lack of training of teachers, inadequate resources and lack of academic support meant that teachers had to rely on teacher-centred approaches highlighting memorisation and reminiscing, instead of utilising learner-centred methods encouraging creative thinking and the acquisition of skills. This meant that learners may have been filled with more theoretical knowledge and less opportunities to acquire the skills necessary to solve real-life problems since they were not taking an active role in their education. In addition, some teachers lacked training in dealing with certain challenges posed by the organisation of schools, such as overcrowding in classes, a lack of instructional resources and gender inequalities (Giva, 2006). In Kenya, Ngesa (2006) showed that Agricultural Sciences teachers used rote learning and classroom discussion teaching methods. Conversely, demonstrations, experiments and projects were barely used. Instructional resources were directly linked to the quality of curriculum implementation. This study aimed to establish whether the practical activities implemented at selected secondary schools in the Mankweng have an effect on learner's skills acquisition.

A Government of Kenya report (2009), observed that quality knowledge and skills could not be attained and conserved if science equipment and other resources were insufficient. It recommended that all schools be supplied with sufficient facilities, instructional resources and apparatus to develop quality learning. Conversely, teachers may have been competent and well-trained, but it would have be difficult to deliver the content efficiently because of a lack of adequate instructional resources applicable to the Agricultural Sciences context (Lebala, 2016). The difficulties of insufficient instruction materials in institutions are a concern globally and may, therefore, have a negative influence on how learners acquire practical skills as there is a general lack of resources to implement practical activities. The lack of resources, for example, course books, posters, graphs and lab apparatus, encourage learners to lose focus on the discipline and, consequently, decreases their performance (Mwaba, 2011; Mwenda *et al*., 2013; Makgato & Mji, 2016;). The lack of materials stimulates an incapability to promote fruitful education because the discipline is still being taught theoretically (Makgato, 2017; Dhurumraj, 2013). In addition, lack of resources also restricts the content as teachers cannot give home activities because some learners share textbooks (Onwu, 2009).

Research conducted by Momoh (2010) on the impact of teaching materials on learner performance in West Africa concluded that material properties dramatically impact on learner achievement. Moreover, they inspire the education of theoretical concepts and opinions, and weaken rote knowledge. Several factors seem to deter teachers from conveying learner-centred tasks, such as practical activities. Lack of skills in handling learner practical activities, attitudes towards practical activities and unwillingness to become flexible are perceived as the key challenges to the implementation of learner-centred approaches (Diise, Zakaria & Mohammed, 2018). Moreover, teachers may be hesitant to change teaching practices to a more learner-centred technique of learning, based on their views, habits and experiences (Park Rogers *et al*., 2010). According to Brooks and Brooks (2019), most teachers are not trained in a practical-based learning environment and are not skilled at relating to practices such as practical activities. In addition, the number of years of being exposed to traditional classroom contexts has an effect on how teachers perceive teaching and learning. Hence, most teachers tend to view education as a practice for learners to acquire and recall knowledge, as opposed to constructing their own knowledge (Thomas, 2000; Park Rogers *et al*., 2010; Borko & Putnam, 2016; Brooks & Brooks, 2019). This may have an effect on how learners perceive the acquisition of skills and knowledge.

In addition, large class sizes makes it difficult to implement practical activities because of the large number of learners. In a practical activity, teachers should ensure that each learner has hands-on experience with the practical tools and apparatus. Teachers may find it difficult to monitor learners effectively as a result of overcrowded classrooms. Likewise, Otekunrin *et al*. (2017) identified that the main feature challenging the education of Agricultural Sciences in secondary schools of Nigeria was rote learning approaches. Moreover, insufficient teaching resources, lack of exposure to practical activities among learners and a lack of funding to implement practically-based tasks were some of the major challenges. In addition, Samuel, Fawole and Badiru (2016) identified the key issues preventing the acquisition of agricultural skills by secondary schools as a lack of interest, a lack of tools and apparatus in agricultural laboratories and a lack of school gardens. Similarly, Otekunrin, *et al*., (2017) and Samuel *et al*., (2016) identified the same issues preventing the acquisition of agricultural skills. Moreover, Darko *et al*., (2016) recognised similar constraints, such as insufficient infrastructure, a lack of instructional resources, and poorly trained and motivated teachers preventing the acquisition of Agricultural Sciences farming skills by learners.

In South Africa, Adeogun (2001) showed a direct proportional relationship between teaching resources and learner performance. The author further asserted that schools with adequate resources achieved better results than schools with fewer resources. This confirmed investigations by Babayomi (2009) that private institutions achieved better results than public institutions did, given suitable teaching and learning resources. In addition, Mwiria (2005) showed that learner achievement was influenced by the value and amount of materials in schools. The author observed that schools with available resources, such as course books, had a higher likelihood of performing well in assessments than ineffectively equipped schools. Consequently, poor acquisition of farming skills may be credited to lack of resources and apparatus at schools.

This section showed different challenges faced by both teachers and learners on the implementation of practical activities at schools. The researcher has noticed that there are many factors that hinder the proper implementation of practical activities in Agricultural Sciences as deliberated by the above literature. Factors that seemingly affect most schools were identified as poor subject delivery; and a lack of teaching aids and apparatus for incorporating practical skills (Obi, 2015; Egbule, 2018; Ikeoji, 2018; Olaitan, 2018). Based on the researchers experience in Agricultural Sciences, factors such as lack of proper trained teachers, large class sizes, poorly equipped laboratories and lack of school gardens affects many schools as showed by Samuel *et al*., (2016); Otekunrin, *et al*., (2017) and Darko *et al*., (2016). Therefore, affecting proper implementation of Agricultural Science practical activities.

2.2.9 Strategies to overcome challenges associated with the implementation of practical activities

The West African Examinations Council (WAEC) guideline (2007), demands that every school that intends to offer agriculture as part of their curriculum must have a school farm or demonstration field because they are vital for the subject. The involvement of the learner in the practical activities is an important aspect to consider in the measures to be employed to stimulate the learner interest. Uche (2005), emphasised the notion that, for the learner to develop a keen interest in practical agriculture, they must be thoroughly engaged in practical activities.

According to Ekwere, (2014), the major way of improving and enhancing the impact of practical agriculture is by addressing the problems in the sector, which include funding, where teachers are underpaid and are expected to deliver like their counterparts in other sectors. Furthermore, the provision of school farms in schools makes it very easy for teachers to supervise and inspect learners, and to also assess the tasks and learner participation (Ekwere, 2014). School farms may also benefit learners by providing an opportunity to handle equipment and practice what was taught in the classroom (Ekwere, 2014). Hence, this may enhance their practical skills and their perceptions when choosing a career related to Agricultural Sciences for sustainable agricultural practices. Teachers may also be given a chance to train, and attend seminars and workshops, to ensure that they teach learners according to the current curriculum (Tunde, 2009). This may help to activate learner interest in the subject and, thus, their acquisition of skills and knowledge.

The above literature presented strategies that may be used to overcome challenges associated with the implementation of practical activities. The researcher agrees that a school farm is very essential in schools that offer Agricultural Sciences as a subject. This is because is not costly to have and also offers learners an opportunity to work with tools and apparatus that are needed in the Agricultural industry as shown by (Ekwere, 2014). Hence, if the above strategies are implemented in schools, the acquisition of farming skills by learners may be evident by learners.

2.3 Theoretical Framework for the Study

Kolb’s experiential learning theory was used to guide this study. The experiential learning theory (ELT) is a constant perception of education constructed on a learning cycle that is asserted by the tenacity of the dual dialectics of action/reflection and experience/abstraction (Kolb, 2007). It expresses learning as a cycle in which knowledge is formed through the alteration of experience. Knowledge is formed by acquiring and converting experience (Kolb, 2007). Acquiring experience denotes the procedure of capturing data, while converting experience is how people understand and use this data. ELT recommends a constructivist theory of learning in which social knowledge is shaped and reformed, based on the knowledge of learners. In contrast, the ‘transmission’ model, where most of the present educational practice is grounded, states that predetermined ideas are transferred to learners (Kolb & Kolb, 2018).

Kolb's ELT guided the plan of this project, which incorporated the four stages of the learning cycle, namely concrete experience, reflection, conceptualisation and experimentation (Kolb, 2007). This theory was selected to guide this project because learning in this era is more advanced when the learners are exposed to real experiences, rather than in a stationary setting where data is conveyed passively. Learners want to be active participants in the learning process. This idea proposes that concrete experiences enable learners to engage in a collaborative activity, such as a practical task, and to carry out their roles (Kolb, 2007). The practical activity offers a setting for the learners to reflect on their experiences, come up with inferences and make choices regarding future behaviours (Fewster-Thuente & Batteson, 2018). Resulting from the practical activities, learners can abstract new knowledge from observations and experimentation with new behaviours (Fewster-Thuente & Batteson, 2018). Thus, this can be applied to upcoming concrete experiences, thereby finalising the phases.

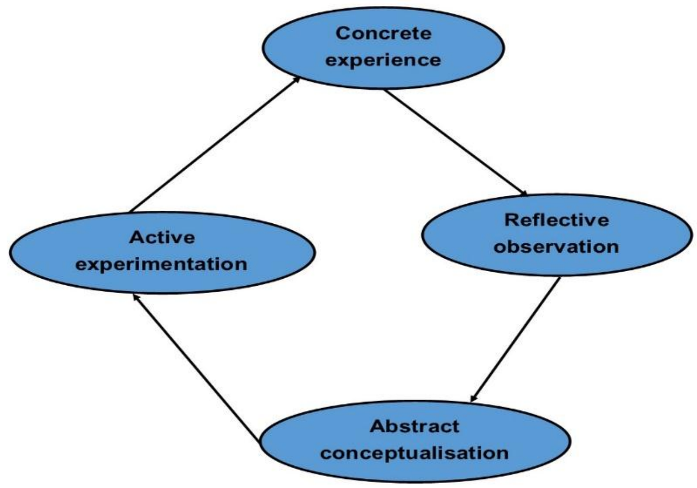

Figure 2.1: Kolb's experiential learning theory (2007)

The processes and validation underlying the study design using Kolb's theory are depicted in the ELT model illustrated in Figure 2.1. To begin with, Kolb's ELT is a powerful educational style of study that requires the learners to use the information and their abilities gained through participation in practical exercises (Kolb & Kolb, 2018). It is also critical that the learners put their new abilities to use as soon as possible. Secondly, it provides a chance to measure this precise paradigm in terms of inter-professional education (IPE) research and practice (Kolb, 2007). Finally, the changes in cognitive processes, such as metacognition, scaffolding and reflection, are at the heart of any curriculum (Kolb & Kolb, 2018). The use of case studies through participation in practical activities was constructed on the four steps of ELT and they provided justification for variations in the cognitive process, learning and behaviour when studied qualitatively. Using Kolb's ELT, data was collected in line with the four stages of the theory (Lori & Tamzin, 2018). For data analysis, the following stages of Kolb's experiential learning theory were used:

Stage 1: Concrete experience

The first stage in Kolb's ELT is to attain a concrete experience by feeling and doing (Kolb, 2007). In keeping with Kolb's ELT, learners were given a practical activity to conduct. The practical activity had a practical guide attached to it stating the objectives, apparatus, materials and methods that guided the learners on how to conduct the activity. The researcher was an observer in this case and noted down how the practical activities were conducted. Meaning that the researcher wanted to see whether the activities were conducted by the learners in line with the practical guide and, if not, what factors might have contributed to this. John Dewey emphasised the notion that, to initiate reflection and learning, the normal flow of experience must be interrupted by deep experiencing (Kolb & Kolb, 2018). In this case, Agricultural Sciences teachers provided a direct concrete experience event, which were the instructions and the clarifying of any misconceptions that learners might have had while conducting the activity. The practical activity was based on the topic: 'The structure of the alimentary canal of a chicken'. In this case, chickens were dissected by learners to show their alimentary canals. The objectives, apparatus and materials and methods on how to dissect a chicken were given to the learners, who followed in the practical guide.

Most theorists are of the opinion that all philosophies and procedures are grounded in conceptual metaphors (understanding of ideas in relation to each other) that come from practical activities (Glenberg, Gutierrez, Levin, Japuntich, & Kashak, 2004; Barsalou, 1999). Conversely to learning progresses that form knowledge principally on experiences, Vygotsky (1978) stressed that socially planned scientific theories convey intellectual growth. By scientific concepts, Vygotsky meant a belief collected from symbolic knowledge (i.e. the mental representation of objects and experiences), which is passed on from generation to generation. This simply implies that scientific thoughts are distinguishable from daily concepts taken from concrete experiences.

Stage 2: Reflective observation

The second stage in Kolb's ELT is reflective observation, which is associated with watching (Kolb, 2007). Therefore, learners processed all the information that was gathered from concrete experience on Stage 1. In keeping with Kolb's theory, the learners undertook reflection. This was done by them briefly describing what had occurred during the practical activity. Learners gave an account of their own experiences of the process of dissecting a chicken. In addition, Paulo Freire (1992) emphasised the significance of classifying people's experiences in a dialogue, stressing the practice and transformational reasoning in reflection and action. If neither action nor reflection is stressed, dialogue is impracticable. In this study, learners were given an opportunity to share their experiences through participation in dialogues since they were separated into groups during the practical activity. On the other hand, a strong experience can cause reconsideration of a rooted belief, while new ideas may restructure different ways that we experience objects. Reflection on an action can assist to correct mistakes and enhance future actions, while acting on reflections may end constant ideas.

The significance of reflection is highlighted by Boreham (1987), who asserted that learning from experience means learning from reflection on experience. A related view was held by Boud, Keogh & Walker, (1985), who created a slogan in the title of their book, *Reflection: Turning experience into learning*. A lack of reflection on experiences could learners vulnerable and they could continue to do similar errors. In this case, learners explained their understanding regarding what had occurred during the practical activity at this stage. Furthermore, learners reflected on how the practical activity helped to instil certain agricultural farming skills that they could not demonstrate before the implementation of the practical activity.

Stage 3: Abstract conceptualisation

In the third stage of the ELT, the researcher wanted to find out whether learners could make sense of what had occurred during the practical activity. When learners reached the abstract conceptualisation stage, they began to think about the experience as an abstract concept (Kolb, 2007). They focused on understanding the meaning of the experience and on explaining new concepts that might have been acquired through participation in the practical activity. Learners came up with new concepts learnt and a better understanding of the dissection process of Stage 1 of Kolb's experiential learning.

Learners were asked to think about what had transpired during the implementation of the practical activity and to attempt to explain it. This gave the teacher an idea of whether learners understood the concepts taught during practical activities.

The learners in this stage also concluded the dissection process by reflecting on their previous knowledge, from the concepts that they had experienced and deliberated on possible ideas with their group members (Kurt, 2020). In addition, learners moved from the second stage to the third stage when they were able to categorise ideas and formulate conclusions based on the events that had taken place during the practical activity. This also involved analysing the experience and creating comparisons to their existing knowledge of the concepts (Kurt, 2020).

Stage 4: Active experimentation

In the final stage of Kolb's ELT, learners can actively apply and implement the practical activities on their own (Kolb, 2007). Learners were given a task to answer the questions given in the practical guide. This task was given as a practical investigation to test learners whether they could apply the skills and knowledge that they have learnt to a new experience. This was to check whether learners could make assumptions, analyse the activity and come up with future plans for the acquired knowledge and skills (Kurt, 2020). Moreover, this helped to check whether learners could apply what they had learnt previously in the first stage of Kolb's ELT. The practical activity provided an opportunity to learners to experience real objects through the use of tools and apparatus in Agricultural Sciences. Thus, certain skills and knowledge were acquired by learners through participation in the dissection of a chicken.

2.4 Chapter Conclusion

In this chapter, we looked at how different studies are related to this study based on their research methodologies, research findings, conclusions and recommendations. The different roles, effects, challenges and strategies relating to practical activities and the acquisition of Agricultural Sciences farming skills by learners were reviewed. The theoretical framework of this research is based on Kolb's ELT since it enabled the researcher to collect and analyse data using the different steps of this learning theory.

