INTEGRATING INDIGENOUS KNOWLEDGE IN A LIFE SCIENCES CLASS: AFFORDANCES AND HINDRANCES TO GRADE 11 LEARNERS' UNDERSTANDING OF FERMENTATION

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INTEGRATING INDIGENOUS KNOWLEDGE IN A LIFE SCIENCES CLASS: AFFORDANCES AND HINDRANCES TO GRADE 11 LEARNERS' UNDERSTANDING OF FERMENTATION

By

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DISSERTATION

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LIST OF ABBREVIATIONS

IK	Indigenous knowledge
NCS	National Curriculum Statement
CAPS	Curriculum Assessment and Policy Statement
DBE	Department of Basic Education
IKS	Indigenous Knowledge Systems
TK	Traditional Knowledge
TEK	traditional ecological knowledge
BAAS	British Association for the Advancement of Science
NOIK	Nature of Indigenous Knowledge
NOS	Nature of Science
SLT	Situated Learning Theory
LPP	Learners as Legitimate Peripheral Participants
FET	Further Education and Training
FAL	English First Additional Language

DECLARATION

I declare that the dissertation hereby submitted to the University of Limpopo for the degree of Master of Education has not previously been submitted by me for a degree at this or any other university; that it is my work in design and in execution, and that all material contained herein has been duly acknowledged.

Mogashoa M.C 03 JULY 2023

DEDICATION

This work is dedicated to the Almighty God that I serve, who ushered me by His grace throughout this journey. The dedication is also to my loving husband pastor Sello Alfred Mogashoa and my two lovely daughters, Tiang and Maatla Mogashoa.

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ABSTRACT

This study explored the affordances and hindrances of grade 11 Life Sciences learners' understanding of fermentation when learning through the integration of indigenous knowledge. Situated Learning theory (SLT) was used as a theoretical framework of the study. The study employed the qualitative case study design treating a single case, which was presented by 42 grade 11 Life Sciences learners in a secondary school in Dimamo Circuit, Limpopo Province. Data was gathered through observations, unstructured interviews and document analysis. Categorical aggregation was employed to analyse data. The findings of this study revealed that the integration of indigenous knowledge afforded learners' understanding of fermentation. This was evident when the use of traditional beer, mageu and bread making were involved in the study to learn the topic of fermentation. The other factor that displayed an affordance was the use of terms used at home regarding fermentation. Lastly, the influence of caregivers acted as an agent to bring about an affordance to the understanding of fermentation. The following were identified as factors that reflected the hindered version towards the understanding of fermentation. These include reactions such as withdrawal and passiveness of learners during activities; learners not relating to the indigenous knowledge that was intended to be integrated; and lastly, religious beliefs hindered learners' understanding. This implies that there are affordances as much as there are hindrances to grade 11 Life Sciences learners' understanding of fermentation when learning through the integration of indigenous knowledge. It is recommended for future research that more studies of this nature should be done so that learning should be effective.

***Key words**: Indigenous knowledge, Situated Learning Theory*

CHAPTER 1: SITUATING THE STUDY

1.1 Introduction

The principal goal of this study was to explore whether there are hindrances and affordances to grade 11 learners' understanding of fermentation when integrating indigenous knowledge. In this chapter, I presented the background to the study followed by the problem statement, the purpose of the study, and the research questions.

1.2 Background and motivation

The South African cabinet adopted the Indigenous Knowledge System (IKS) in 2004. The adoption of the policy aimed at the recognition and protection of indigenous knowledge (IK) in the country (Department of Science & Technology, 2004). The National Curriculum Statement (NCS) needed to be revised and the Curriculum and Assessment Policy Statements (CAPS) for different subjects was developed with effect from January 2012. The CAPS document outlined the principle of valuing IKS as a way to acknowledge the wealthy background and heritage of South Africa as remarkable contributors to bring up the values incorporated in the constitution; and credibility, quality and efficiency. This principle provided an education comparable in impartiality, breadth and depth to those of other countries (South Africa [SA]. Department of Basic Education [DBE], 2011). The main objective of the CAPS document was to give support to all educators and to assist them in dealing with the complexity of the curriculum (Department of Education [DoE], 2003). The learning outcomes in the NCS were replaced by the CAPS' subject Specific Aims in Life Sciences. Specific aim 3 in the CAPS document replaced learning outcome 3 of the NCS. Specific aim 3, which relates to understanding the applications of Life Sciences in everyday life requires learners to understand the relationship between IK and science. That is CAPS offers that knowledge skills and values should be expressed in the learning of Life Sciences. The emphasis is on ensuring that learners accumulate and apply knowledge and skills in ways relevant to their lives. In this sense, knowledge is grounded in the local context, and on the other hand, global imperatives are taken into consideration (DBE, 2011). Learners had a problem in

relation to the understanding of the relationship between IK and Science (DBE, 2011). The wisdom of indigenous people through IK is lost and must be revived and used to improve the lives of South Africans (Ogunniyi, 2007).

IK, according to Ronoh (2017), is defined as ways of knowing regarding cultural practices, strategies and techniques, including cultural beliefs and values of a group of people. These practices are said to be carried over from generation to generation through observations over time, and are confined to a particular locality (Foley, 2003; Kibirige & Van Rooyen, 2006). Ogunniyi (2007) and Hoppers (2004) acknowledge that IK is continually changing due to the influence of interactions among knowledge. Indigenous thinking was not recognised in the past within the curriculum. Therefore, there is a need for IK to be recognised and incorporated into the present curriculum to address the division created by the past within the South African context (McKnight, 2015). On the other hand, Hewson and Ogunniyi (2011) refer to IK as the knowledge that existed before colonialism and it is non-western, which is the day to day knowledge of people's life experiences. However, the deliberations about how the Life Sciences curriculum in South Africa will impact both IK and Life Sciences in the classroom have been made. The mentioning of what IK should be included in class is not clear. Hoppers (2009) declares that in Africa, IK, which was used for many generations, has been declared unilaterally unfit, too primitive or irrelevant.