Therefore, to conclude this chapter, the lack of Agricultural Sciences farming skills has encouraged the need for investigating and evaluating the implementation of practical activities in schools, as this influences the acquisition of farming skills by Grade 12 learners. This research project aimed to analyse the implications of practical activities on the acquisition of farming skills in various schools in the Mankweng Circuit. The next chapter takes us through the research methodology part of this study. The chapter looks at the research paradigm, approach, design, sampling method, data collection and analysis, quality criteria and ethical considerations adopted in this study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Chapter Introduction

The previous chapter took us thorough the different studies related to this study. The theoretical framework part of this research, which was based on Kolb's experiential learning theory (ELT), was also highlighted in the previous chapter. In this chapter, the overall methods, materials and tools that deal with the methodology used in conducting this research are deliberated on in detail. Therefore, the research design, data sampling methods, data collection and sample size, along with the instruments and data analysis, are thoroughly discussed. In addition, the quality criteria that ensure credibility, confirmability, transferability and dependability of the research tools and data analysis procedures, along with the ethical considerations, are also included in this chapter.

3.2 Research Approach

This research project was based on the interpretivist research paradigm because reality was understood from the views that the research participants expressed, based on their real experiences (Creswell, 2009). A qualitative research approach was used since this study attempted to comprehend the problems from the views of the research participants (Creswell, 2009). In addition, the qualitative research approach considered the experiences of research participants. Therefore, the research approach was important in this study since it considered the experiences of learners when exposed to practical activities. This ensured that the researcher understood the different behaviours and attitudes of learners when exposed to a practical method of learning compared to a theoretical one. The qualitative research approach was distinguished by the fact that it took place in a natural setting. In this context, school classrooms, laboratories and resources were used. Thus, this approach was suitable as this study attempted to comprehend the participants' behaviour as it took place naturally without exterior restrictions.

3.2.1 Research design

A qualitative case study was established to look at the experiences of actual cases functioning in actual contexts. In this study, a multiple case study research design was chosen since there was more than one case being studied. The researcher focused on each case to understand each specific case individually. According to Stake (2006), in multiple case study research the cases must be similar in certain ways. In this study, the cases were similar because they consisted of a set of teachers and learners. The schools were chosen as cases in this study because they were the actual settings that could easily be visualised by examining their functioning and their activities. After carefully studying and examining each individual case separately, the researcher was able to relate the findings to the other cases.

Qualitative knowledge of a case studies involves experiencing the tasks of the case as they take place in its own setting and specific location (Stake, 2006). In addition, the context was estimated to create the task, and also the experience and analysis of the task (Stake, 2006). The advantages emphasised by Gustafsson (2017), are that a multiple case study permits broad findings of theoretic growth and study questions. Moreover, this approach allows the researcher to acquire a profound knowledge of the explorative topic and the findings gathered from a multiple case design are valid and trustworthy (Gustafsson, 2017). Multiple case design allowed the researcher in this study to discover variations within and across the cases since comparisons could be drawn (Stake, 2006). Therefore, this research design allowed the flexibility needed for the researcher to study the practical activities and the schools as that she sought to understand how the activities were implemented in different schools.

In addition, a multiple case study research design was useful because the data collected consisted of different contexts. In this sense, each Grade 12 classroom from each school represented a case. This multiple case study consisted of acquiring the learners' opinions, attitudes and behavioural descriptions. The researcher interpreted these experiences and perspectives of learners. This was done to acquire a greater understanding and the contextual differences of the influence of practical activities on the acquisition of Agricultural Sciences farming skills. The major advantage of using this research design was that it allowed the researcher to do a cross-case analysis. Moreover, it helped the researcher to understand the differences and similarities between the three cases. Thus, this study was not just about conducting more case studies but also getting to an understanding of different contexts.

3.2.2 Sampling methods

According to Cohen, Manion and Morrison, (2018); Rahi, (2017), sampling is defined as the procedure of creating choices regarding the participants, location, contexts or activities to study. According to (Windsong, 2018), the sample size of a qualitative study is relatively small as scientists discover small amounts of various sets. Therefore in this study, three secondary schools were selected from the entire population of secondary schools in Mankweng Circuit where Agricultural Sciences was a subject taught in Grade 12. Only Grade 12 Agricultural Sciences classrooms in these three schools participated in this study because the study strove to analyse the influence of practical activities on the acquisition of Agricultural Sciences farming skills by Grade 12 learners in secondary schools in the Mankweng Circuit.

In addition, Cohen *et al*., (2018) asserted that there are two sampling techniques in inquiries, namely probability sampling and the non-probability sampling. Non-probability sampling was used in this study since it consists of convenience and purposive sampling (Cohen *et al*., 2018). This choice was made because the study targeted Agricultural Sciences learners who were not a representative of a broad population, thus, results from this study cannot be generalised.

3.2.3 Purposive sampling

McMillan and Schumacher (2010) described purposeful sampling as a sort of sampling that permits the selection of fewer groups of people who might have knowledge and information regarding the phenomenon in question. Purposive sampling was used because the research participants needed to fit the study’s purpose. Moreover, purposive sampling allowed the researcher to select participants based on the subject and the grade in relation to the significance of the study, and the main and sub research questions. This means that participants ought to be Agricultural Sciences learners who were doing Grade 12 at the time of the study. In addition, purposive sampling was adopted so as to easily access individuals who were knowledgeable about certain problems (Etikan, Musa & Alkassim, 2016). Thus, through the implementation of purposive sampling, the researcher was able to make decisions regarding the type of schools to sample.

3.2.4 Convenience sampling

According to Etikan *et al*., (2016), convenience sampling is the sampling of individuals according to their accessibility and availability. Similarly, Cohen *et al*., (2018) agreed that, in convenience sampling, researchers choose samples from the participants who are easiest to access. In this study, convenience sampling was used to recruit participants who were convenience and easily accessible for research interviews. In addition, the researcher was able to easily access the schools in the study area without incurring high travelling costs, thus making it much easier to generate data. The sample was not representative of the entire population, only of Mankweng Circuit, thus the results cannot be generalised. The selected schools are identified alphabetically using X, Y and Z.

3.2.5 Data collection

The researcher used two instruments for data collection to cover almost all the aspects of this study. In this study, the researcher gathered all the available information in order to deliver a detailed comprehension of the phenomenon being researched. Two data collection methods were incorporated to gather data. The different tools were used for data triangulation in order to verify the attainment of quality criteria in the research findings. The data was collected by using qualitative tools that included classroom observations and the participant's interviews. The qualitative approach applied to this study included interviewing the learners and lesson observations. Classroom observations were chosen for this study because they allowed the researcher to collect data directly during the lessons (Creswell, 2009). This is important because the researcher was able to witness the first-hand data within a real-life context and in a natural setting, in line with a qualitative research approach. Moreover, participant interviews were relevant to this study since learners were able to best voice their experiences without being constrained by any perspectives of the researcher or by previous research findings (Creswell, 2009). This approach was selected since the researcher was an unbiased observer who neither partook in nor impacted on this study.

3.2.6 Data collection plan

Implementation of the practical activities

The practical activities were done in the form of experiential learning. As part of data collection, the practical activities conducted included the structure of the alimentary canal of a fowl and the extraction of DNA. The activity was envisioned to show a different technique of learning. Therefore, this gave the researcher an opportunity to differentiate this technique of learning from the one previously used.

Learners' perceptions on the acquirement of Agricultural Sciences farming skills after the implementation practical activities

After the practical activities were implemented, participant interviews were conducted in each school. The aim of these interviews was to get the learners' perceptions of the practical activities and how they influenced their acquisition of Agricultural Sciences farming skills. This was achieved by getting the individual perceptions of learners regarding their experiences and opinions of the practical activities.

3.2.7 Development of research instruments

Two research instruments were used in this study, namely:

- Observation schedule (Appendix A)
- Interview schedule for learners (Appendix B)

Each instrument was informed by the research questions.

Observation schedule

An observation schedule is a method of qualitative data collection that helps investigators understand the views held by the participants under study (Creswell, 2016). According to Creswell (2016), the aim of observation is to gain an understanding of the values, the location or the societal phenomenon being studied, according to the perceptions of participants. Therefore, participant observation was chosen in this study since it gave the researcher different information that may not have been easily accessed and to familiarise herself with the different contexts in the schools. During the practical lessons, the researcher took the observing role. The observation schedule (Appendix A) measured the learning activities taking place during the practical activities and it was used for four purposes:

1. To check the learners' active participation in the activity.
2. To check the learners' interaction with the equipment and tools.
3. To check whether the higher order learning questions that instilled Agricultural Sciences skills were included in the activity.
4. To demonstrate the implications of practical activities on the acquisition of Agricultural Sciences farming skills.

Interview schedule

According to Cohen *et al*., (2018), interviews are dialogues between people that are intended to get data as a result of direct communication. Qualitative techniques in the form of interviews are assumed to deliver profound knowledge on social phenomena to a greater extent than quantitative techniques can (Gill, Treasure & Chadwick, 2008). In this study, an interview schedule was developed to get learner's perceptions on the practical activities conducted and to find out whether participation in these activities improved their acquisition of Agricultural Sciences farming skills. The interview questions were developed based on the reviewed literature and the purpose of the study. All the Grade 12 learners who participated in the practical activities were interviewed using an interview schedule (Appendix B).

The study consisted of semi-structured interviews in which open-ended questions were included. The semi-structured interviews were used because they provide flexibility in gathering data and allow researchers to ask questions based on the participant's views during the interviews (Mahati-Shamir, Neimeyer & Pitccho-Prelorentzos, 2021). The researcher was able to ask further questions according to what participants said during the interviews, since the interviews were semi-structured. Open-ended questions were used because they allowed the learners to provide responses in their own words without having predetermined answers**.** Moreover, they allowed the researcher to take a universal and inclusive look at the issues related to the implementation of practical activities, since open-ended questions permit participants to deliver more of their perceptions and views, thus, making the data more diverse than would be the case with closed-questions.

In addition, Boyce and Neale (2006) viewed a detailed interview as a qualitative research method involving conducting one-on-one interviews with a few individuals to discover their perceptions of a specific thought or context. These interviews are beneficial to the studying of in-depth information regarding an individual's ideas and actions or when one wants to discover new problems in detail (Boyce & Neale, 2006). The learners were interviewed individually to permit them to express themselves easily. All the learners who participated in the practical activities were interviewed since they all fitted the purpose of the study.

The individual interviews were also selected because they offer a more comfortable environment for data collection. Therefore, the researcher interviewed all of the participants individually to avoid bias and to get real-life experiences from the learners' point of view. By conducting the interviews, the researcher was able to comprehend the learners' thoughts regarding being educated using practical activities and whether these activities had an effect on their acquisition of farming skills. Interviews were tape recorded and replayed later for data analysis.

Description of research participants

The research participants in this study were Grade 12 Agricultural Sciences learners. All the learners from the three schools were allowed to participate in the two practical activities and they were observed and interviewed later. School X had 50 Agricultural Sciences learners in Grade 12, with 31 females and 19 males. Whilst school Y consisted of 35 Agricultural Sciences learners, with 21 females and 14 males. The last school, which is school Z had 21 Agricultural Sciences learners consisting of 12 males and 9 females. In addition, the age range of the learners in the three selected schools was from 17-20 years. Learners were grouped differently in each school during the implementation of the practical activities and the detailed description is given in Chapter 4.

3.2.8 Data analysis

According to Saldana (2016), a code in a qualitative research is often a term or a small expression that symbolically assigns a collective or suggestive characteristic to verbal or visual information. Collection of data may comprise of interview records and participant observation. Therefore, the individual interviews were grouped into similar views and each view was assigned a code. According to Braun and Clarke (2012), codes are helpful to classify and assign labels to a piece of information that is significant in answering research questions. In this study, coding was done at all the levels of meaning. In addition, the codes helped to look outside of the individual's ideas and provided an analysis of the data collected (Braun & Clarke, 2012).

In this study, a thematic analysis was used to examine the data collected in relation to Kolb's ELT. According to Braun and Clarke (2012), thematic analyses is a technique for analytically classifying, establishing and providing insights into themes across a set of data. Furthermore, it gives the researcher an opportunity to understand and create a logic of the shared ideas and behaviours. This analysis helped to recognise, analyse and report meanings across the data. Each theme was informed by Kolb's experiential learning cycle, thus, allowing the study to be categorised into the four stages mentioned in the role of theory. This analysis was chosen because of its accessibility and flexibility, and because it allowed the researcher to focus on the data using several diverse techniques.

In addition, a case analysis was done for each case and was followed by a cross-case analysis. Cross-case analysis, according to Stake (2006), helps the researcher to understand the variations and similarities between the cases in order to deliberate statements about the phenomena in question. Themes were compared between the cases, along with the research questions. Therefore, data was transcribed and organised into themes. Those transcripts were written down to find out what was common across all the cases (Thomas, 2003).

3.3 Quality Criteria

According to Hadi and Closs, (2016), quality criteria in qualitative research must be examined to ensure the quality and validity of the findings of the study. Quality criteria ensure the distinctiveness of the study and the individual's trust that the results are reliable (Noble & Smith, 2015). Furthermore, the findings depend on the accessibility of detailed and relevant data (Noble & Smith, 2015). To ensure that quality criteria were met, procedures and tools used to collect data were planned and then verified by professionals, including the teachers and supervisors (Hadi & Closs, 2016). Therefore, the interview schedules were established and accredited by experts in Agricultural Science education. Those experts verified the relevancy and the quality of the research interviews to be answered by research participants. Thus, the interview questions were submitted to the ethical clearance committee of the University of Limpopo (TREC). Within qualitative research, credibility, confirmability, transferability and dependability are to be ensured throughout the study (Anney, 2014).

3.3.1 Credibility

Anney (2014) describes credibility as an assurance that can be used to verify the truthfulness of research findings. To ensure the credibility of research findings, the data was triangulated. The triangulation principle was sustained by the use semi-structured interviews, individual interviews and open-ended questions (Farquhar, 2012). According to Farquhar (2012), data triangulation involves the collection of data from diverse sources. Moreover, the author asserts that triangulation is an important theory in a research that involves case studies. Similarly, Marshall and Rossman (2011) assert that triangulation is the action of conveying diverse sources of data in a single study**.** To achieve this, All the learners from each secondary school were interviewed. In cases where bias is unavoidable, this was visibly specified since conforming credibility is a significant factor in creating consistency (Lincoln & Guba, 2004). Thus, testing for the trustworthiness of the results from different sources is critical.

3.3.2 Confirmability

Confirmability is described as the extent to which findings in a research can be confirmed (Anney, 2014). Confirmability in this study was ensured by conducting individual semi-structured interviews, meaning that triangulation was also applied to confirm research results in this study. In addition, to establish confirmability, an audit trail that pinpoints all stages of data analysis to be made in delivering a validation on any decision made was conducted (Lincoln & Guba, 2004). This aided in ensuring that the research results precisely depict participant's responses.

3.3.3 Dependability

According to Cohen, Manion and Morrison (2018), dependability is regarded as offering precise and direct data in qualitative research. This was achieved by ensuring that all participants from each school were appropriate for the purpose of the study. Moreover, proof of data collected from interviews and observations was provided. Similarly, according to McMillan and Schumacher (2010), dependability measures the consistency of research results and the degree to which the research methods can be documented. To establish this, the researcher used a review audit that required a person outside the study to evaluate and inspect the research methods and data analysis. This confirmed the consistency of the results and the usefulness thereof. Hence, the interview questions were organised in an explicit and clear manner, using a language that can be understood by all the participants and those outside of the study (McMillan & Schumacher, 2010).

3.3.4 Transferability

Transferability measured the extent to which the research findings can be generalised and transmitted to other settings or contexts (Cohen, Manon & Morrison, 2018). The researcher used detailed descriptions of the results to indicate that research findings can be applied to other contexts. Moreover, the multiple case study design ensured that the data collected from participants involved in the study was taken from different contexts (Brink, 2018). Therefore, this chapter outlined a detailed sequential description of how data was sampled, collected and analysed. The research findings may be replicated for future use since detailed descriptions may be accessed when possible.