According to Jegede (1999), if any science curriculum is inconsiderate of the indigenous worldview of the learner, it is likely to destroy the framework through which the learner will possibly interpret concepts. This suggests that if the educator concerned does not regard the learners' prior knowledge and indigenous background as important (Mavuru & Ramnarain, 2017), that educator is more or less alienating the learners in a science class. The implementation of the Curriculum and Assessment Policy Statement (CAPS) through amendments in the previous curriculum is more accurate on the aims of IK integration in the classroom (Jacobs, 2015).

Handayani (2018) indicates that IK has not been taken into consideration and was kept away from science curricula for some years, and as a result, it tends to limit scientific knowledge. Govender (2014) argues that educators usually teach African

learners in a westernised way in the absence of their IK. The neglect and omission of IK from science is being perceived as a hindrance in a science classroom (Kibirige & Van Rooyen, 2006). Alkholy (2017) emphasised the fact that traditional learners think that the study of science amongst others does not match their cultural ways of knowing. They tend to think that they will lose their traditional values if they participate in learning science (Alkholy, 2017).

Colonial education did not value local IK, and regarded it as primitive, and made learners believe that they were inferior. Subsequently, If IK is integrated into the science curriculum, it will promote social justice and equity in society (Jacobs, 2015). When IK is integrated into school science, great learner performance is maximised (Zinyeka, 2016). Learners' local IK support their literacy development and thus improves the rate of literacy across the community concerned (Ngasinke, 2019). The integration of IK into Life Sciences learning will enable learners to get the foundation that is relevant for learning, and the viewpoints that are diverse are encouraged. Lave and Wenger's (1991) opinion is that the learning that is effective involves daily activities, context of learners as well as their culture and social environment. The construction of knowledge by learners is mediated socially due to their experiences at a cultural level. The impacts that the introduction of IK has on learners are: firstly, it makes and allows learners to gain new ways of understanding natural phenomena (Seehawer, 2018). Secondly, learners develop an in-depth understanding of scientific concepts (Visagie, 2016). Thirdly, learners are allowed to see the world with two eyes rather than one (Hewson, 2015). The latter statement suggests that learners will only be free from western thought patterns but also focus on indigenous ways of knowing. As a result, they will realise the similarities that exist between IK and science learning if they are allowed to embrace their local IK (Kruger & De Beer, 2019).

In this study, the researcher aimed to integrate IK by allowing learners to bring their ways of knowing from home about the making of traditional fermented food into the learning of fermentation (Creswell, 1999). Fermentation in food processing is the process where carbohydrates (sugars) are converted to alcohols and carbon dioxide by yeast, bacteria, or a combination of the two (Hanisi, 2016). The researcher investigated the affordances and hindrances that may arise as learners learn the art

of fermentation through the integration of IK in a grade 11 Life Sciences class. Integration is the act of creatively merging or combining ideas and knowledge to form a whole or cognitive advancement (Ngasinke, 2019).

This study explored affordances and hindrances to grade 11 learners' understanding of fermentation by integrating IK in the class. Affordances are aspects of the setting of learning that provide potential for learning (Gibson, 1986). Hindrances are situations and relationships amongst the aspects which provide constraints to learning (Greeno, 1998). I acknowledge the affordances and hindrances as defined by Gibson (1986) and Greeno (1998). I am also of another opinion. In the context of this study, hindrances are referred to as things that make it difficult for learning to be accomplished or happen properly, while affordances are things that allow us to do some learning activities in an effective way (Mayana, 2020). This study focuses mostly on the integration of IK, and explores whether this integration will allow or deny learners an opportunity to learn the topic of fermentation effectively.

1.3 Problem statement

Curriculum and assessment policy statement (CAPS) for Life Sciences by the DBE (2011, p.13) “Specific Aim 3, which relates to understanding the applications of Life Sciences in everyday life, requires the learners to understand the relationship between IK and science”. Thus, it is expected from Life Sciences educators to integrate IK in their classrooms to help learners to experience meaningful learning. Learning activities that include real-life environmental situations should be presented to prevent indigenous learners from feeling alienated (De Beer & Whitlock, 2009).

The major concern area in the education system is that in reality, most of the educators’ classroom practices are dominated by western values, knowledge, and pedagogies at the expense of IK and epistemologies (Ronoh, 2017). This kind of practice denies learners an opportunity to bring knowledge from their own lived experiences into the learning process (Ronoh, 2017), thus inhibiting their learning experiences (Shaza, 2013). CAPS assume that all Life Sciences educators know how to integrate IK into their classroom teaching (Khuphe, 2014). But the literature seems to reveal that there are educators who still do not have IK in their classrooms (Seehawer, 2018). This makes it difficult for educators to integrate IK, and learners’

knowledge will be alienated and not considered, thus learners will not be able to relate their ways of knowing to science learned in class (Seehawer, 2018). Another factor that makes the introduction of IK a challenge in a science classroom is educators' perceptions that the introduction of IK may constitute a pseudo-science (De Beer & Mothwa, 2013). This perception and attitude leads to educators being reluctant to introduce IK (Mayana, 2020)

The reluctance to integrate IK by Life Sciences educators will consequently lead to the misalignment between the curriculum outlined by CAPS and the actual curriculum offered by Life Sciences educators (Mc Knight, 2015). This will further prevent Life Sciences learners from being able to relate their ways of knowing to the science learned in class (Mayana, 2020). Learners will ultimately fail to see the relevancy of the skills and knowledge acquired in a science classroom and post-school (Mavuru & Ramnarain, 2017). In light of the aforementioned, the researcher aimed to explore affordances and hindrances of integrating IK while teaching the topic of fermentation to grade 11 Life Sciences learners.