3.4 Ethical Considerations

Ethical considerations are of significance, particularly when animals and people are involved in a study (Dooly, Moore and Vallejo, 2017). The authors defined ethical considerations as ethics that protect an individual's behaviour during data collection. These ethics comprise of participant's confidentiality, informed consent and privacy since they may stop any transgressions from taking place during data collection. In this study, the researcher got permission to conduct the study by obtaining a clearance certificate from the Turfloop Research Ethics Committee (TREC) of the University of Limpopo. Thereafter, permission to conduct the study was granted by the Limpopo Department of Education committee. This was followed by sending letters to the school principals of the three selected schools involved, to request for approval to conduct this study.

Informed consent is a procedure in which an individual chooses whether or not to take part in the study after being informed about all features that may have an influence on their choice (Kara & Pickering, 2017). In this study, informed consent forms were given to the learners to obtain permission to interview them. In cases where some learners were minors, a parental consent form was included. The researcher considered confidentiality by not displaying and disclosing the names and the faces of the learners during the interviews. Furthermore, the daily processes of teaching and learning at the schools were not disturbed. In addition to ensuring confidentiality, any personally identifiable information was kept safe and those personal identifiers were removed from the study documents as soon as possible to protect sensitive information.

To mitigate any risk or harm associated with the study, learners were given an opportunity to withdraw from the interviews whenever they felt emotionally or psychologically unfit to continue. In addition, the research design was amended when any part of the design could cause any harm to the learners and adequate information was provided during informed consent and debriefing. Before granting an ethical clearance certificate, the University of Limpopo School of Education committee looked at the study procedures and instruments to ensure that they would not harm research participants in anyway.

3.5 Chapter Conclusion

In this chapter we looked at the different aspects of research methodology in detail. A thorough discussion of the research approach adopted in this study was undertaken. This then influenced the research design, sampling methods and data collection instruments, as they should be in line with a qualitative research approach. For the analysis of data, codes and themes were used as informed by Kolb’s ELT. In addition, the quality criteria aspects of qualitative research were followed, as outlined, and all the steps were followed to ensure that the relevant ethical considerations were adhered to. The next chapter will take us through the results and discussion of this study. Therefore, the detailed research findings of this study, along with discussions about those findings, looking at the different relevant literature, will be given.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Chapter Introduction

In this chapter, the focus is on the presentation of findings from the main research question. Furthermore, this study included complementary sub-research questions that assisted the researcher to respond to the main research question. The sub-research questions are: ‘How do practical activities influence the acquisition of farming skills by Grade 12 Agricultural Sciences learners at selected secondary schools in Mankweng Circuit?’; ‘What are the implications of practical activities on the acquisition of farming skills by Grade 12 Agricultural Science learners?’ and, ‘What are the learners’ perceptions on the practical activities of Agricultural Sciences?’

In the first part of data presentation the researcher will start by describing the classroom context where the practical activities were conducted in each case. Thereafter, a description of how the first practical activity was conducted is given, followed by a description of the second practical activity. Interpretation of results was done for each case. The second part of data presentation looks at the individual interviews that were conducted with learners after they had participated in the practical activities. The researcher grouped responses of the learners from each case into similar views by using codes. The last part of this chapter presents a discussion of the results. This was done by firstly addressing the first sub-research question, followed by the second sub-research question and, lastly, by the third sub-research question. The sub-research questions are addressed in accordance with the steps in Kolb’s experiential learning theory (ELT) and relevant literature is used in the discussion of research findings.

4.2 Data Presentation

Data are presented for each case separately. Descriptions for each classroom context where the practical activities where conducted are given in detail for each case. This is followed by discussions on how the first and the second practical activities were conducted for each case. The first practical activity for all the three cases was presented under the discipline of Animal Sciences. For this practical activity, learners dissected chickens and had a practical view of the alimentary canal and digestion of a fowl. The second practical activity was on the topic of genetics. Schools X and Z conducted a practical activity on monohybrid and dihybrid crosses. Red and white beads were used for genetic crosses. School Y, on the other, hand conducted the second practical activity on the extraction of DNA from onions. The main reasons for having DNA extraction and monohybrid and dihybrid crosses in the second practical activity was lack of resources and knowledge from the teachers. The DNA extraction practical was recommended from the CAPS document, but instead teachers from school X and Z opted for monohybrid and dihybrid crosses since it was easier and more accessible to them.

The last part of data presentation for each case deals with the individual interviews. This is where the researcher wanted to check the learner's perceptions of the practical activities. Codes were assigned to learners for the interpretation and analyses of responses given.

4.2.1 Description of the classroom for school X

School X is a public secondary school located in Mankweng. The school falls within the Capricorn South District in Limpopo. It has only one teacher who offers Grade 12 Agricultural Sciences. The classroom is fairly large, with 50 Agricultural Sciences Grade 12 learners. The females outnumbered males by 12, with 31 females and 19 males. None of the learners showed any disabilities and the classroom was inclusive of all cultures and religions. The classroom's atmosphere was slightly negative, with only a few learners actively participating during the practical activities. The classroom experienced many interruptions and had only a few teaching and learning materials. The classroom had a chalkboard fixed on the wall, chalk and few Agricultural Sciences textbooks as resources used for teaching and learning. The school did not have a laboratory in which to conduct laboratory practical activities, or a library as a source of information or for study purposes. Since the learners were many and there was no hall or a bigger space that could accommodate all of them, the practical activities had to be conducted outdoors (outside the classroom but inside the school yard).

Agricultural Sciences was taught four times per week for 55 minutes per lesson in this school. The disruptions typically included talking during the demonstrations of the practical, learners entering late, some learners showing confusion and the teacher answering cell phone calls during the lesson. The school yard where learners conducted the practical activities was not clean and not a conducive place for them to learn because there was a large number of learners and it was dirty, littered with paper on the ground. Therefore, some learners were not able to participate effectively when conducting the practical activities. The school yard was not adequately organised, with tables and chairs arranged in groups. Some learners showed a little confusion, while others were interactive. Thus, some learners were unresponsive when asked questions, meaning that they misunderstood some of the concepts taught. Even when the teacher highlighted some of the misconceptions, learners remained silent and confused. Learners were grouped into five groups when conducting the practical activities, meaning that each group consisted of 10 members.

Interpretation of the classroom for school X

From the classroom description of school X, it can be seen that the Agricultural Sciences classroom is overcrowded, with 50 learners, meaning that the classroom is not conducive for learners to learn Agricultural Sciences effectively. This is because it was not well ventilated, the atmosphere was slightly negative and only a few learners actively participated during the practical activities. In addition, there were many interruptions and only a few teaching and learning materials were available. This indicates that the classroom is used for teaching using a teacher-centred approach, which is the traditional method of teaching. The teacher was not able to move around and interact with learners because of congestion in the classroom. Learners in this classroom were passive participants and learning did not deviate from their own needs and interest. Learners mostly remained confused and ended up not comprehending concepts because of the many interruptions that occurred during lessons. The school did not have a laboratory, which made it difficult to conduct laboratory practical activities.

Practical activity 1

Topic: Animal science: Alimentary canal and digestion

- Objectives of the practical activity

1. To have a closer practical view of the fowl's digestive system
2. To measure the specific organs of the digestive tract
3. Determine the pH of some contents of certain organs
4. Answer questions based on some parts placed on the tables as you move from station to station

- Materials and method

Five chickens, knife, ruler, school tables, newspaper

The practical activity was conducted by 50 learners who were grouped into five groups, meaning that each group consisted of 10 members. Each group selected two group leaders, the one to hold the chicken for dissection and the other to dissect it. Most of the girls did not want to hold or dissect the chickens, since they were afraid that it might hurt them and also did not want to get dirty because of the blood. Therefore the boys ended up volunteering, meaning that two boys were chosen from each group as group leaders. This was done since the five chickens were still alive and needed to be slaughtered. The practical activity started when the teacher instructed learners on what to do as written in the practical guide. The teacher called the first group to come forward and demonstrated to them on how to dissect the chicken properly. The first group listened as the teacher instructed them on what to do and the other groups had to observe. The first group demonstrated the dissection process step by step in accordance to the teacher's instructions.

The four remaining groups had to dissect their chicken without any instructions from the teacher and had to read through the practical guide. The groups dissected the chickens along the back in the mid-ventral vein using a knife. This was done to reveal the internal organs of the chicken and to be able to pull out the alimentary canal. The head and feathers were still intact when this process was done. Learners were able to observe the internal structure of the alimentary canal after pulling it from the body of the chicken.

The rest of the body that was not a part of the practical was put aside so that learners could focus more on the alimentary canal.

The school tables were used to place the alimentary canal on and newspapers were used as trays to carry the organ since the learners did not want to damage the school tables with blood. A ruler was used to measure the different sizes of the certain organs. For the first part of the activity, learners had to describe the shape of the beak. This was done by touching it and pressing it in order to explain how it felt. In the second part of the activity, learners had to describe the contents of the crops and differentiate between the oesophagus and the trachea. This was done by making a simple drawing of the oesophagus and trachea, and explaining each structure and its importance in relation to its function. Learners used a ruler to measure the oesophagus from the mouth to the crop in centimetres. The third part of the activity was to describe the inner lining of the proventriculus and determining its pH secretion. In this case, the pH secretion of the proventriculus could not be determined since the school did not have a laboratory or a pH meter.

The fourth part of the activity was to determine the outer wall of the gizzard, stating its relationship to digestion. The inner membrane of the gizzard was also described by feeling its texture and also relating it to digestion in fowls. The content of the gizzard was also described. The fifth part of the activity was to measure the length of the small intestine from the gizzard to the point where the bile duct joins the small intestines and also from the gizzard to the large intestines. Learners had to describe the chyme found in the small intestines. Learners were not able to determine the pH content of small intestines because there was no litmus paper or pH meter available. The sixth part of the activity was to measure the length of the large intestine. This was done by measuring the length of the caecum and rectum up to the base of the cloaca and tracing the route of the egg as it moves out of the body. Learners used their findings to explain why the cloaca is called a urogenital opening.

During the process of dissection, when identifying and describing the organs in the alimentary canal, some of the learners could not participate in their groups because the groups were too large and only a few tables were provided. Therefore, some learners were far away and could not see what was happening nor conduct certain parts of the practical. Nonetheless, most learners were able to interact and handle the knife and chickens well as instructed. Moreover, learners were able to work collaboratively in their groups and shared their thoughts, ideas and opinions with their fellow group mates.

Figure 4.1: Teacher demonstrating to learners on how to dissect the chicken properly

The dissection was conducted outdoors, on tables with trays and newspapers being used as apparatus to hold the chickens. The learners in their groups paid close attention on how a chicken is dissected, as demonstrated by the teacher.

Figure 4.2: Learners writing down their observations of the alimentary

Measurements of the small and large intestines were done to compare their sizes and it was found that the small intestine was longer in size in comparison to the large intestine.

Interpretation of the first practical activity for school X

Because there was no laboratory at the school, the practical activity was conducted outdoors. This was possible because the practical did not require many laboratory equipment or apparatus. Therefore, alternative measures were used to dissect the chickens and execute the practical activity as intended. The practical activity had four objectives to be achieved and, while the third objective could not be achieved, the first, second and fourth objectives were successfully achieved. The pH content of the organs (i.e., small intestines, secretions of the proventriculus) could not be determined because the school did not have pH indicators such as litmus paper or a pH meter. This indicates that certain skills that the practical activity aimed to instil in the learners were compromised and that the practical activity was not executed effectively as stipulated from the Agricultural Sciences Curriculum and Assessment Policy Statement (CAPS) document.

Practical activity 2

Topic: Genetics: Monohybrid and dihybrid crosses

Hypothesis: When the allele combination of the parents is known then the genotypic and phenotypic ratios of the generation (F1) can be predicted

Aim: To show that alleles for a particular characteristic can combine in a monohybrid cross

- Materials and method

  30 red coloured beads, 20 white clear beads, 5 reusable putty packs (Prestick), 10 beakers

The practical activity was conducted in the school hall since there was no laboratory at the school. The practical was conducted by 50 learners who were grouped into groups of 10 members per group. Therefore, a total of five groups of learners conducted the practical activity. Each group selected a group leader and one member to read out the guide and record the findings. The first crossing, A, was of homozygous parents. Learners started by setting up crossings using beads (red and white) to study allele combination for a monohybrid cross. The assumption was that red (R) is dominant over white (r). Three beakers were set up by learners, side by side for each group. Ten red beads were placed in the first beaker, which represented the sperm cells. Another set of ten white beads were placed in another beaker, which represented the egg cells. One bead was then removed from each beaker. These beads represented alleles. Reusable putty was used to attach the two beads together and they were placed in the third beaker. This is where fertilisation took place and an offspring was formed. These steps were repeated until all the beads were used. The phenotypic ratio of the offspring in the third beaker (F1 generation) was then recorded.

The second crossing B, was that of a homozygous parent crossed with a heterozygous parent. Each group of learners had to set four beakers side by side. Twenty red beads, representing the sperm cells, were placed in the first beaker. Ten red beads and 10 white beads, representing the egg cells, were placed in the second beaker. The beads in the second beaker were then mixed well. Learners took one bead from the first beaker and one from the second beaker, without looking at them. The learners had to check the beads and paste them together using reusable putty. If both the beads were red, they were placed in beaker three and if one bead was red and the other one white, they were placed in beaker four. The pairs of beads in beakers three and four represented the possible allele combinations of the offspring. These steps were repeated until all the beads were used and the number of offspring in beakers three and four was recorded. The phenotypic and genotypic ratio of the offspring in beakers three and four were recorded, which represented the F1 generation.

The third crossing C, was that of a heterozygous parent crossed with the heterozygous parent. Each group of learners had to set up five beakers side by side. Ten red beads (alleles) and ten white beads (alleles) were placed in the first beaker and also in the second beaker. The beads were mixed thoroughly in each beaker. Learners had to take a bead, representing an allele, from the first and second beakers, without looking. Learners then had to paste the beads together with reusable putty. If both beads were red, they were placed in the third beaker, if one bead was red and the other was white, they were placed in the fourth beaker, and if both were white, they were placed in the fifth beaker. These steps were repeated until all the beads were used and the number of offspring was recorded in the beakers three, four and five. The genotypic and phenotypic ratios of the offspring in beakers three, four and five were then recorded, which represented the F1 generation.

Because of the large number of groups and learners, the apparatus had to circulate from one group to the other in order to accommodate everyone. The teacher was more hands on in demonstrating to the learners how the practical was done. Some learners interacted with each other and the apparatus well, while others were not able to participate effectively because of the large number of learners in each group. Some learners were able to pose questions to their teacher when they experienced difficulties. All the give groups of learners ended up having different offspring types for each crossing.

Interpretation of the second practical activity for school X

The second practical activity undertaken at school X was about monohybrid and dihybrid crosses using red and white coloured beads. The main aim of the practical activity was to show that alleles for a particular characteristic can combine in a monohybrid cross. Learners conducted this practical activity in groups of 10 members inside the school hall. The first crossing, A, of homozygous parents resulted in the fertilisation of offspring. The genotypic ratio of the offspring, which is the F1 generation, was then recorded. The genotypic ratio of the F1 generation was 10Rr. The second crossing, B, of a homozygous parent crossed with a heterozygous parent resulted in the formation of different offspring. The genotypic ratios of the F1 generation from crossing B were 10RR and 10Rr. The last crossing, C, was that of a heterozygous parent crossed with the heterozygous parent. The genotypic ratios of the F1 generation from crossing C were 5RR, 10Rr and 5rr. The results of the findings by learners supported the hypothesis and showed that if the allele combination of the parents is known then the genotypic and phenotypic ratios of the F1 generation can be predicted. The challenge encountered by learners during the practical was that there was a lack of apparatus and materials to accommodate them all at the same time because the beads, reusable putty and beakers had to circulate among the groups. Moreover, some learners were not able to participate effectively because of the large number of learners in per group. Nonetheless, the main aim of the practical activity was achieved.