1.4 Purpose of study and research questions

1.4.1 Purpose of the study

The purpose of the study was to explore affordances and hindrances to grade 11 learners' understanding of fermentation when integrating IK.

1.4.2 Research questions

- How does the integration of IK in the grade 11 Life Sciences promote learners' understanding of fermentation?
- How does the integration of IK in grade 11 Life Sciences hinder learners' understanding of fermentation?

1.5 Definitions of key terms

Definitions of terms that are consistently used in this study are listed below.

Indigenous knowledge: Refers to ways of knowing regarding cultural practices, strategies, and techniques including cultural beliefs and values of a group of people (Ronoh, 2017).

Integration: Refers to the action of merging smaller components into a unified system that functions as a single unit (Handayani, 2018)

Western science: Refers to Western Science which originated in Europe and spread to western and non-western countries (Aikenhead & Ogowa, 2007).

Nature of science: Is a concept that includes aspects of history, sociology and philosophy of science, and has variously been defined as science epistemology (Bell, 2009).

Social interactions: The process through which learners act and react toward other learners around them (Tuner & Nolen, 2015).

Authentic context: Authentic context focuses on participation in natural settings in communities of practice (Lombardi & Oblinger, 2007).

Constructivism: Is an approach to learning where learners actively build their knowledge and learning is actuality determined by the knowledge of the learners" (Elliot et al, 2000).

Affordances: The object's property that shows its possibility of use or how it should be used clearly (Mayana, 2020)

Hindrances: Refers to social, cultural, emotional, physical or mental elements that restrict learners from achieving their learning goals (Anazifa & Hadi, 2017).

1.6 Research design outline

Research approach

The study was a qualitative research. Qualitative research design is an approach that dwells much on data collection in a natural setting, and that particular data is gathered in words than in numbers (McMillan & Schumacher, 2010). The rationale for choosing this approach was to explore the meaning and understanding that the groups can give to a social problem (Creswell, 2014).

This study was a qualitative research which adopted the case study approach. The relevance of the case study was due to the reasons that case studies are descriptive, detailed and studied under real-life contexts. A qualitative case study design was chosen because it provides the researcher with techniques to study complex phenomena in their natural setting (Baxter & Jack, 2008). Case studies seek to expose the descriptions of participants' experiences and opinions, and judgement of situations. The type of case study adopted for this study was a single case study.

Data collection instruments

The use of the case study approach was based on observations, unstructured interviews and document analysis as tools for data collection. This research design is an approach that dwells much on data collection in a natural setting and the data is gathered in words than in numbers (McMillan & Schumacher, 2010). Thus, it is the original plan through which data was collected to address the research questions in the most reasonable way.

Data collection techniques.

Observations

Observations are a technique used to systematically and significantly gather data by looking at events and behaviours of participants in the research site (Marshal & Rossman, 1998). As a participant-observer, I engaged in some of the activities at the research site (Creswell, 2014). For me to establish how the integration of IK in Life Sciences may hinder grade 11 learners' understanding of fermentation, I took field notes as a data collection tool. Field notes are records of what is observed or heard by the researcher (Creswell, 1999).

Interviews

Interviews are qualitative data-gathering techniques involving verbal communication between the researcher and the participant (Boyce & Neale, 2006). The researcher obtains relevant information through verbal responses given by the participants (Gubrium, 2001). In this study, learners were divided into 6 learners per group.

Information was obtained from a group of 6 learners engaged in cooperative learning and from individuals belonging to the groups (Creswell, 2014). The size of the group which was 6 learners in a group allowed the participants to be comfortable talking to me as the researcher and to each other (Corbin & Strauss, 1998).

My main aim was to engage learners and used the opportunity to get a better understanding of how the integration of IK afforded or hindered understanding and sense-making of the topic of fermentation.

Document analysis

Document analysis is a form of data-gathering technique that allows the researcher to use documentary evidence to answer research questions in a systematic way (Bowen, 2009). The technique allowed me to examine and interpret data to get meaning and understanding of the topic of interest (Corbin & Strauss, 2008). To establish how the integration of IK hinders and affords the understanding of fermentation by grade 11 learners, learners were given three activities to write, and I collected the scripts for analysis.

Sampling

Forty-two (42) grade 11 Life Sciences learners from a secondary school in Dimamo circuit, Limpopo Province participated in this study. Learners were divided into seven (7) groups consisting of six (6) learners in each group. Three lessons were offered in three different occasions. During the lesson presentations, learners' behaviour and reactions were observed while they were interviewed simultaneously. This was done due to the nature of the study that drove the researcher to present lessons, observe and ask questions at the same time. The details of this approach are elaborated in chapter three (3).

1.7 Significance of the study

The findings of this study benefited literature, educators, researcher and learners. The afore-mentioned benefited from the study in the following manner. Literature: the study added to the literature on writings based on the integration of IK in Life Sciences. Thus, upcoming researchers have adequate literature within the field of IK.

A new theory of learning related to the integration of IK might be developed through this study. Educators: there is a need for more life-changing learning strategies. There should be a curriculum that provides more detailed IK content and skills, thus developing resource packs to address IK and practical work, including scientific methods. Schools that adopted strategies such as the one resulting from this study are able to facilitate learning properly. As a result, Life Sciences educators are able to develop learning materials by integrating IK. Researcher: the findings of this study helped the researcher to have an understanding of the integration of IK and to build more knowledge on the hindrances and affordances thereof. Learners: the department of education had more light in developing curricula to improve learner performance in life sciences. The researcher revealed essential knowledge in the education system. As a result, indigenous learners in the class were free to express their views and gain free entry to science learning.