4.2.2 Presentation of data for school Y

This section deals with the presentation of data gathered from school Y. The researcher begins by providing the classroom description of school Y and a brief description of school Y. Furthermore, descriptions of the practical activities carried out and an analysis of what transpired during the lesson are presented for school Y.

Description of the classroom for school Y

School Y is a public secondary school located in Mankweng. The school falls within the Capricorn South District in Limpopo. The school has only one teacher offering Grade 12 Agricultural Sciences. The classroom has a total number of 35 Agricultural Sciences learners. The females outnumbered males by 7, 21 females and 14 males. None of the learners showed any disabilities and the classroom was inclusive of all cultures and religions. The classroom's atmosphere was positive, with most learners actively participating during the lessons. The classroom had fewer interruptions and the teaching and learning materials were adequate to conduct the practical activity. Agricultural Sciences was taught five times per week for 45 minutes per day. The school was well equipped with a laboratory, where learners could conduct their practical activities. Therefore, the two practical activities were conducted in the laboratory. The classroom had a white board fixed to the wall and coloured markers, and all the learners had an Agricultural Sciences textbook. The materials and apparatus found in laboratory prior the implementation of practical activities included microscopes, test tubes, beakers, a magnifying glass and a pH meter.

The classroom disruptions typically included talking during the lessons and learners entering the classroom late. The classroom was well ventilated, with sufficient air coming in, and there was little to no litter on the floor. Moreover, the teacher showed thorough preparation for some of the lessons observed, since he went an extra mile in designing learning activities and did not rely on the textbook as the only source of information for learning. The classroom was adequately organised, with the tables and chairs arranged in rows and learners seated in pairs sharing a table. Each learner had their own chair. Learners from second Y were cooperative, interactive and energetic. They felt free to pose questions to the teacher and were disciplined. Therefore, this gave the perception that the classroom was conducive to the teaching and learning of Agricultural Sciences. Learners had to conduct the practical activities in pairs, since the laboratory apparatus and materials were insufficient to cater for all of them. This resulted with a total of 17 groups of learners conducting the practical activities.

Interpretation of data for classroom description in school Y

From the above classroom description of school Y, it can be seen that the Agricultural Sciences classroom has a fair number of learners, 35 in total. This simply means that the classroom could be conducive to the teaching and learning of Agricultural Sciences, if properly managed. Because the classroom was well ventilated, the atmosphere was observed to be positive, and many learners actively participated during the practical activities. In addition, there were fewer interruptions and the classroom, along with the laboratory, had adequate teaching and learning materials available to effectively execute the practical activity. This simply indicates that the classroom was learner-centred since the learners actively participated. The teacher was able to move around and interact with learners and the learners are active participants since their learning emerged from their own needs and interests. The school laboratory made it easy to conduct laboratory practical activities.

Practical activity 1

Topic: Animal science: Alimentary canal and digestion

Objectives of the practical activity

1. To have a closer practical view of the fowl's digestive system
2. To measure the specific organs of the digestive tract
3. Determine the pH of some contents of certain organs
4. Answer questions based on some parts placed on the tables as you move from station to station

- Materials and method

  Two chickens, knife, measuring tape, scissors, tray, gloves, water

The practical activity was conducted by 35 learners who were grouped into 17 groups, meaning that the learners had to conduct the practical activity in pairs. The first chicken was dissected by the teacher. This was done to demonstrate to learners the whole dissection process and how to effectively do it, as informed by the practical guide. Learners had to observe the teacher, take important notes, where necessary, and listen to the teacher as she explained the different steps involved in executing the practical activity. Learners had to volunteer to dissect and hold the second chicken. Several learners volunteered to do that part, but the teacher chose one boy and one girl. The two learners started by putting gloves on; preparing and rinsing the dissection equipment; dissecting and rinsing the chicken with water; and then placing it on the dissecting tray. Other learners had to observe the skin of the chicken and noted down their observations. They had to explain what the skin looked and felt like by touching it. Thereafter the chicken was cut through the keel (the centre of a chicken breast) in the midventral line to reveal the internal organs, as informed by the practical guide. A girl held the chicken as a boy cut it at the back, in the midventral vein, using a knife. A pair of scissors was used to reveal the internal organs of the chicken and to remove the alimentary canal, as it was difficult to see the organs clearly when cut only using a knife . The head and feathers were still intact when this process was done. Learners were able to observe the internal structures of the alimentary canal after pulling it out of the body of the chicken. The part of the body that was not used during the practical was put aside so that learners could focus on the alimentary canal.

A tray was used to hold the alimentary canal that was to be used during the practical. Learners used a ruler to measure the different sizes of the certain organs. For the first part of the activity, learners had to describe the shape of the beak. This was done by touching it and pressing it, so that they could explain how it felt. For the second part of the activity, learners had to describe the contents of the crop and differentiate between the oesophagus and the trachea. This was done by making a simple drawing of the oesophagus and trachea, and explaining each structure and its importance relative to its function. Learners used a measuring tape to measure the size of the oesophagus from the mouth to the crop in centimetres. The third part of the activity was to describe the inner lining of the proventriculus and determine its pH secretion. In this case, the pH secretion of the proventriculus was determined using a pH meter. The pH meter showed that this secretion is acidic since the pH reading was 4.8.

The fourth part of the activity was to determine the outer wall of the gizzard and to state its relationship to digestion. The inner membrane of the gizzard was also described by feeling its texture and also relating it to digestion in fowls. The contents of the gizzard were also described. The fifth part of the activity was to measure the length of the small intestine from the gizzard to the point where the bile duct joins the small intestine, and also from the gizzard to the large intestine. Learners had to describe the chyme found in the small intestine. The pH of the content of the small intestine was determined using a litmus paper. This content was determined to be slightly neutral, with a pH reading of 6.5. The sixth part of this activity was to measure the length of the large intestine. This was done by measuring the length of the caecum and rectum, up to the base of the cloaca, and tracing the route of the egg as it moved out of the body. Learners used their findings to explain why the cloaca is called a urogenital opening.

During the process of dissection, when identifying and describing the organs in the alimentary canal, all of the learners were able to participate since all of them touched and felt the different organs as instructed. This was because the laboratory provided sufficient space for learners to move freely and interact with each other in their pairs and also as a whole class. All the apparatus and equipment were handled cautiously and with care to avoid damage and injury. Moreover, learners were able to work collaboratively in pairs and share their opinions with the rest of the class.

Figure 2.3: Learners from school Y measuring the length of the small and large intestines.

This was done by measuring the length of the caecum and rectum, up to the base of the cloaca and traced the route of the egg as it moved out of the body.

Interpretation of data for the first practical activity in school Y

The practical activities were conducted in the laboratory. Learners were able to move around, discuss and ask questions during the practical. Learners also showed a lot of interest, and interacted with the apparatus and equipment used in the laboratory. The first practical activity had four objectives, all of which were successfully attained. Learners were able to dissect, feel, identify and compare the different structures found in the alimentary canal of a chicken. The pH of the contents of certain organs, e.g. secretion of the proventriculus, was acidic. This indicates that certain skills that the practical activity aimed to instil in the learners was accomplished.

Practical activity 2

Topic: Genetics: Extraction of DNA from Onion

Objectives:

1. To isolate DNA from onion tissue
2. To make observations regarding the results of the isolation
3. To study DNA

- Materials and method

  Test tube, an onion solution, pipettes, 95% ethanol

The teacher had already prepared a solution before the practical activity. This was done for each paired group and the solution was kept in a fridge for approximately a day before it was dispensed in the test tubes. The solution was made from an onion that was treated with salt, purified water and dishwashing soap. Learners were grouped in pairs to conduct the practical activity. They started by adding cold alcohol to the test tube that had a capful of an onion solution inside. This was done to create an alcohol layer on top. The alcohol was added to the solution by mixing it into the test tube, to approximately 1 cm, and adding the onion solution. The DNA was observed to be insoluble in alcohol. After the alcohol was added to the mixture, the constituents of the mixture remained in the solution, while the DNA precipitated out into the alcohol solution. The solution was left for approximately two minutes without any disturbance. Learners were able to observe the white DNA as it precipitated out into the alcohol solution and coiled onto a glass rod. The DNA had the appearance of white mucus. After completing the practical activity, learners disposed of their test solution and any unused DNA, as directed by the teacher. Learners washed their hands with soap before leaving the laboratory.

Figure 4.4: A peeled onion along the solution prepared by the teacher

The solution was prepared approximately 24 hours prior conducting the practical activity. The onions were peeled by learners in their pairs using knives.

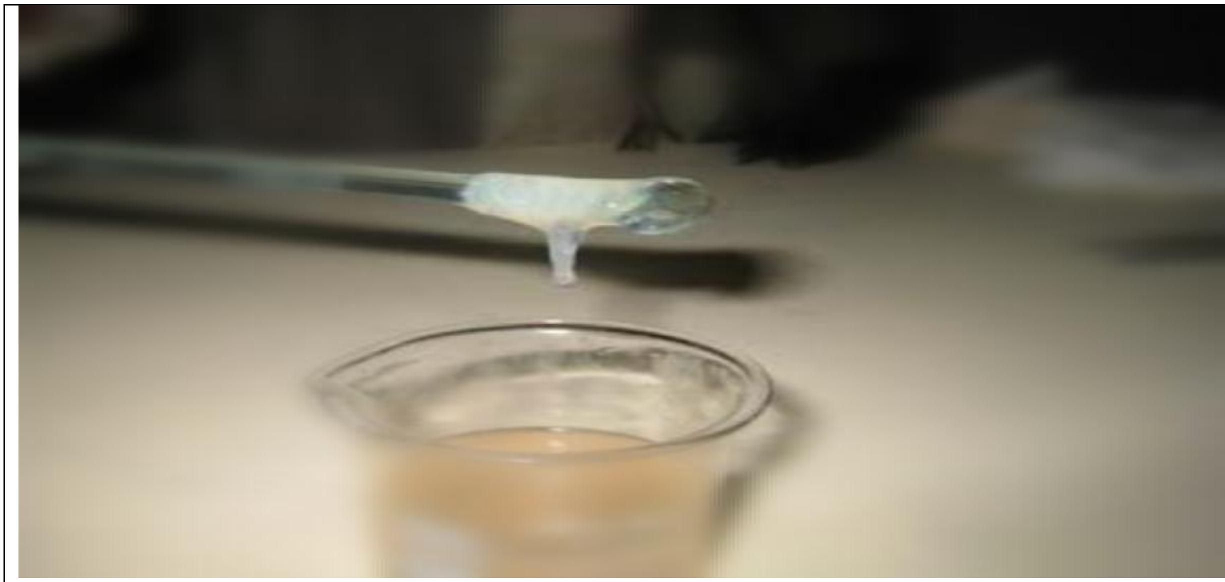

Figure 4.5: The DNA coiled onto a glass rod

This was observed after leaving the solution for approximately two minutes without any disturbance. The white DNA then precipitated out into the alcohol solution and had an appearance of white mucus.

Interpretation of data for the second practical activity in school Y

The DNA extraction practical activity in school Y was conducted in the laboratory by learners who were grouped in pairs. The teacher arranged a solution made from an onion that was treated with salt, purified water and dishwashing soap. In their groups, the learners were able to add alcohol to the test tubes that contained a mixture of the solution. Since the DNA was not soluble, it precipitated out of the alcohol layer and coiled onto a glass rod. This showed coiled DNA, which appeared as a white mucus. Learners were actively participating in the practical activity and worked well with the apparatus, as instructed by the teacher. None of the learners got hurt and all apparatus were operated with caution, therefore nothing was broken during the practical activity. Hence, learners demonstrated an ability to operate laboratory equipment and apparatus and to achieve the objectives that were set on the practical activity.

4.2.3 Presentation of data for school Z

This section is a presentation of data gathered from school Z. The researcher begins by providing the classroom description of school Z, followed by a brief description of school

Z. Further, a description of practical activities carried out and analysis of what transpired during the lesson follows.

Description of school Z

School Z is a public secondary school located in Mankweng. The school falls within the Capricorn South District in Limpopo. The school has only one teacher offering Grade 12 Agricultural Sciences. The classroom is fairly small, with 21 Agricultural Sciences learners. The males outnumbered females by 4, 12 males and 9 females. None of the learners showed any disabilities and the classroom was inclusive of all cultures and religions. The classroom’s atmosphere was slightly positive, with many learners actively participating during the lessons. The classroom had few interruptions and only a small amount of teaching and learning materials. Agricultural Sciences was taught four times per week for 55 minutes per period. The resources available in the classroom for teaching and learning included a white board fixed on the wall, coloured markers, Agricultural Sciences textbooks and a periodic table chart posted on the wall.

Classroom disruptions typically included learners talking during the lessons and entering the classroom late. The classroom was well ventilated and there was enough air coming into the room. Few to no papers littered on the floor. Moreover, the teacher showed thorough preparation for some of the lessons observed, since she went the extra mile to design learning activities and did not rely on the textbook as the only source of information for learning. The classroom was not adequately organised, with the tables and chairs arranged in rows and each learner had their own table and chair. Most of the learners were interactive and felt free to share their opinions with the rest of the class. Thus, they were responsive when asked questions. Learners had to conduct the practical activities inside the classroom since the school laboratory was not functioning well.

Interpretation of data for classroom description in school Z

The classroom description of the classroom for school Z above shows that the Agricultural Sciences classroom had a fairly small number of learners, being 21. This simply means that the classroom could be conducive to the teaching and learning of Agricultural Sciences if properly managed because it was well ventilated, the atmosphere was observed to be quite positive, with few interruptions and many learners actively participating during the practical activities. Nonetheless, the classroom had inadequate teaching and learning materials to effectively execute the practical activity, as stipulated in the CAPS document. This indicates that the classroom could be used for a learner-centred teaching approach because the teacher was able to move around and interact with the learners.

Practical activity 1

Topic: Animal science: Alimentary canal and digestion

Objectives of the practical activity

1. To have a closer practical view of the fowls digestive system
2. To measure the specific organs of the digestive tract
3. Determine the pH of some contents of certain organs
4. Answer questions based on some parts placed on the tables as you move from station to station

- Materials and methods
  Two chickens, knife, ruler, school tables, tray

The practical activity was conducted by 21 learners who were grouped into two groups, meaning that each group consisted of 10 members. Each group had its own chicken to dissect. Each group had a group leader and an assistant who helped to read out instructions from the guide. This assistant had to loudly read out the instructions so that every learner in the group could hear. Thus, the group leader, with the help with their assistant, held and dissected the chickens from the back. This was done because each group had a chicken that was still alive and needed to be slaughtered. The teacher explained to learners what was written in the practical guide and called out the first group to come forward and dissect the chicken. The chicken was then dissected from the back using a knife. Thereafter, the alimentary canal was removed and placed on a sliver tray. Following the first group, the second group did exactly as mentioned above. After removing the alimentary canal, the internal organs of the chickens were visible, while the head and feathers were still intact. The rest of the body that was not a part of the practical was put aside so that learners could focus on the alimentary canal.

The school tables were used to place the alimentary canal in a tray to hold it. A ruler was used to measure the different sizes of certain organs. For the first part of the activity, learners had to describe the shape of the beak. This was done by touching it and pressing it so that they could explain how it felt. For the second part of the activity, learners had to describe the contents of the crop and differentiate between the oesophagus and the trachea. This was done by making a simple drawing of the oesophagus and trachea and explaining each structure and its importance in relation to its function. Learners used a ruler to measure the oesophagus from the mouth to the crop in centimetres. The third part of the activity was to describe the inner lining of the proventriculus and determine its pH secretion. In this case, the pH secretion of the proventriculus could not be determined because the school did not have a laboratory or a pH meter.

The fourth part of the activity was to determine the outer wall of the gizzard, stating its relationship to digestion. The inner membrane of the gizzard was also described by feeling its texture and also relating this to digestion in fowls. The contents of the gizzard were also described. The fifth part of this activity was to measure the length of the small intestine from the gizzard to the point where the bile duct joins the small intestine and also from the gizzard to the large intestine. Learners had to describe the chyme found in the small intestine. Learners were unable to determine the pH of the content of small intestine because there was no litmus paper or a pH meter. The sixth part of the activity was to measure the length of the large intestine. This was done by measuring the length of the caecum and rectum up to the base of the cloaca, and tracing the route of the egg as it moved out of the body.

During the process of dissection, all the learners were able to identify and describe the organs in the alimentary canal, hence they actively participated in their pairs because the number of learners in the classroom was fairly small.

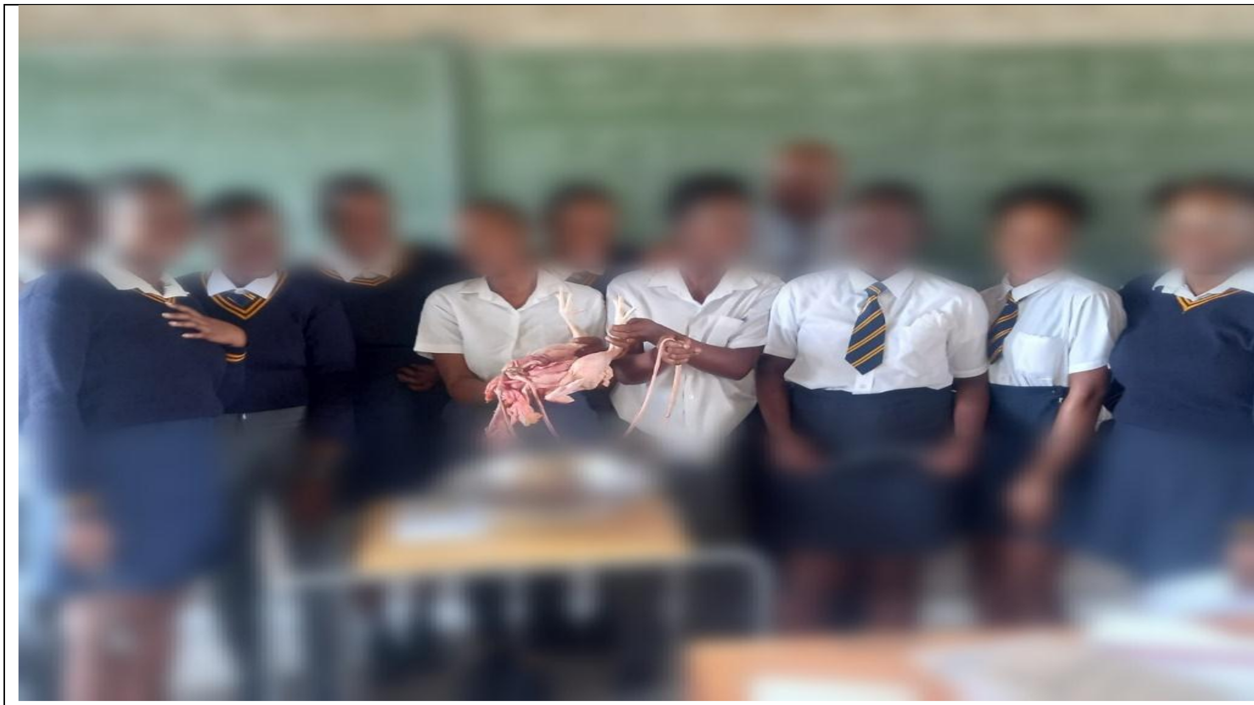

Figure 4.6: Learners showing the chicken’s alimentary canal after dissection

The chicken was cut at the back to reveal the internal structure of the alimentary canal. The other parts of chicken that were not part of the practical were put away.

Figure 4.7: Learners showing the chicken’s alimentary canal after dissection

The silver tray was used to carry the alimentary canal after being dissected out of the chicken. One learner was noting down the discussions made in their groups, as the group leader and their assistant dissected and held the chicken.

Interpretation of data for the first practical activity in school Z

The school does not have a laboratory and this made it difficult to conduct laboratory practical activities. Nonetheless, the practical activity was conducted in the classroom. This was possible because the practical did not require much laboratory equipment or apparatus. Therefore, alternative measures were used to dissect the chickens and execute the practical activity as intended. The practical activity had four objectives that had to be achieved, however, the third objective could not be achieved, while the first, second and fourth objectives were successfully achieved. The pH content of certain organs could not be determined because the school did not have a laboratory, litmus paper or a pH meter. This indicates that certain skills that the practical activity aimed to instil in the learners were compromised and that the practical activity was not executed effectively, as stipulated in the CAPS document.

Practical activity 2

Topic: Genetics: Monohybrid and Dihybrid crosses

Hypothesis: When the allele combination of the parents is known then the genotypic and phenotypic ratios of the generation (F1) can be predicted

Aim: To show that alleles for a particular characteristics can combine in a monohybrid cross

- Materials and Method
  30 red coloured beads, 20 white clear beads, 10 drinking glasses, glue stick (Prit)

The practical activity was conducted by 21 learners, who were divided into five groups consisting of four learners each. One learner was selected as a group leader, a second member helped to read the guide, while the remaining two members recorded the findings from each group. The practical was conducted in a classroom since the school laboratory was not functioning. The school lacked the apparatus needed to conduct the practical and drinking glasses were used instead of beakers. They used 30 red and 20 white coloured beads to and a glue stick was used instead of reusable putty (Prestick) to conduct the practical. Each group selected a group leader and one member to read the guide out aloud and also record the findings.

The first crossing, A, was of homozygous parents. Learners started by setting up crossings using beads (red and white) to study allele combination for a monohybrid cross. The assumption was that red (R) is dominant over white (r). Three drinking glasses were set side by side by the learners in each group. Ten red beads were placed in the first glass, which represented the sperm cells. Another set of ten white beads were placed in another glass, which represented the egg cells. One bead was then taken from each glass, each bead representing an allele. The glue stick was used to attach the two beads together and they were placed in the third glass. This is where fertilisation took place and an offspring were formed. The steps mentioned above were repeated until all the beads were used up. The phenotypic ratio of the offspring in the third glass (F1 generation) was then recorded.

The second crossing, B, was that of a homozygous parent crossed with a heterozygous parent. Each group of learners had to set four glasses up side by side. Twenty red beads, representing the sperm cells, were placed in the first glass. Ten red beads and 10 white beads, representing the egg cells, were placed in the second glass. The beads in the second glass were then mixed well. Learners took one bead from the first and one from the second glass, without looking at them. The learners had to check the beads and paste them together with the glue. If both the beads were red, they were placed in glass three and if one bead was red and the other one white, they were placed in glass four. The pairs of beads in glasses three and four represented the possible allele combinations of the offspring. These steps were repeated until all the beads were used and the numbers of offspring in glasses three and four were recorded. The phenotypic and genotypic ratios of the offspring in glasses three and four were recorded, which represented the F1 generation.

The third crossing, C, was that of a heterozygous parent crossed with the heterozygous parent. Each group of learners had to set up five glasses side by side. Ten red beads (alleles) and 10 white beads (alleles) were placed in the first glass and also in the second glass. The beads were mixed thoroughly in each glass. Learners had to take a bead, representing an allele, from the first and second glasses, without looking. Learners had to paste the beads together with glue. If both beads were red, they were placed in the third glass, if one was red and the other was white, they were placed in the fourth glass, and if both were white, they were placed in the fifth glass. The steps were repeated until all the beads were used and the number of offspring were recorded from the glasses three, four and five. The genotypic and phenotypic ratios of the offspring in glasses three, four and five were then recorded, this represented the F1 generation.

The teacher was a bit confused when demonstrating the practical activity to the learners because it was the first time that he had conducted a practical activity like this one. Nonetheless, the learners were well behaved and gave each other a chance to ask questions and helped each other when they encountered problems. All the learners from each group participated since each one was assigned a role. All the five groups of learners ended up having different offspring types for each crossing.

Interpretation of the second practical activity for school Z

The second practical activity from school Z was about monohybrid and dihybrid crosses of red and white coloured beads. The main aim of the practical activity was to show that alleles for a particular characteristic can combine in a monohybrid cross. Learners conducted this practical activity in groups of four members each in the classroom. The first crossing, A, of homozygous parents, resulted in the fertilisation of offspring. The genotypic ratio of the F1 generation was 10Rr. The second crossing, B, of a homozygous parent crossed with a heterozygous parent resulted in the formation of different offspring. The genotypic ratios of the F1 generation from crossing B were 10RR and 10Rr. The last crossing, C, was that of a heterozygous parent crossed with the heterozygous parent. The genotypic ratios of the F1 generation from crossing C were 5RR, 10Rr and 5rr. The results of the findings by learners supported the hypothesis and showed that if the allele combination of the parents is known then the genotypic and phenotypic then the ratios of the F1 generation can be predicted. The challenge encountered by learners during the practical was that the teacher was a little confused when demonstrating the practical activity to them for the first time. Nonetheless, all the learners were able to participate effectively because they were all assigned a role in their groups. The learners showed a lot of interest and willingness to execute the practical activity, thus, the aim of the practical activity was achieved.

4.2.4 Learner perceptions of the practical activities

To gather more information on the effects of practical activities on the acquisition of Agricultural Sciences farming skills, individual interviews were conducted. This section presents learner perceptions of the implemented practical activity. Learners' responses were grouped according to similar concepts and, thereafter, a code was assigned to each response. For instance, similar grouped responses from learners in school X are assigned codes XL1, XL2, XL3, XL4 and XL5. XL1, for example, simply means that the X stands for school X, the L is for learner and the 1 is for the first response. The same step was followed when assigning codes for responses in school Y and Z.

Table 4.1: Codes assigned to learners

School identification	Learner 1	Learner 2	Learner 3	Learner 4	Learner 5
School X	XL1	XL2	XL3	XL4	XL5
School Y	YL1	YL2	YL3	YL4	YL5
School Z	ZL1	ZL2	ZL3	ZL4	ZL5

1. What do you understand about Agricultural Sciences as a science subject?

Responses from school X

XL1: Agricultural Sciences is a subject that teaches us how to handle our natural environment.

XL2: It teaches us about farming and also how to understand animals and plants.

XL3: Agricultural Sciences as a science subject deals with the production and processing of food and fibre, including technologies used in soil cultivation.

XL4: It is concerned with the handling of crops and farm animals, sometimes it teaches us about making profit and maintaining households.

XL5: It is a subject that teaches us about how the agricultural industry works.

From the learners' responses in school X, learner XL2 and XL4 share the same sentiments that Agricultural Sciences is all about farming and the handling of crops and animals. While learner XL1 asserted that it is a science subject that teaches them about the handling of our natural environment and learner XL5 shared that it teaches them about the agriculture industry. These responses given by the learners are true based on the fact that Agricultural Sciences involves many disciplines, such as plant production, soil sciences, animal production and agricultural economics. Nonetheless learner XL3's response was somewhat in line with the CAP's document because it describes Agricultural Sciences as dealing with the production and processing of food and fibre, including technologies used in soil cultivation.

Responses from school Y

YL1: Agricultural Sciences teaches us more about the handling and digestion of farm animals.

YL2: It teaches us about how to handle different types of farm animals, plants and the soil and how they all respond to the environment.

YL3: Agricultural Sciences is all about farming, resources and tools used to handle livestock and plants.

YL4: It teaches us about farming method and the handling of crops, either for profit or for household needs.

YL5: This subject teaches us about farming skills and how we should treat and control farm animals. It also teaches us about how animals produce and reproduce.

From the responses of learners in school Y, it is indicated that learners perceive Agricultural Sciences as a science subject similarly. Learners YL1, YL2, YL4 and YL5 said it teaches them how to handle different types of farm animals, plants and the soil and how they all respond to the environment, while learner YL3 said it is all about farming skills, resources and tools used to handle livestock and plants. Their descriptions indicate that they perceive Agricultural Sciences as related to farming and the acquirement of skills to treat and handle crops and animals.

Responses from school Z

ZL1: Agriculture is not all about farming per se, it also give us a chance to study about science around us, which includes soil science and animal science.

ZL2: I understand that as a science subject it needs us to conduct practical and experiments so that we can learn and use the knowledge and skills to solve real problems.

ZL3: Agricultural Sciences is the science of teaching about basic farming skills, animal nutrients and animal health. In this subject we learn about how to determine different feeds and how to handle farm animals.

ZL4: Agricultural Sciences help learners to adjust to a healthier method of food production. It seeks to develop our scientific knowledge and approach to relevant agricultural sciences concepts.

ZL5: Agricultural Sciences teaches us to conserve and take care of resources without damaging our land. It is also the science of cultivating, handling and protecting farm animals in a good way so that they can grow faster.

Responses of learners from school Z indicated that they view Agricultural Sciences differently as a science subject. Learner ZL1 asserted that it is not all about farming per se, it also give us a chance to study science around us, which includes soil science and animal science. On the other hand, learners ZL2 and ZL3 view it as a subject that needs them to conduct practicals and experiments in order to use their knowledge and skills to solve real problems. While learner ZL4 asserted that it helps them to adjust to a healthier method of food production and seeks to develop their scientific knowledge and approach to relevant Agricultural Sciences concepts. In addition, learner ZL5 said that it teaches them to conserve and take care of resources without damaging our land. Their responses to this question gave the impression that they knew the importance of Agricultural Sciences and how to apply the discipline in their daily lives.

2. How often do you carry out practical activities in Agricultural Sciences?

XL: We do practical activities once a year.

All the learners from this school agreed that practical activities were carried out only once in a year. In contrast, the CAPS document clearly stipulates that practical activities must be carried at least once per quarter. The main reason for learners to conduct practical activities once in a year is that most practical activities require a laboratory or field trip. However, the school does not have a laboratory and it is rare for them to have field trip excursions.

YL: Once per quarter.

Learners from school Y asserted that practical activities are conducted once per quarter, depending on the topics and the available materials and resources to conduct them. This indicates that practical activities in school Y are conducted as stipulated in the CAPS document because at least two formal practical activities are conducted in the school.

ZL: In our entire three years of learning Agricultural Sciences, we have conducted two practical activities.

The above response from learners in school Z shows that practical activities are not conducted frequently because their school's laboratory is not well equipped with tools and apparatus for practical activities and they have never been on a field trip.

3. Do you think it is necessary for Agricultural Sciences to be taught both theoretically and practically?

Responses from school X

XL1: Yes, because practically I will be able to see what was taught and will be able to learn and understand better.

XL2: Yes, because agriculture is a subject that needs both theory and practice in order to understand it and to ensure that the things that we learn in class are also proven practically.

XL3: No, because some learners learn slow and will not understand both of them at the same time.

Learners XL1 and XL2 shared the same sentiments, namely that it is necessary for them to be taught both theoretically and practically because they think that agriculture is a subject that needs both theory and practice in order to be understood and to ensure that the concepts that they learn in class are also proven practically. However, learner XL3 disagreed with them, saying that some learners who learn slowly will not understand both of them at the same time.

Responses from school Y

YL1: Yes, to see and feel what has been taught about in the classroom.

YL2: Yes, because we understand the concepts better by experiencing the objects.

YL3: Yes, because some learners understand being taught theoretically and some practically hence both methods are suitable for learners and because seeing and doing is much better.

Responses from the learners also indicted that they all agreed that theory and practice must go hand in hand. Learner YL1 asserted that it is better for them to see and feel what has been taught in the classroom. Learners YL2 and YL3 also added that they understood the concepts better by experiencing the objects, hence both methods are suitable for them to acquire skills and knowledge.

Responses from school Z

ZL1: Yes, because when we see things practically we have a better understanding of what was taught in class.

ZL2: Yes, it is necessary because it can be applied later in our lives since we would know how to treat farm animals and make profit.

ZL3: Yes, personally I think that theory is not enough to acquire skills in Agricultural Sciences, some topics need practical; because it gives us a chance to see, feel and identify different structures.

ZL4: Yes, because as learners we learn differently, some may understand the content that was taught theoretically while others learn through practical activities.

ZL5: Yes, I think learning practically is a good way because we can see what we are talking about as compared to learning about things that we do not know or cannot see, because it will assist learners to not forget what they have done in a practical since they were exposed to it.