1.8 Research report plan

This report is organised into five chapters. Chapter one outlines the introduction, background and motivation of the study. The research problem statement is presented with the purpose of the study together with the research questions. This chapter also provides the outline of chapters of this dissertation. The summary of the current and the next chapter are provided.

Chapter 2 focuses on the literature review where nationally and internationally conducted research is included and reviewed. This chapter begins with the introduction, followed by the conceptualisation of the study and the discussion of indigenous knowledge and western science. The nature of indigenous knowledge and of sciences were discussed together with their tenets. The role of theory underpinning this study is also elaborated in this chapter. The conclusion and summary of the next chapter are outlined.

The third chapter outlines the methodology employed in this study to respond to the research questions. Following the discussion of the research design is sampling, data collection and data collection tools. Data collection, quality criteria and ethical consideration are also presented. Lastly, the chapter presents the summary of chapter 3, which is linked with the next chapter.

Chapter 4 in particular will focus on the presentation of findings and the discussion thereof. The presentation of data was done based on observations and unstructured interviews, which were done simultaneously. Finally, data presentation and document analysis were discussed. The chapter closes by presenting the outline of the chapter and the summary of the chapter that followed.

Lastly, chapter 5 presents an overview of the findings, limitations, conclusions and recommendations for further research.

1.8 Chapter conclusion

The introduction, background and motivation of the study were outlined in this chapter. This was followed by the research problem, which outlines the problem that persuaded this study. This is followed by the purpose of the study and research questions. The research design is also presented. The significance of the study and the report plan are discussed. The next chapter will focus on the review of literature and the theory underpinning the study.

CHAPTER 2: LITERATURE REVIEW

2.1. Introduction

This chapter will focus on the literature review where national and international conducted research is included and reviewed. According to Creswell (1999), a literature review should bring forth the themes on issues around the topic of a study and must highlight how the study could contribute towards the enrichment of the existing literature around the topic. Studies which are related to the integration of indigenous knowledge (IK) in a science classroom were at centre of discussions in this chapter.

Previous research has shown that there are different knowledge systems, which are given different labels in different settings (Mayana, 2020). These labels include among others, indigenous knowledge systems (IKS), traditional knowledge (TK) and traditional ecological knowledge (TEK). In the study, I chose to use indigenous knowledge (IK), where local knowledge of learners informs decision-making about day-to-day activities in the classroom. The integration of IK and its effect on the curriculum is indicated by many researchers locally and around the world. In this chapter, I review some research conducted on the topic of the integration of IK. The discussion will follow a focused approach, starting with studies conducted outside the borders of South Africa, narrowing it to the integration of IK into the South African curriculum in particular.

2.2. Conceptualising the study

2.2.1 Indigenous Knowledge

At this stage, I see it fitting to define IK and what it entails. Many authors have defined IKs in different ways. Madinkonza (2019) defined IK as local knowledge coming from relations between the community and their environment. Handayani (2018) defines it as people's knowledge and skills that are possessed in a particular locality, which makes the people benefit from their environment. De Beer and Whitlock (2019) provide a similar definition: practices of knowledge in totality and the

knowledge used and practised to manage life spiritually, socially, economically and ecologically.

A diverse body of knowledge developed apart from the formal schooling system and skills that ensure the survival of communities is referred to as IK (UNESCO, 1999). Similarly, Rankoana (2017) describes the way indigenous people acquire their IK by stating that it is 'the knowledge that is accumulated through informal experiments and understanding of their environment'. Ogunniyi (2011) further shares the same sentiment, that most African learners (young people) possess a wealth of IK about their environments, citing examples of knowledge like classification of organisms, weather patterns, indigenous games, conservation methods, the control/cure of diseases and the origin of the water source. This knowledge is accumulated even before learners could attend formal school.

IK and the survival of communities are closely related. To support my statement, CAPS (South Africa, DoE, 2011, p.8) states that “IK includes knowledge about agriculture and food production, pastoral practices and animal production, forestry, plant classification, medicinal plants, management of biodiversity, food preservation, management of soil and water, iron smelting, brewing, making dwellings and understanding astronomy”.

Parallel to CAPS (2011), Keane, Khupe and Muza (2016) consider IK as knowledge and skills that developed apart from the formal school science that makes indigenous people survive. However, Hewson and Ogunniyi (2011) posit that IK is the day-to-day knowledge that ordinary people gather about their experiences of life or the non-western knowledge that existed before colonialism. The latter definition implies that the current or existing knowledge is somewhat euro-centric.

In this study, I take a stance in support of Rankoana (2017), Ogunniyi (2011) and Keane (2016). I refer to IK as the knowledge that learners possess from home regarding the making of fermented food and beverages. This knowledge is orally transferred and learned from elders and is unique to learners’ culture. It is integrated into the learning of fermentation. I use the prior knowledge of learners that they acquired from home as their IK to be used in a Life Sciences classroom throughout the study.

2.2.2 Indigenous knowledge across geographical barriers

IK is also defined according to geographical regions and different cultural practices**.** I cite a few examples of definitions of IK given by other authors specifically in certain geographical regions. Though IK is defined as non-western knowledge by Hewson and Ogoniyi (2011), Alkholy (2017) holds a different view, defining IK within the context of North America as the knowledge that is possessed by a group of respected elders who are referred to as gatekeepers of knowledge. North America consists of the majority of whites and non-whites. The white population means those Americans who identify as white people and non-whites refer to people whose origin predominantly non-European. The non-whites include Black Americans, Amerindians, and Latin Americans, who are the minority. On the other hand, in India, the Indians possess a holistic science that is practised as the interaction between the mind, body, sensory actions and spirit. This IK is known as Ayurveda (Reddy, 2019). In Indonesia Zindny (2021) says IK is an association of science-related knowledge and practice of indigenous cultures.