Learners from this school asserted that it is better to learn using both theory and practical methods. Learner ZL1 believes that when they see and feel things practically they have a better understanding of what was taught in class. Moreover, learner ZL2 thought that it is necessary because it can be applied later in their lives since they would know how to treat farm animals and make a profit. Learner ZL3 went on to add that theory alone is not enough to acquire skills in Agricultural Sciences; some topics need practical activities because it gives them a chance to see, feel and identify different structures. Responses from learners ZL4 and ZL5 showed that learners learn differently, some may understand the content taught using theoretical methods while others need practical methods to understand concepts better.

4. Do you think practical hours must be increased? Explain why

Responses from school X

XL1: Yes, because practical activities require more time for observations and to understand in greater details about what we were learning.

XL2: Yes, so that we can find more time to repeat this practical and find reliable results to correct errors that might have occurred.

XL3: Yes, because setting up the apparatus and tools takes more time, this consumes the time to actually do the practical.

XL4: Yes, because practical measurements need more time to be taken.

XL5: Because the time is too short to do the practical and to observe and also write down what you've observed, it will help us to have enough time to discuss the practical in depth and learn from each other to understand it better.

Responses of learners from school X show that they all think that the time allocated to practical activities must be increased in order for them to observe and make accurate measurements, and to set up the apparatus and tools. In addition, they need more time to discuss the practical in depth, and learn from each other to understand it better. Therefore, this can be more effective for learners to acquire the necessary skills needed in the agriculture industry.

Responses from school Y

YL1: No, it could make us to lose interest and focus if we are doing them for a long period of time.

YL2: Yes, because it enables to check your work and make accurate measurements and to observe carefully and handle the different apparatus as instructed.

YL3: Yes, it consumes more time than the time allocated for the practical activity.

YL4: Yes, for us to get an in depth explanation of the content of the practical so that we can understand better.

YL5: Yes, because some learners are slow in solving problems related to the practical activity.

Responses from learners from school Y indicated that learner YL1 does not think that it is necessary to increase the time allocated to practical activities because it could make them to lose interest and focus if done for a long period of time, while learners YL2, YL3, YL4 and YL5 said that practical time should be increased because it enables them to check their work, make accurate measurements and handle the different apparatus as instructed. Moreover, it enables them to get an in depth explanation of concepts and solve problems that may be related to the practical activity. This enables them to understand Agricultural Sciences better.

Responses from school Z

ZL1: Yes, because the actual preparation of the tools and apparatus requires more time than the actual execution of the practical.

ZL2: Yes, because it helps us to contextualize theory and makes it easy to comprehend and understand it.

ZL3: Yes, so that we can also accommodate slow learners who cannot measure and identify certain organs faster.

ZL4: Yes, because we may need more time to check our results, repeat the practical if there are mistakes and have accurate results.

ZL5: Yes, because practical activities are time consuming, we have to observe, make measurements, write down and also answer questions based on the practical guide.

Learners from school Z thought that the time allocation for practical activities must be increased and provided various reasons for this. Learner ZL1 asserted that the actual preparation of the tools and apparatus requires more time than the actual execution of the practical, while learner ZL2 asserted that an increase in time allocation would help them to contextualise theory and make it easy to comprehend and understand. Learner ZL3 thought that it will help to accommodate slow learners who cannot measure and identify certain organs faster. In addition, learners ZL4 and ZL5 asserted that it will help to repeat the practical if there are mistakes and to get accurate results through accurate measurements and answering questions correctly.

5. In which method of teaching and learning do you mostly acquire Agricultural Sciences farming skills?

Responses from school X

XL1: Through practical activity.

XL2: When we were working in groups.

XL3: Both practically and theoretically.

Learner XL1 asserted that practical activities are more helpful in acquiring skills, while learner XL3 asserted that both theoretical and practical methods of learning are helpful in acquiring skills. Learner XL2, on the other hand, said that working in groups is more helpful in acquiring skills. Therefore, their responses show that each and every learner has a different learning ability. Nonetheless, this can be catered for by teachers through incorporating several teaching methods when presenting a lesson.

Responses from school Y

YL1: Theoretically.

YL2: Practically.

The above response from learner YL2 indicated that the practical activity was more helpful for them to acquire certain Agricultural Sciences farming skills. In contrast, learner YL1 asserted that theoretical methods are more helpful to acquire certain Agricultural Sciences farming skills.

Responses from school Z

ZL1: Both practical and theory.

ZL2: Through practical.

Learner ZL1 asserted that both practical and theory are more helpful in acquiring Agricultural Sciences farming skills, while learner ZL2 agreed that practical activities are more essential. Nonetheless, practical activities were emphasised as being the most helpful method.

6. Can you elaborate on the types of farming skills that you know in Agricultural Sciences and those that you have learned during the practicals you carried out?

Responses from school X

XL1: Handling of chickens, treating of animals.

XL2: Time management and decision-making.

XL3: Organisational skills and monohybrid and dihybrid crosses.

XL4: Interpersonal skills.

XL5: Measurement and following instructions correctly.

From these responses it is clear that learners were able to acquire skills such as handling of chickens and treating of animals (XL1), time management and decision-making skills (XL2), organisational skills (XL3), interpersonal skills (XL4), measurement and following instructions correctly (XL5) from the implemented practical activities. This is an indication that more skills can be acquired by learners if they engage more in practical activities.

Responses from school Y

YL1: Handling of chickens and DNA extraction.

YL2: Determining the pH secretions of certain organs in the chicken.

YL3: Time management.

YL4: Communication skills.

The responses from learners YL1 and YL2 showed that skills on how to handle chickens and to determine pH secretions of certain organs in the alimentary canal were acquired from the first practical activity. This means that the learners are now able to participate in certain poultry farming industrial activities since they have an idea of what is happening. Learners YL3 and YL4 also acquired skills, such as time management and communication skills. These are essential skills in the agriculture industry.

Responses from School Z

ZL1: Handling of chickens.

ZL2: Identification of organs in a fowl/

ZL3: Behaviour of chickens and genetically crossing using beads.

ZL4: The type of feed and shelter to provide for chickens.

The first practical activity was essential for instilling skills such as handling of chickens, identification of organs in a fowl, behaviour of chickens and the type of feed and shelter to provide for chickens, as per learners ZL1, ZL2, ZL3 and ZL4. This indicates that the learners are now more knowledgeable about poultry farming and they can use these skills to increase the production of poultry.

7. Have you noticed any differences in your acquirement of farming skills before and after engaging in a practical activity?

Responses from school X

XL1: Yes, I can see a difference after engaging in the practical activities.

XL2: No, there’s no difference, I still feel the same.

Learner XL1 agreed that after the practical activities they saw a difference in their knowledge and acquirement of agricultural skills and wished that practical activities could be done more often. In contrast, learner XL2 said that there was no difference in their acquirement of Agricultural Science farming skills because the learner preferred being taught theoretically and not practically.

Response from school Y

YL: Yes, there is a difference, we are now able to dissect a chicken and extract DNA.

Based on the skills acquired from the practical activities, learners did assert that there was a difference in their acquirement of skills since they did not poses some of the skills prior to the implementation of the practical activities.

Response from school Z

ZL: Yes, there is a difference, we can extract DNA from beads and dissect a fowl

Responses of learners from school Z showed that the practical activities helped them to acquire skills that they could not demonstrate prior engaging in the practical activities. Such skills are mentioned below in question

8. After conducting the practical activity what are your perceptions towards Agricultural Sciences as a subject and as a career in general?

Responses from school X

XL1:. Agriculture is an important career because it teaches learners how to care for livestock because South Africa is nothing without agriculture.

XL2: Agricultural Sciences is a great subject but other chapters are unnecessary and general.

XL3: It can be a good career as there is a lot of profit and it requires labour, meaning that there are many job opportunities.

XL4: Agricultural Sciences is an interesting subject, after conducting the practical it inspires us to be farmers and it has many careers to choose from.

XL5: Agricultural Sciences is a good subject and a career. Many people don't take it serious but it can take you to different places and explore the world of farming.

Responses from the learners showed that they viewed Agricultural Sciences as being a good career because there is a lot of profit and it requires labour, meaning that there are many job opportunities, referring to learner XL3. Moreover, XL2 was a bit sceptical since the learner asserted that most of the chapters taught are unnecessary. However, learners XL1, XL3, XL4 and XL5 seemed very keen and interested to engage in Agricultural Sciences careers because they viewed our country as being nothing without agriculture since it has many careers to choose from.

Responses from school Y

YL1: Agricultural Sciences is not a good career because it makes people dirty.

YL2: It inspires us to be veterinarians and good farmers.

YL3: I want to continue learning about Agricultural Sciences because I am interested in the handling of farm animals.

YL4: The practical made me see that Agricultural Sciences is an interesting subject and a wonderful career that needs a passionate person.

YL5: Agricultural Sciences increases the production of food and job opportunities, hence it is more interesting.

The majority of learners (YL2, YL3, YL4 and YL5) agreed that the practical activities inspired them to become veterinarians and good farmers because it is an interesting subject and a good career that offers an opportunity to increase food production and job opportunities. Therefore, they want to continue learning more about Agricultural Sciences. However, learner YL1 shared a different view from the rest of them, and asserted that Agricultural Sciences is not a good career because it makes people dirty.

Responses from school Z

ZL1: It is a good career in general and it requires a lot of farming and scientific skills such as animal science and soil science.

ZL2: Agriculture is a hands-on career, it needs someone who is very active and willing to get dirty while working. It is very much interesting.

ZL3: I think it's a good career choice because I wanted to be a veterinarian and the practical helped me to know the digestion and the handling of fowls.

ZL4: It is an interesting subject, because I can know the effective ways of treating and handling farm animals so that they do not die. It does not only help you to pass in school, but It also helps us to know how to treat our plants and animals and to prevent our animals from affecting the climate.

ZL5: My teacher inspires me to become an Agricultural Sciences teacher because he makes it to be simple and understandable.

The practical activities led learners from school Z to conclude that Agricultural Sciences is a good career in general, and learner ZL1 asserted that it requires a lot of farming and scientific skills, such as animal science and soil science, while learner ZL2 saw that agriculture is a hands-on career that needs someone who is very active and willing to get dirty while working. Moreover, learners ZL3, ZL4 and ZL5 shared the same views and said that it is an interesting subject because they can know of effective ways of treating and handling farm animals so that they do not die. Learner ZL4 also added that it does not only help them to pass school, but it also helps them to know how to treat plants and animals and to prevent them from affecting the climate. Hence responses really showed how much effect the practical activities had on the learners' perceptions of Agricultural Sciences.

4.3 Discussion of Research Findings

In this section, research findings are discussed according to the research questions. The discussions take into consideration the four stages of Kolb's ELT. For the first sub-research question, the first stage of Kolb's ELT, namely concrete experience, was taken into account when discussing how the learners acquired Agricultural Sciences farming skills through the implementation of a practical activity. For the second sub-research question, the three stages of Kolb's ELT, namely reflective observation, abstract conceptualisation and active experimentation, were taken into account when discussing the implications of the practical activities on the learners. For the third sub-research question, learner's interviews were discussed according to their perceptions of the practical activity.

4.3.1 The acquisition of Agricultural Sciences farming skills by learners

This section looks at how the learners acquired Agricultural Sciences farming skills based on the types of practical activities conducted. In addition, the objectives and aims of each practical activity are essential in identifying the types of Agricultural Sciences farming skills acquired by learners.

The notion of agricultural farming skills at the secondary school level

According to Department of Basic Education (DBE) (2011), the purpose of Agricultural Sciences is to afford learners with the relevant skills and knowledge to engage in agricultural enterprises. The subject aims to increase knowledge and the acquisition of research skills by learners for the production and processing of agricultural products. Practical skills that are needed in the agriculture industry include accurate observations, conducting surveys, analysing, recording, interpreting data from surveys and entrepreneurial skills (DBE, 2011). The DBE emphasises thorough preparation to ensure that advanced skills and knowledge are attained by learners. In Grade 12, learners use their knowledge and skills of handling basic agricultural machinery, equipment and technology to meet the challenges of a wide range of problems related to agriculture (DBE, 2011). The learner should be able, independently or in groups, to hypothesize and predict problems and also find cost-effective sustainable solutions.

According to Biyela (2019), the general management skills needed to manage a farm business include analytical skills, financial management skills, leadership skills, communication and interpersonal skills. Moreover, farming skills such as problem-solving skills, decision-making skills, entrepreneurial skills and organising skills are also included in the Agricultural Sciences curriculum (Biyela, 2019). In addition, various skills that are essential to operate a farm are hand working skills, technical skills, creative thinking skills and investigative skills (Biyela, 2019).

The discussions about how learners acquire Agricultural Sciences farming skills are made taking into account the first stage of Kolb's ELT, which is concrete experience. This stage, as mentioned in Chapter Two, is associated with feeling and doing. Therefore, deliberations on how the practical activity was done and how the experience led learners to acquire certain Agricultural Sciences farming skills are made.

The acquisition of Agricultural Sciences farming skills from the first practical activity

By implementing the first practical activity, learners from the three school were able to have a closer practical view of the fowl's digestive system. This gave learners an opportunity to acquire skills on how to dissect a fowl properly without damaging the structure of the alimentary canal. When practically viewing the digestive system of the fowl, learners acquired skills by seeing, feeling and/or touching the different parts of the alimentary canal. This is in line with 'feeling' and 'doing' as stated in the first stage of Kolb's ELT (Kolb, 2007). This practical view enabled learners to classify the chicken as a non-ruminant because it did not have a fore stomach, rather the oesophagus and stomach are adapted to digest the type of food that fowls ingest.

The digestive tract is crucial in determining the ingestion, chewing, swallowing, gastric and intestinal digestion, absorption of nutrients and excretion of waste in the chicken. Therefore, the aforementioned parts are important in acquiring skills on how to handle chickens and to know the relevant type of feeds that are suitable for poultry farming in Agricultural Sciences. Learners acquired measurement skills by measuring specific organs in the digestive tract. The major reason for the measurement of the small and large intestine is to acquire skills on how nutrients are absorbed in chicken because the size and mass of the intestines differs between types of fowls (Hassouna, 2001). Therefore, this will help learners to identify the type of poultry farming to engage in, according to their own preferences.

In comparison to schools X and Z, learners from school Y acquired skills on how to determine the pH of the contents of the proventriculus and that of the small intestine. The latter had an acidic pH of 4.8, while the former had a slightly neutral pH of 6.5. The determination of the pH of the contents of these organs is imperative because it helps learners to know the well-being of the poultry and the types of feed to ingest. This is so, mainly because the pH in the digestive tract affects the overall health and growth of poultry. This is in concord with a study conducted by Rahmani, Speer & Modirsanei (2005), who concluded that the pH level in particular parts of the chicken influences the growth of microbes, affects digestibility and absorption of nutrients.

In addition, all learners who participated in the practical activity were able to answer questions based on some body parts placed on the tables as they moved from station to station. This helped learners to develop an idea of how a fowl picks up its food and how this relates to the chicken's ingestion. Learners gained knowledge about why the upper part of the beak gets cut off by commercial farmers, which is done to prevent chickens from harming one another in cases of overcrowding, forced lighting and unnatural feeding (Gandhi, 2016). This is a very essential skill for the treatment and handling of chickens in commercial farming.

From the first objective where learners a closer practical view of the fowls digestive system, they were able to acquire skills such as time management, organisational skills, interpersonal skills, following instructions correctly and decision-making skills. Hence, they were able to execute the practical activity in their groups and follow all the instructions as stated. Learners in school Y were able to achieve all the four objectives of the practical activity, in comparison to those in school X and Z. This implies that a practical activity aimed to develop one learning outcome cannot develop skills acquisition in different levels of learning (Kibirige, Maake & Mavhunga, (2014). Various studies (NAS, 2010; Abrahams and Millar, 2018) have suggested that practical activities must improve problem-solving skills, investigative skills, examination of data and additional essential skills. Findings by Kibirige and Teffo (2014), revealed that fundamental skills such as measuring, observing, analysing and preparing apparatus are significant skills in scientific subjects, which is in line with the skills acquired by learners through this practical activity.

The acquisition of Agricultural Science farming skills from the second practical activity

From the implementation of the second practical activity in school X and Z, learners were able to acquire different skills by simulating the monohybrid and dihybrid crosses of red and white coloured beads. Findings from the first crossing of homozygous parents showed an offspring with a genotypic ratio 10Rr from the F1 generation. In addition, findings from the second crossing of a homozygous parent crossed with a heterozygous parent showed a genotypic ratios of 10RR and 10Rr from the F1 generation. Lastly, the crossing of a heterozygous parent crossed with the heterozygous parent resulted in the genotypic ratios of 5RR, 10Rr and 5rr from the F1 generation. Findings by Stewart (2013), showed that some learners were unable to execute any of the procedural steps for either monohybrid or dihybrid problems, while others had no difficulty in executing the monohybrid procedural steps when conducting practical activities. Their findings corroborate the findings in this study, since some learners in school X were not even able to participate in the practical activity. Nonetheless, findings involving learners from this study support the hypothesis and showed that if the allele combination of the parents is known then the genotypic and phenotypic then the ratio of the F1 generation can be predicted.

In contrast to school X and Z, school Y conducted a practical activity based on the extraction of DNA from onions. The findings from school Y showed that learners were able to acquire skills on how to isolate DNA from onion tissue by mixing alcohol with an onion solution. This was shown when the DNA precipitated out into the alcohol layer and coiled onto a glass rod. The findings of Susantini *et al*., (2017) showed that learners acquired information from DNA extraction and that this process consists of three stages, namely extraction, purification and precipitation. Learners from school Y showed good understanding of the role of ethanol, stating that the ethanol would cause the DNA to be precipitated. Learners were also able to make observations and study the structure of a DNA after isolating it from the onion tissue. The findings are corroborated by Susantini *et al*., (2017), who showed that learners' creative thinking in designing and conducting DNA extraction data was obtained from a laboratory report.

Previous studies have reported that the teacher's understanding level could contribute to learners' misconceptions, i.e., concepts related to genetics (Altunoglu & Seker, 2015; Flores & Gallegos, 2003). This is in line with findings from this study, where the teacher in school Z showed a little confusion when demonstrating to learners how the genetic crosses are done. Thus, learners tend to memorise biological facts, a common practice by learners when learning biology because of their failure to relate the biology lesson with real life (Cimer, 2012). This simply implies that practical activities are effective to help learners to relate scientific lessons to their real life experiences. Thus, there is a need to include practical activities in order to guide learners towards a better understanding of genetics by using visual aids or by relating biology lessons to real life concepts (Awang-Kanak *et al*., 2016).

According to Demet & Ozlem, (2019) and Slavin, (2015); Tran, (2014), dividing learners into groups of four to six creates cooperative learning opportunities. This method has a positive effect on learning outcomes, increases information retention, and improves communication skills, problem-solving and creativity. Findings from this study are corroborated by these findings, since it was found that learners demonstrate better communication skills, creative thinking and problem-solving skills when they collaborate with their peers. This is also in line with a study that showed that learners who are involved in discussion and group work have a deeper understanding of the resources and increase their problem-solving skills (Davis, 2009). The processes carried out in this learning allowed learners to acquire higher order thinking skills (Chen, Lui, & Martinelli, 2017; Hwang *et al*., 2019). This is shown by the increase in the learners' ability to answer questions from the practical guide.

Remarks on the acquisition of Agricultural Sciences farming skills

Engaging in practical activities such as the dissection of the alimentary canal, genetics and DNA extraction, helps learners to acquire different skills. These skills include the identification of cultivars, describing the crop phenology, prediction of crop growth status under stress, evaluation of the effect of fertilisers and the prevention and control of agricultural diseases and pests (Fang *et al*., 2016). According to Voet *et al*., (2003), the kind of motivations offered by practical activities may contribute to the potential development of critical thinking and problem-solving skills, both highly praised on cell and molecular biology curricula. Similarly, practical activities also involve learners in data interpretation, problem solving, experimental design, scientific report writing and collaborative work, along with analysis of results and possible errors (Coil *et al*., 2010; Azer, 2013), thus, learners get first-hand contact with the professional environment, techniques and equipment.

Findings of research by Rohaida and Hidayah (2017) indicate that practical activities give learners the ability to recognise apparatus and their functions, identify parts and features of apparatus, and an understanding of the basic principles of using and handling apparatus. This indicates that learners acquire appropriate approaches to minimise standard errors during measurements and observations. Zeidan and Jayosi (2015) found that the skill of observation and predicting are easier than the other skills. In other words when learners understand the science process skills, science becomes more interesting to them, which increases their positive attitudes towards science. The challenges encountered by learners during the practical were the lack of apparatus and materials to accommodate them all at the same time. Moreover, some learners were not able to participate effectively because of the large number of learners in per group. Nonetheless, the main aim of the practical activity was achieved.

4.3.2 The implications of the practical activities

Discussions on the effects of the practical activity on the learners' Agricultural Sciences farming skills are made taking into account the second, third and fourth stages of Kolb's ELT, these are reflective observation, abstract conceptualisation and active experimentation.

Reflective observation

The practical activities helped learners to experience a practical view of the alimentary canal of a chicken, monohybrid and dihybrid crosses and the extraction of DNA from onions. The experiences made it easier for learners to understand the structure of the alimentary canal and that of a DNA. These findings are supported by Abdi (2014), who found that learners understood the concepts taught through interpretation and observation. According to Jacob (2020), it is important to develop a productive and cost-effective feeding scheme for agricultural production and to recognise problems, taking precautionary measures to correct them. A basic understanding and skills acquired through participation in the practical activities helps learners to recognise everyday situations, like a bulging crop, diseases and pests (National Institute of Food and Agriculture, 2020).

The knowledge gained from the practical activities is effective for understanding and correcting any problems that may arise. This assists in understanding the nutritive requirements of a chicken (Pestcatore, 2019). Similarly, learners acquire knowledge of how to identify cultivars, predict crop growth and prevent and control diseases and pests through genetics (Fang *et al*., 2016). This indicates that, if learners can get more exposure, they will know how to manage and handle agricultural products effectively so that they can increase production. According to Amunga *et al*. (2011), practical activities afford learners an opportunity to better acquire science concepts. The commitment to achieve objectives set in a practical activity makes learners play an active role in the learning context (Amunga *et al*., 2011). This can generate measures to the challenges of the activities incorporated in the practical. According to Lunetta *et al*., (2007), participating in scientific practical activities offers imitation experiences that make learners learn in contexts of inquiries that need sensitive conceptual and physical participation. This participation leads to an improved understanding and progression.

Most of the learners in school X and Z were not knowledgeable on how to use the apparatus and equipment, and waited for the teacher to demonstrate the activity to them. On the other hand, most learners from school Y were mostly familiar with the tools and apparatus. This showed that they were able to operate them because those apparatus were always available in the laboratory. According to Kennedy (2011), this may be caused by lack of apparatus and resources for scientific inquiries in schools. Umar and Ma'aji (2010) asserted that the accessibility of proper infrastructure develops learning by permitting learners to engage in practical activities and training continually builds their skills. Their findings also indicated that learners who were taught by participating in practical activities understood biological concepts better than those taught without incorporating practical activities into their learning. This is concord with findings of Njokwu (2010) and Obinna (2012), who perceived that learners' appropriate use of learning apparatus and practical guides influences their acquirement of skills and knowledge in science.

Abstract conceptualisation

Findings from the learners in the three selected schools showed that from the first practical activities they learnt how the process of dissection works and also had a practical view of the alimentary canal of a chicken. Moreover, learners from schools X and Z learnt how the different fertilisation processes take place using monohybrid and dihybrid crosses, while those in school Y learnt how to extract DNA from an onion. The findings on the effects of practical activities on learners' abilities to understand new concepts are in concord with Aladejana and Aderibigbe (2007) and Kibirige & Tsamago (2017). According to Johnstone and Al-Shuaili (2015), scientific investigations can supply learners with chances to be more actively involved in their activities and discover new information in order to solve complex problems since they will be learning from experiences and solving problems. Thus, scientific investigations are essential in enhancing learners' life skills and helps to improve their acquisition of farming skills. In line with this study, findings by Abrahams and Millar (2018), Aladejana and Aderibigbe

(2007) and Kibirige and Tsamago (2013) documented similar effects of participation in practical activities.

Active experimentation

In this stage, the researcher wanted to find out whether learners were able to apply and construct what they had learnt during the practical activity on their own. The findings in respect of most learners showed that they were able to apply what they had learnt in the future because they knew that the correct way to dissect a chicken, genetic crosses and to extract DNA. These results are confirmed by several studies that concluded that, in science education, learners must be given the chance to think like scientists by participating in the practice of thinking and being able to apply what was learnt (Bushman & Peacock, 2010; Gillies *et al*., 2014; Yao, 2012). Learners asserted that they were able to do the practical activities on their own since these activities were simple and did not require many apparatus and tools, meaning that if the teacher gave them an investigation or a research to perform dissection on a fowl, genetic crosses and DNA extraction with proper procedures it could done because they had been exposed to these activities.

According to Pedaste *et al*., (2015), inquiry-based learning has been highly associated with learners' higher order thinking skills training. Their findings indicated that learners who applied inquiry exhibited better higher order thinking skills and were able to apply what they had learnt. These results also corroborated the findings of Saido *et al*., (2020). Findings from their study showed that applying knowledge in the form of solving problems and hands-on activities improved learners' higher cognitive skills. The findings are also in line with those of Talisayon (2006), who established that learners showed better attitudes towards scientific disciplines when engaged in practical activities.

Remarks on the effects of the practical activities

Findings from this study on the effects of practical activities are corroborated by Hofstein and Lunetta (2004), who have shown that practical activities offer opportunities for learners to connect science concepts and theories to observations and measurements. Similarly, Heindl (2019) showed a trend towards improved learning outcomes as a result of inquiry-based learning in comparison to traditional approaches.

Furthermore, findings by Halawa *et al*., (2020) showed that learning science in accordance with guided inquiry has positive effects on learners in terms of both conceptual knowledge and procedural skills.

According to Parsons (2007), participating in practical activities provides advanced problem solving abilities. Learners are usually unenthusiastic towards extreme note-taking, the lack of learner-centred practical activities and limited opportunities for self-reliant investigations (Parsons, 2007). Therefore, learners may become critical thinkers who are able to investigate, observe and apply what they have learnt through practice. A study by Toplis and Allen (2012) showed that practical activities are essential to ensure that learners acquire an in-depth understanding when studying science in secondary schools.

Findings from this study also support the idea that 'participating in scientific inquiry needs coordination from both the knowledge and skills simultaneously' (National Research Council, 2012, p. 41). Findings from research by Olowu (2023), showed that by participating in practical activities, learners are exposed to a basic understanding of classifying objects, and observing and measuring concepts. Their findings also indicate a significant level of basic scientific knowledge in the learners resulting from scientific inquiries. This is in line with the findings of this study, since learners were able to make measurements and observations, met the specified objectives and proved the hypothesis to be true. This indicates that the practical activities indeed had an effect on the acquisition of certain Agricultural Sciences farming skills.

4.3.3 Learner's perceptions of the practical activities

Reponses from the learners indicted that they viewed Agricultural Sciences as a broad and abstract subject that requires a lot of practical skills and passion regarding farming activities. In addition, learners XL4, YL1, YL4 and ZL5 asserted that Agricultural Sciences teaches them about the handling of crops, animals and different farming systems. This is in accord with Heinert and Robert (2017), who view the subject as the art and science of rearing plants and animals. Likewise, the CAPS (2012) document asserts that Agricultural Sciences studies the link between soils, plants, animals and agricultural economics.

Almost all the learners (except YL1) from the three schools supported the notion that the allocated time to conduct practical activities and the number of times that practical activities are conducted during lessons should be increased in order for them to understand and acquire more knowledge and skills. This is in accordance with the research findings of Konadu (2016), who determined that sufficient practical activities in secondary schools were helpful to learners in order to acquire new skills and gain decent attitudes towards Agricultural Sciences. These findings were also confirmed by Saina, Kathuri, Rono and Kipsat (2012), who asserted that agriculture in secondary schools develops learners' capabilities, make them more independent and creative, and also able to solve farming problems. In addition, the CAPS document stipulates that, to measure and improve different skills in learners, they should be given several chances to accomplish all the potential practical activities separately or in groups.

Research findings from this study show that most schools do not adhere to the CAPS document since practical activities are not conducted as often as they should. In contrast, the CAPS document states that at least two practical activities in Grade 12 most be conducted and recorded formally, while a practical activity must be given once in each term (DBE, 2011), meaning that a total of four practical activities should be given to Grade 12 Agricultural Science learners. Moreover, it is evident that learners XL1, XL2, XL3, YL2, ZL1 and ZL2 perceived that the active and collaborative methods, such as practical activities, enables them to understand the content easily and quickly. This was shown in a study conducted by Reinoso, Collazos, Martínez and Delgado (2021), where learners perceived that engaging in practical activities during lessons and working together with their class mates and teachers in diverse learning contexts was constructive. Findings from this study show that, when learners conduct practical activities in groups, they benefit by brainstorming their thoughts and helping each other. Hence, a lot of interest and an advanced understanding of Agricultural Sciences is acquired by learners.

Learners XL1, YL2, ZL1, XL5 and YL4 in this study asserted that they learn better when both practical and theoretical teaching methods are used. According to Kumar and Kashyap (2012), theory must be accompanied by practice in science subjects. These findings are validated by Bhurulf and Kilkbrink (2012), who argued that, in order to bridge the gap of knowledge between theory and practice, learners should be taught simple knowledge prior engaging in practical activities. It is stated that it is helpful for learners to practice what they have learnt from theory. In contrast, Mjelde (2005), maintains that a comprehensive approach in linking theory to practice is that theory and practice need to be learnt simultaneously.

Findings of this study also indicate that learners XL1, XL2, XL4, YL4 and ZL3 acquired skills, such as handling and treating chickens, time management and decision making, organisational skills, interpersonal skills, measurement and following instructions correctly. Moreover, learner XL3 indicated that they acquired organisational skills and monohybrid and dihybrid crosses, while learner YL1 acquired skills in the handling of chickens and DNA extraction from the practical activities. This is in line with Kibirige and Tsamago (2013), who recommended that incorporating practical activities is efficient in promoting learners' acquisition of scientific skills.

In addition, the teacher's contribution played a significant role during the practical activities as this helped learners to understand the practical activities better. Literature has shown that the attitudes and motivation of a teacher are imperative since these directly affects learners' perceptions of the subject (Alam & Farid, 2011; Kumar & Kashyap, 2012). Learners benefited from the teacher's demonstrations by asking questions, discussing and reflecting on the practical activities. Findings from learners XL4, YL4, YL5, ZL2 and ZL4 showed that Agricultural Sciences is more interesting when practical activities are part of the learning experience, but what is more encouraging is that the learners reported that they learned better when they were able to be more active in their science learning, rather than being passive participants. According to Cerini, Murray and Reiss (2003)**,** learners are clearly inspired and motivated by practical activities. This finding is in line with research findings from this study, where learners perceived practical activities to be interesting and motivating.

The lack of agricultural apparatus and equipment for practical activities in school X and Z have also contributed to some learners losing interest in pursuing Agricultural Sciences. This is in accord with a study conducted by Osuala (2004), who found that the lack of equipment and apparatus for practical activities hinders the training of learners. Furthermore, upon completing their studies, the learners have not acquired adequate skills to engage in the farming industry. Nonetheless, the implementation of the practical activity spurred a lot of interest in learners XL4, YL3, YL4, YL5, ZL2 and ZL4 and motivated them to consider Agricultural Sciences as a career since they found it interesting.

Findings from this study show that a lack of practical activities has a negative effect on the perceptions of learners towards the learning of Agriculture Sciences. Learner XL2 perceived Agricultural Sciences as more abstract, instead of being more practically focused. Therefore, it can be assumed that a lack of practical activities in Agricultural Science may be a prominent factor accountable for the poor acquisition of farming skills by learners. This findings are corroborated by Vandenbosch (2006), who asserted that Agricultural Sciences learning and training is distinctive, in contrast to other types of learning and training. Hence, Agricultural Sciences cannot be learned only outdoors or in the classroom' both contexts should go hand in hand.