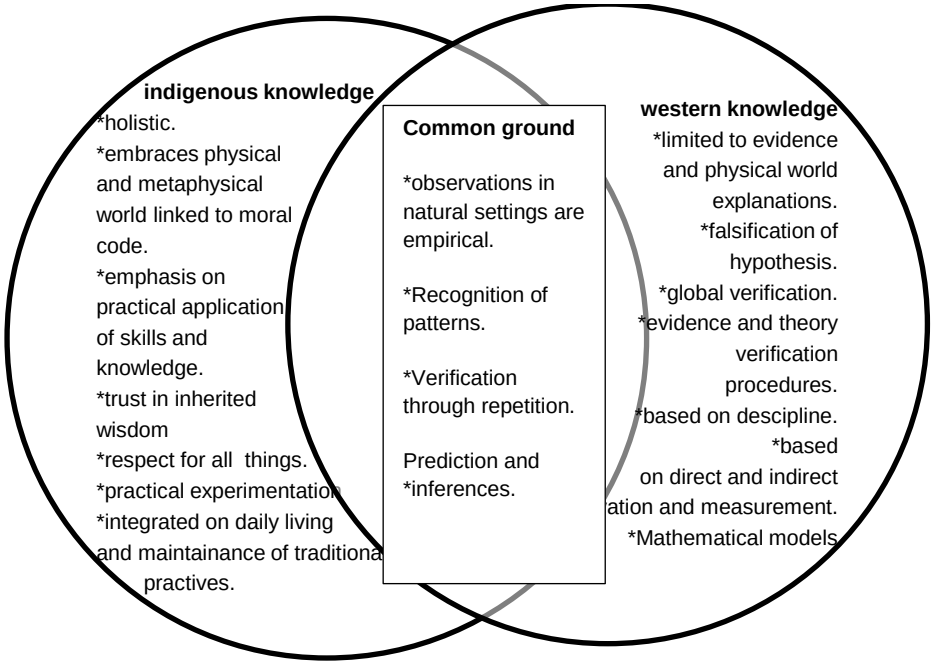
According to Abah, Mashebe, and Denuga (2015) IK in Africa is referred to as ways of knowledge creation which is based on the truths that are ecological and seasonal. The elders in the community are practically teaching culture and the environment through recreational activities such as stories and songs. Learning also takes place through ceremonies, meetings, and awareness of taboos. In support of Abah et al (2015)., Mateus and Ngcoza (2020) found that in Namibia the Avawambo people hold a cultural practice where only elderly females are allowed to teach young girls how to make clay pots while the males can only watch. This implies that IK is passed on from generation to generation among the female gender. IK in this regard is gender-based. Therefore, it is regarded as a taboo for males to engage in the activity of clay pot making.

Given the above definitions, IK is the knowledge that holistically integrates different aspects of life into common knowledge that is dependent on the locality of people over generations (Hoppers, 2001).

2.2.3 Western Science in contrast to indigenous knowledge

Natural philosophy, as it was known in the 17th century, refers to western Science, which originated in Europe (Aikenhead & Ogawa, 2007). The British Association for the Advancement of Science (BAAS) renamed natural philosophy into Science in 1831 to free themselves from natural philosophers. Western science is referred to as euro-centric and spread to western and non-western countries. The study further argues that the separation of western thinking from non-western thinking resulted from the idea that modern science is regarded as the main way to accumulate knowledge. This way is still utilised as a framework according to western culture (Jegede, 1997). Supporting Jegede (1997), Cronje, De Beer and Ankiewicz (2015) assert that western science is still regarded as senior to IK despite measures to integrate IK into science learned in school. In the same line of argument, Hoppers (2004) posits that the acknowledgment and affirmation of IK integration into the Science curriculum is a global knowledge system. Hoppers (2004) perceives it as the knowledge system that is continually bringing about disputes amongst learners, educators and scientists. De Beer and Van Wyk (2012) view IK and western science to be similar. The two knowledge systems can supplement one another in a science classroom. Handayani (2018) views the two knowledge systems as being different. As a result, they will battle against each other. Ezeanya, Mhakure and Otulaja (2017) affirm that the battling of the two knowledge systems will make it difficult for indigenous learners to learn euro-centric science. To support the latter researchers, De Beer and Peterson (2017) deem subjecting IK and western science to similar verification as difficult because of the difference in epistemologies and methodologies. What distinguishes western science from IK is its domestic nature because western science is rooted in a global orientation, while IK originates from local people's practices and their territories.

Figure 2.1: The knowledge synthesis model adopted from Barnhardt and Kawagley (2005).



2.2.4 The Nature of Indigenous Knowledge (NOIK)

Ahanonye (2021) acknowledges the struggle of South African educators on the integration of IK because the CAPS document does not give clarity on the methodology of integration. Science educators in South African schools are phasing the challenges in their day-to-day practice in schools. Ahanonye explored how IK is presented by educators and the perceptions that educators have on the integration of IK. She argues that two knowledge systems do not possess any documentation of their integration: educators' views of IK and Westernised science, after critically analysing the NCS and CAPS documents.

In the same line of argument, Mathebula (2020) conducted a study on a critical analysis of the CAPS document and examined the two genres of philosophy: western and African philosophy. Mathebula proposes the third knowledge which he identified as endogenous knowledge, which will allow the merging of African and Western knowledge against the fact that CAPS emphasises African IKS. This knowledge system must indicate that the aim is not to compare the two knowledge systems or to show superiority among the systems. The argument here is that there is a battle of minds and there is no way that the two philosophies may cooperate;

and the third knowledge will bring unity among the two, in other words, the two philosophies will cross borders. Then, as a result, we will have African knowledge, IK, and Western knowledge. IK is a merger between African and Western knowledge. To support Mathebula and Ahanonye, Singh-Pillay and Nwokocha (2017) conclude that IK is lost knowledge due to a lack of documentation and a lack of interest by educators. The four researchers mentioned emphasise and recommend that educators should be supported by policymakers on the integration of IK.

The NOIK embraces the four underpinnings such as ontology, epistemology, methodology, and the violation of IK as outlined by Ankiewicz (2013). Ontology is a belief system that shows an interpretation of an individual about what compose a fact and it is associated with what is rendered as reality. Epistemology is a division of philosophy that assesses the nature of knowledge, processes through which we gather knowledge and the value of the knowledge gathered. Methodology is a system of methods utilised in a certain area of activity or study. Violation of IK is a state where indigenous people encounter threads, particularly in their land rights. The rights include extraction of natural resources, infrastructure projects, conservation and agriculture. The four aspects are woven together even if one may be able to differentiate between them. Ankiewicz's basis of argument is that if educators may understand the knowledge of such underpinnings, they will be able to reach out to learners with proper strategies for integration.

2.2.5 Tenets of the Nature of Indigenous Knowledge

As outlined by Cronje et al. (2015), the NOIK portrays different perspectives, but the general aspects of IK are emerging from the literature. In their study, Cronje et al. (2015) highlighted that there are some characteristics of IK that correspond with the NOIK framework.

Firstly, IK is "naturally Metaphysical and Empirical". In support, Ogunniyi (2004) and Le Grange (2007) said that the natural world is actual, metaphysical, and foreseeable. "Observations in this regard are monist and related to the metaphysical systematic ways of knowing by community elders" (Aikenhead & Ogawa, 2007, p. 562). Being monist means that community elders deal with the metaphysical aspects

of their native traditions and cultures. Secondly, it is “resilient yet tentative". IK existed for a long period and was pulled through many generations (Hewson & Ogunniyi, 2011). Discoveries in time may lead to change of IK with change in traditions yet displaying flexibility and transformability (Cronje et al., 2015).

Thirdly, IK is “inferential and intuitive”. The facts about IK can be gathered through observation and testing. Practical experiments are also involved where phenomena that are natural and unnatural are observed and tested by indigenous people through experiments and make conclusions from them (Le Grange, 2007; Dei, 1993).

Fourthly, IK is “mythical and creative”. Indigenous people have a nature of creativity when doing their crafts. This nature is also observed in their creative reasoning. Some myths are detected among the elderly and indigenous people, and the role that they play is very unique in their way of life (Ahanonye, 2021). Ahanonye conducted a study and discovered that the Shangaan community in South Africa creatively practices a myth that discourages young girls to engage in sexual activities at a tender age. Having sex at a young age will result in the girls losing parts of their hair for good.

Fifthly, IK is “subjective in nature” because the ways of knowing involves the intertwining of spiritual and cultural knowledge based on the theory of the origin of the universe. Elders in every community are subjected to the influence of prior knowledge and beliefs (Cronje et al., 2015)

Sixthly, IK is “collaborative, social and cultural in nature”. According to Mateus and Ngcoza (2020), indigenous people live by oral tradition where they participate in traditional activities. Elderly people transfer knowledge by teaching traditional dances and singing in ceremonies in a cultural context and can be transferred among community members. The transferred knowledge is passed from generation to generation (Abah, Mashebe & Denuga, 2015).

Seventhly, IK is referred to as "wisdom in action". IK engages the accumulation of knowledge through practical experiences of local people using the trial and error method. This knowledge engages in imitating, repeating, and cultural activities which allow indigenous people to keep and emphasise ideas (Zindny, 2021). Rankoana

(2017) posited that IK is not the final stage of knowledge discovery but a way towards gaining wisdom.

Eighthly, the NOIK embraces the “functional application”. It involves knowledge about the day-to-day living of indigenous people and the reasons behind the occurrence of things in nature (Handayani, 2018). Ninthly, IK is based on the "holistic approach of IK” (Hoppers, 2001). It is a form of knowledge that is holistic and inclusive. Several knowledge systems such as science, psychology, and religion can be located within IK. The NOIK indicates the presence of science in IK as much as there is science in western science.

The next discussion on the Nature of Science (NOS) and its tenets which is the same as that of the NOIK will assist us towards a better understanding of the relationship between NOS and NOIK.

2.2.5The Nature of Science (NOS)

The relationship between IK and the NOS needs to be addressed. The discussion on the NOS will assist in answering the research questions in my study, which explores the affordances and hindrances on learners' understanding of fermentation through the integration of IK. Science education aims at scientific literacy, and may initiate an impact on the worldviews of individuals (Lederman, 2013). In support of Lederman, Yenice and Ozden (2022) argue that the science that learners receive in schools currently concentrate on the development of scientific literacy on learners rather than mastering theories. In addition to the latter statement, Lederman (2013) and Koponen (2021) posit that Western science dominates the science curriculum that is taught in schools throughout the world and South Africa.

The NOS viewpoint admits that science does not only involve laws, theories and facts but processes, investigations, attitudes, and beliefs are also involved (De Beer, Ankiewicz & Cronje, 2015). Referring to the literature on the NOS, it is clear that it is a complex component of knowledge globally, meaning that there can never be a single definition of what the NOS implies, but some common tenets arise (Kruse, Kent-Schneider, Zacharski & Rockfeller, 2019).

2.2.6 The tenets of the Nature of Science

In the first instance, NOS is “inferential”: it deals with the natural phenomena that are easily accessible to the observer where the latter comes up with the conclusions thereof (Cronje, 2015). For instance, in Life Sciences, learners usually observe processes such as the growth of plants and factors affecting growth in green plants. In instances like the above mentioned, learners will be curious and desire to learn more about the Life Sciences processes. Science is the existence of a merger between observation and inference similar to NOIK; as I mentioned that indigenous people make observations of natural phenomena and come up with conclusions.