Remarks on the learner's perceptions of the practical activities

Learners perceived Agricultural Sciences as interesting and motivating when practical activities are included in their learning. In addition, learners perceived practical activities as helpful in acquiring Agricultural Sciences farming skills and saw a difference when exposed to practical activities. Findings from Susantini *et al*., (2017) showed that learners gave relevant responses indicating that they understood exactly what was done during the practical activities. The study further asserted that learners were able to acquire new information, which improved their understanding about the subject**.** This is because they understood better when they were able to observe, feel and experience the objects rather than listening to the teacher explain concepts. Hence, they perceived the subject as an interesting career that has a lot of job opportunities and needs a person who is passionate about farming and not afraid to get dirty.

4.4 Chapter Conclusion

This chapter dealt with the presentation and analysis of data from each school. Data for each case (school) were presented, interpreted and discussed in relation to the three research questions, Kolb's ELT and the relevant literature. The presentation of data was done looking at the classroom descriptions, the first practical activity and the second practical activity, and codes were assigned to learners' responses in the interviews. The key findings from the study were made by summarising the research questions into themes. Interpretation of data was done for each result presented. Thereafter, discussions were entered into in order to compare the results within and across each case, as per Kolb's ELT. The next chapter takes us through a summary of the study, the implications of the findings, a conclusion and recommendations.

CHAPTER 5: SUMMARY, IMPLICATIONS OF THE FINDINGS, CONCLUSION, RECOMMENDATIONS AND LIMITATIONS OF THE STUDY

5.1 Chapter Introduction

In the previous chapter, I looked at the presentation, interpretation, analyses and discussion of data. This study analysed the effects of practical activities on the acquisition of farming skills among Grade 12 Agricultural Sciences learners in the Mankweng Circuit. The study aimed to answer the main research question. Namely 'How do practical activities influence the acquisition of farming skills by Grade 12 Agricultural Sciences learners at selected secondary schools in Mankweng Circuit?' This question was separated into three sub-questions that were answered using lesson observations and semi-structured individual interview questions. This chapter deals with a summary of this study, and the implications of the findings, conclusion and recommendations.

5.2 Summary of the Study

This section provides an overview of the whole research project as presented sequentially. The main purpose of this study was to analyse the influence of practical activities on the acquisition of Agricultural Sciences farming skills by the learners at selected secondary schools in the Mankweng Circuit. The aim of conducting this study was to analyse how practical activities influence the acquisition of Agricultural Sciences farming skills by learners in Agricultural Sciences. The background to the study showed that several studies related to this topic have been undertaken, mostly outside of South Africa. Therefore, there was a need to analyse the effects on practical activities on the acquisition of Agricultural Sciences farming skills in our country in order to close the gap of knowledge in the existing literature. This study was underpinned by Kolb's Experiential Learning Theory (2007). This theory was helpful since the four stages enabled the researcher to collect and analyse data based on the learners' experiences of the practical activities and how they helped the learners to acquire Agricultural Sciences farming skills.

This study used an interpretive qualitative approach that allowed the researcher to observe the real-life experiences of participants. The participants in the study were Grade 12 Agricultural Sciences learners from three secondary schools in the Mankweng Circuit. These participants were selected using purposive and convenience sampling. Data collection was done using semi-structured individual interviews and lesson observations. The findings gathered from the sub-research questions were discussed to analyse the implications of practical activities on the acquisition of farming skills. The implications of the research findings, conclusion and recommendations are presented below.

5.3 Implications of the Findings

Thematic analysis was use to analyse data collected from, lesson observations and research interviews. The analysis was checking the influence of practical activities on the acquisition of Agricultural Sciences farming skills among learners in selected secondary schools in the Mankweng Circuit. The findings generated from, the overall study imply that practical activities do have an implications on the learners' acquisition of farming skills. From the first practical activity, learners were able to have a closer practical view of the fowl's digestive system. This afforded learners an opportunity to acquire skills on how to dissect a fowl properly and to classify the chicken as a non-ruminant. Learners also acquired measurement and observation skills by the measurement of specific organs in the digestive tract of the fowl. This implies that learners are knowledgeable about how to handle chickens and the relevant type of feeds that are suitable for poultry farming. The objectives attained from the practical activity by learners showed that they also acquired time management, following instructions correctly and problem solving skills.

From the second practical activity, learners were able to do monohybrid and dihybrid crosses and also extract DNA from onions. By conducting monohybrid and dihybrid crosses, learners were able to support the null hypothesis and showed that if the allele combination of the parents is known then the genotypic and phenotypic ratio of the F1 generation can be predicted. In addition, findings from school Y showed that learners were able to acquire skills on how to isolate DNA from onion tissue by mixing alcohol with an onion solution. This was shown when the DNA precipitated out into the alcohol layer and coiled onto a glass rod. Learners were also able to make observations and study the structure of a DNA after isolating it from the onion tissue. This findings imply that learners are now creative thinkers who can solve problems related to genetic crossing and DNA extraction. Moreover, learners showed decision-making, communication and organisational skills when they were able to work collaboratively with their peers in executing the practical activities. This implies that practical activities do have an effect on the acquisition of Agricultural Sciences farming skills if executed properly.

5.4 Conclusion

In conclusion, the main purpose of this research project which was to analyse the influence of practical activities on the acquisition of Agricultural Sciences farming skills by the learners from selected secondary schools in the Mankweng Circuit was achieved. The main research question was addressed by dividing the study into three sub-questions. This was done through the use of lesson observations and semi-structured individual interviews. The study found that practical activities do have an influence on the acquisition of farming skills by Grade 12 Agricultural Sciences learners. This is based on the fact that learners were able to explain what they saw and what they were doing during the practical activity. They were of the opinion that they understood the content being taught much better in practical activities than when the teacher explains content to them because it can be difficult to understand certain concepts. Hence, practical activities enabled them to know scientific concepts and acquire certain skills needed in the agricultural farming industry.

5.5 Recommendations

The research findings from the first sub-research question revealed that learners acquire different types of Agricultural Sciences farming skills by engaging in the practical activities. Therefore, Agricultural Sciences learners need to engage in practical activities more often because each and every activity instils different farming skills into the learners. Moreover, the lesson objectives specified in the practical activities must be taken into consideration since they also determine the types of farming skills to be acquired by learners. It is recommended that teachers go an extra mile to design learning activities that incorporate learner-centred teaching approaches in the classroom. Thus, learners will become active participants and acquire certain skills needed in the agricultural industry.

Findings from the second sub-research question show that practical activities have an effect on the acquisition of Agricultural Sciences farming skills by Grade 12 learners in the Mankweng Circuit. In this regard, learners are able to play an active role in their learning and this leads to the acquisition of those Agricultural Sciences farming skills, which was the aim of the practical activities. Findings from this sub-research question recommend that teachers, curriculum advisors and the Limpopo Department of Education must ensure that Grade 12 Agricultural Sciences practical activities are delivered as outlined in the CAPS document. Moreover, application for funding and sponsorships from companies that cater for teaching and learning resources can also be done since practical activities needs a lot of resources and funding.

Research findings from the third sub-research question show that most learners from the three schools concurred that practical activities are more helpful to them in acquiring Agricultural Sciences farming skills. Findings also revealed that, after engaging in practical activities, learners perceive Agricultural Sciences as an interesting subject and that they were motivated and inspired to engage in Agricultural Sciences-related careers. It is therefore recommended that the Department of Education must provide contributions to practical subjects like Agricultural Sciences. Secondary schools in the Mankweng Circuit must also incorporate practical activities that generate profit, such as planting and selling vegetables. This will also be helpful in assisting learners to acquire Agricultural Sciences farming skills. Thus, the aforementioned issues should be taken into consideration to improve the overall acquisition of Agricultural Sciences farming skills by Grade 12 learners in Mankweng Circuit.

5.6 Limitations of the Study

According to Queiros, Faria and Almeida (2017), limitations of a study are conditions that cannot be controlled by the researcher which may affect research results. This study is limited to the influence of practical activities on the acquisition of Agricultural Sciences farming skills only in the three selected Secondary Schools at Mankweng Circuit. In addition, time was a limiting factor. Learners were very cautious of their time since they were having work on other subjects and they wanted to study after hours. Nonetheless, the researcher along with the teachers and learners arranged to conduct some of the practical activities and interviews during weekends. This was done to ensure that the study does not affect participant’s normal school schedules. The lack of resources to conduct practical activities in some schools was also a limiting factor. Therefore, learners had to share some of the apparatus and also work in groups.

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APPENDICES

Appendix A

LESSON OBSERVATION SCHEDULE

Please tick the appropriate column and make the necessary comments for each observed statement

Statement	Yes	Partially	No	Comments
1. Practical activity effectively conducted				
2. Enough practical materials to execute the activity				
3. Learners actively participate in the lesson				
4. Collaborative learning incorporated within the lesson				
5. Learners handled and interacted with equipment and apparatus				
6. Learners demonstrated skills on how to operate some of the Agricultural Sciences tools and apparatus				
7. Higher order questions were asked during the practical activity				
8. Learners demonstrated acquirement of any Agricultural Sciences				

farming skill during the practical activity				

Appendix B

SEMI-STRUCTURED INTERVIEW QUESTIONS

Dear Participant

The purpose of this interview is to determine the influence of practical activities on the acquisition of Agricultural Sciences farming skills among grade 12 learners at Mankweng Circuit. Your responses will be treated with confidentially.

Learner's interview questions

1. What do you understand about Agricultural Sciences as a science subject?
2. How often do you carry out practical activities in Agricultural Sciences?
3. Do you think it is necessary for Agricultural Sciences to be taught both theoretically and practically?
4. Do you think practical hours must be increased? Explain why
5. Which method of teaching and learning do you mostly acquire Agricultural Sciences farming skills?
6. Can you elaborate on the types of farming skills that you know in Agricultural Sciences?
7. What are some of the practical activities that you have conducted thus far?
8. Have you noticed any differences in your acquirement of farming skills before and after engaging in a practical activity?
9. After conducting the practical activity what are your perceptions towards Agricultural Sciences as a subject and as a career in general

Appendix C

CONSENT FORM

(Applicable to both the learners and their parents' i.e in cases where the child is a minor)

Project title: The influence of practical activities on the acquisition of farming skills among Agricultural Sciences learners

Project leader: Kgomo M.D [redacted]

I,………………………, hereby voluntarily consent to participate in the following project: "The influence of practical activities on the acquisition of farming skills among Agricultural Sciences learners".

I understand that:

1. My responses will be treated with confidentiality and only be used for the purpose of the research. In reporting the research findings pseudo names will be used
2. No harm will be posed to me.
3. The research project aim has been explained to me.
4. I do not have to respond to any question that I do not wish to answer for any reason.
5. Access to the records that pertain to my participation in the study will be restricted to persons directly involved in the research.
6. Any questions that I may have regarding the research, or related matters, will be answered by the researcher.
7. Participation in this research is entirely voluntary and I can withdraw my participation at any stage.
8. I understood the information regarding my participation in the study and I agree to participate.

Signature of interviewee   Signature of witness

______________________   ______________________

Signature of interviewer

____

Signed at_______________________ on this ____ day of ____________20_____

Appendix D

LETTER TO THE LIMPOPO DEPARTMENT OF EDUCATION

DEPARTMENT OF MATHEMATICS SCIENCE AND TECHNOLOGY EDUCATION

Private Bag X1106, Sovenga, 0727, South Africa

Cell: 0606120602, Email: kgomodinah@gmail.com

P O BOX 55761

POLOKWANE

0700

03 OCTOBER 2021

Head of Department

Limpopo Provincial Department of Education

113 Biccard and 24 Excelsior Streets

Polokwane

0700

Dear sir/Madam

Request for permission to conduct research

1. The matter above bears reference.
2. I am a Science Education, Master's learner at the University of Limpopo. As part of the requirements for the fulfilment of the degree I need to conduct a research and produce a thesis.
3. This letter serves to request for permission to conduct research at **three high schools in Mankweng** Circuit of the **Capricorn Education District.**

4. The topic of the proposed research is **“The influence of practical activities on the acquisition of farming skills among Agricultural Sciences learners”**. The envisaged participant will be one grade 12 Agricultural Sciences classroom in each school. Even though the research will be activity based, my research process will not affect the day-to-day academic activities of the school. All the relevant research ethics will be adhered to.
5. I will be glad if the department can grant me the permission to conduct this research.

Yours in Education

Kgomo M.D

Appendix E

LETTER TO THE CIRCUIT

DEPARTMENT OF MATHEMATICS SCIENCE AND TECHNOLOGY EDUCATION

Private Bag X1106, Sovenga, 0727, South Africa

Cell: 0606120602, Email: kgomodinah@gmail.com

P O BOX 55761

POLOKWANE

0700

03 OCTOBER 2021

CIRCUIT MANAGER

MANKWENG –A

MANKWENG

0727

Dear sir/Madam

Request for permission to conduct research

1. The matter above bears reference.
2. I am a Science Education, Master's learner at the University of Limpopo. As part of the requirements for the fulfilment of the degree I need to conduct a research and produce a thesis.
3. This letter serves to request for permission to conduct research at **three high schools in Mankweng** Circuit of the **Capricorn Education District**.

4. The topic of the proposed research is **“The influence of practical activities on the acquisition of farming skills among Agricultural Sciences learners”**. The envisaged participant will be one grade 12 Agricultural Sciences classroom in each school. Even though the research will be activity based, my research process will not affect the day-to-day academic activities of the school. All the relevant research ethics will be adhered to.
5. I will be glad if the department can grant me the permission to conduct this research.

Yours in Education

Kgomo M.D

Appendix F

LETTER TO THE SCHOOL PRINCIPALS

DEPARTMENT OF MATHEMATICS SCIENCE AND TECHNOLOGY EDUCATION

Private Bag X1106, Sovenga, 0727, South Africa

Cell: 0606120602, Email: kgomodinah@gamil.com

P O BOX 55761

POLOKWANE

0700

03 OCTOBER 2021

School principal

Limpopo Provincial Department of Education

Polokwane

0700

Dear sir/Madam

Request for permission to conduct research in your school

1. The matter above bears reference.
2. I am a Science Education, Master's learner at the University of Limpopo under the supervision of Prof. SM Mtshali, Dr MF Masha and MR KJ Chuene. As part of the requirements for the fulfilment of the degree I need to conduct a research and produce a thesis.
3. This letter serves to request for permission to conduct research at **your school**.
4. The topic of the proposed research is **"The influence of practical activities on the acquisition of farming skills among Agricultural Sciences learners"**. The envisaged participants of this study are grade 12 learners of Agricultural

Sciences. Even though the research will be classroom based, my research process will not affect the day-to-day academic activities of the school because all relevant research ethics will be adhered to.

5. The confidentiality of the information gathered will be maintained. And as such anonymity of the learners of the school will be maintained throughout the whole process. I trust that my request will be favourably considered

Yours in Education

KGOMO M.D (Ms.)

Appendix G

University of Limpopo
Department of Research Administration and Development
Private Bag X1106, Sovenga, 0727, South Africa
Tel: (015) 268 3935, Fax: (015) 268 2306, Email: anastasia.ngobe@ul.ac.za

TURFLOOP RESEARCH ETHICS COMMITTEE

ETHICS CLEARANCE CERTIFICATE

MEETING: **27 June 2022**

PROJECT NUMBER: **TREC/283/2022: PG**

PROJECT:

Title:	The influence of practical activities on the acquisition of Agricultural science farming skills among grade 12 learners at Mankweng Circuit in Limpopo province.
Researcher:	MD Kgomo
Supervisor:	Dr. MF Masha
Co-Supervisor/s:	Mr. KJ Chuene Prof. SM Mtshali
School:	School of Education
Degree:	Master of Education (Science Education)

PROF D MAPOSA
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

Note:

i) **This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.**

ii) **Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.**

iii) **PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.**

Finding solutions for Africa

ETHICAL CLEARANCE CERTIFICATE