Second, NOS entails “validation of scientific knowledge” because it provides empirical verification to defend results from observed data. This means that scientific knowledge depends solely on empirical findings to back up scientific reports (Lederman, 2013). The theory of the evolution of humans is an example of which fossil remains discovered by scientists are used as evidence. Indigenous people also justify their knowledge through the stable implementation of fresh knowledge found through the observation of their authentic environment.

Third, NOS engages "scientific methods" which connect with systematic methods of doing science. It offers distinctive approaches to doing science due to the scientist's preferred way of using numerous procedures in producing scientific understanding (Bell, 2008). It entails the scientific processes of collecting and analysing data such as statements and conclusions. Although IK does not observe the systematic scientific techniques outlined according to the way of the western scientists, these procedures are implemented when they are set up in an authentic environment.

Fourth, scientific knowledge is “tentative”, which explains the fact that there is no such thing as the 'truth'' in science. This shows that the facts, laws and theories are provisional, meaning they may change or can be rejected by using other choices as empirical proof (De Beer, 2019). An instance can be drawn from Lamarck’s concept of inherited traits which did not have genetic proof at that time; it was later rejected with proof from Darwin’s concept of survival of the fittest. The tentative nature of IK offers a discovery of a new understanding through 'trial and error'. African traditional

healers additionally halt the African standard medication or standard practices that display potential danger to the fitness and health of human beings.

Fifth, NOS entails “creativity” because it offers alterations and stimulants in the science discipline. Though scientific knowledge is rooted in observations of the natural setup, it additionally comprises the creativity and creativeness of humans. It takes the scientist's explanatory ability of a located phenomenon into consideration (Lederman et al., 2013)

The sixth tenet indicates that scientific knowledge is "objective and subjective". It offers the interaction of the scientist with the object to be discovered and the environment of the occurrence. According to Peterson, Golightly, and Dudu (2019), there is an area of science to be objective and subjective, entailing the experiences, beliefs, preceding knowledge, and anticipations that sooner or later have an impact on the production of scientific understanding. This is odd with local indigenous people. This means that the subjectivity and objectivity of science is strange to the indigenous people.

The seventh tenet is about “methods and NOS”. This tenet indicates that scientific knowledge is not gathered universally one step at a time. Scientists use different methods when solving problems and testing theories (Cronje et al, 2015).

Eighthly, NOS is concerned with “laws and theories” where scientists explain the phenomena that happen in nature using theories and laws. What happens in a phenomenon is described by scientific law, while how and why things come to be in nature is explained by scientific theories (Cronje et al., 2015). To add to what the above researchers posited, Ahanonye (2021) argues that laws describe the associations amongst observable occurrences while theories are inferred descriptions of conclusions on explanations of observable phenomena.

The ninth tenet of NOS employs the “reductionist approach”, which is a composite phenomenon that can be separated into smaller parts to be analysed. A section or the method as a whole is used in this approach. The NOIK approach is holistic and addresses the smaller parts without boundaries. This means that IK is a collection of

knowledge systems such as psychology, religions, science, and others (Cronje et al., 2015)

Vhurumuku (2010) posited that the point of view of the NOS acknowledges the truth that science is made up of theories, facts, and laws together with processes, beliefs investigations, and attitudes as human activities. NOS and NOIK share tenets that display similar traits even though they do not bear similar processes. Hence, Aikenhead (1996) argues that science is present in all cultures, the sub-culture of IK and euro-centric science is science. The argument by Aikenhead ultimately renders everybody directly or indirectly a scientist through human activities that we engage in daily. Science learners and educators are also included as they possess their IK that originate from their cultures (Ahanonye, 2021). Cronje et al. (2015) argue that for learners to accept the integration of IK into western science, there is a need for recognition of NOIK as much as NOS is recognised.

The above list is probably most recognised by most scientists and is regarded as appropriate for school science learning because it brings forth a more precise view of scientific knowledge.

2.3. Affordances and Hindrances to learning

Learners' ability is the potential to learn in a setting provided by the learners, prior knowledge, skills, understanding of concepts and disposition (Greeno, 1994). On the other hand, there are some settings that are provided by the educator for leaner activity and for learning purposes. Other settings are naturally present as part of the learners' culture and learning environment. The setting in relation to this study is the integration of IK into the learning of fermentation in a grade 11 class. Learners are expected to perform tasks with goals based on learning and outcomes. In this study, tasks involving learning included comparing the making of traditional beer and industrial beer processes, and the importance and use of yeast in fermentation. These activities also included knowing the involvement of fermentation in the making of mageu and integrating the knowledge regarding the making of bread at home into fermentation learned in class. The tasks based on outcomes included the writing of answers in response to the questions asked in the activities designed by the educator as part of the lessons presented. The existing abilities of learners combined

with the supporting features of the setting were used to achieve the outcomes. The supporting features in the context of this study are the behaviour of learners as observed by the researcher and their responses during the unstructured interviews. Some cognitive effort from the side of learners was needed to bridge the gap between their existing abilities and intended abilities (Salomon & Globlerson, 1987).

Affordances are factors of the learning setting that provide potential for learning, while hindrances are the conditions and relationship among factors which provide guidance for learning (Kennewell, 2001). For instance, in this study possession of IK by learners affords learners' understanding of fermentation while lack of IK from the side of learners and their background hinders the understanding of fermentation. Hindrances do not oppose affordances but are complementary and equally important. Factors of the supporting features may be categorised as affordances (Gibson, 1986) and hindrances (Greeno, 1998). The affordances and hindrances may restrict other actions which are more favourable. This means that in some cases affordances may not result in the achievement of learning outcomes. There is no factor that is considered to be absolute in nature. Nevertheless, the relatedness of affordances and hindrances must be considered in relation to the learners' abilities in the activity they support. Relating to this study, little IK will not afford learners' understanding of fermentation to learners with less prior knowledge, and lack of IK will be too great a hindrance for a learner who does not know what and how to integrate IK.

2.3.1. IK integration into the Life Sciences curriculum as an affordance to learners' understanding of Science concepts.

The use of IK integration has been adopted as a strategy in learning and is used as an affordance to learners' understanding of classroom science (Handayani, 2018). The integration of IK as a setting for learning warrants a special place for IK in a framework of learning in a science classroom (Kennwell (2001). When learners are engaging in an activity intended to bring about learning, their progress relies on the potential for relevant action provided by the affordance of the setting. Some studies have been conducted to show how the integration of IK may afford the learners' understanding of science concepts and school science as a whole.

Science is referred to as a product of culture (Hoppers, 2002). Hoppers also mentioned the necessity of acknowledging the diverse manifestation of science. This means that the teaching and learning of science should embrace the indigenous ways of knowing and understandings in a cultural way to make learners appreciate and acknowledge their identity.

Handayani (2018) and Anazifa and Hadi (2017) conducted two separate studies on the integration of IK of the Javanese people who are native to Indonesia. They both discovered that there are similarities between western science classes and Javanese IK. They both indicated that the integration of IK into science learning is an essential tool for constructing knowledge and breaking the gap between classroom science and the knowledge that learners get from the community. This means that the integration of IK afforded learners the ability to connect scientific knowledge and real situations.

Another qualitative study and analysis of IK of the Baduy community in Indonesia was conducted by Zindny et al (2021). The aim was to describe how IK can bring about an applicable context in learning scientific concepts. They viewed the putting in place of Life Sciences teaching and learning through Baduy community IK in two ways: firstly, as a strategy to enhance learners' opinions on the relevance of western science learning. Secondly, it is viewed as a way to contextualise science teaching and learning to sustain education development. The findings indicate that IK of the Baduy community coincides closely with school science concepts. The findings of this study are more or less similar to the findings by Handayani (2018), and Anazifa and Hadi (2017). In a nutshell, the authors of the above studies have shown that the integration of IK assists in the relevance of the science curriculum, the link between science and IK, and the sustainable development of the education system. Most importantly, they show the similarities between IK and scientific knowledge. I take a stance that the learners we are teaching nowadays are the kind that needs the content they can relate to and which is relevant to their lifestyle. Hence I created a setting that engaged the learning of fermentation through the integration of their day-to-day practices at home.

Nevertheless, a concern was raised by Carter (2011) that in Canada, the history and worldviews of the Aboriginal people was not taken into consideration by the

education system due to colonisation. Carter posits that if Aboriginal IK and western science can be combined in one setting, the learners will be afforded an opportunity to acquire a new approach; and as a result, they will understand the world around them. In this regard, my concern as researcher is that learners' IK regarding the making of fermented foods and beverages was not fully considered in the teaching and learning methods. I agree with Carter (2011) on the basis that, learners understand better if they are taught using their prior knowledge. If we combine the IK of learners regarding fermented foods and beverages, they will understand the topic of fermentation as it is taught; and they will also be able to approach any scientific problem around the topic. IK is usually considered as an African concept, but I think western people also have their IK that should be looked into. In North America, Alkholy et al (2017) conducted a study intending to investigate how the indigenization of western biochemistry could have an impact on white and non-white learners. They had all the learners co-taught by Aboriginal indigenous science teachers. A greater number of learners were interested in science, technology, engineering and mathematics (STEM). Their findings suggest that it is important to expose learners to IK through cooperation between indigenous science educators and western trained science educators. My standpoint is that learners should be exposed to the teaching and learning of science in school, thereby collaborating with the knowledge taught by non-scientific parents or elders. The reason for the above practice is that our learners seem to understand a concept better when they are not only taught in a formal setting.

Similarly, Alkholy et al (2017) and Jacobs et al (2018) posit that IK is a useful source of bringing education to all learners, and will improve how people associate all-around communities. This argument was based on attempts by the United States to convert the public school curriculum. They indicate that if the educators in schools and departmental policy inventors are unobstructed, they may learn a lot from IK and advancement issues in science learning and teaching.

With my experience as a Life Sciences educator, I agree with the latter researchers. I take a stand that integration of IK into science learning will make the learning of western science less complicated as learners regard school science as such. I

further posit that the positioning of IK into the curriculum and policies will be easier to implement in a day-to-day teaching and learning program.

While the learners in general are struggling to identify and position themselves with the relevant IK, traditional African educators have been using different educational and tuition strategies as well as models and facilities to educate the youth. Education in African communities has taken place in formal and non-formal areas. Other contexts of curriculum delivery may be used to benefit west- African education (Semali & Kincheloe, 1999).

In Africa, the curriculum should be continuously re-examined by departmental policymakers and educators. Re-examination aims to avoid all the expressions of colonial supporting structures, thereby stressing indigenous ideas and handling Africa's distinctive actualities and challenges (Ezeanya, 2011). Ezeanya argues that entrusting IK as a basic principle in science learning and teaching in Africa will bring about the tendency which has been established as the base of creativity and innovation. Supporting Ezeanya (2011), Mhakure and Otulaja (2017) indicate that African children should be taught in a way that science will make sense to them. Perhaps more learners from rural areas will choose Life Science as a school subject. I agree with the latter researchers and support their conclusions because what learners understand better is what is happening around them; they are also part of it (Mayana, 2020).

2.3.2 IK integration as affordance to learners' understanding of science within the borders of South Africa

Although society is quickly changing, the role that IK plays in the development of learners cannot be ignored. Learners already possess knowledge from home before they attend school, though not documented but transferred orally and through observations of traditional practices (Ronoh, 2017). South African curriculum aims at making the Life Sciences classroom a culturally relevant place. Msimanga et al. (2017) recommend that all learners should be given an equal opportunity to learn in a Life Sciences class, including the language of teaching and learning. Ramirez and Ross (2019) and Mandikonza (2019) are of the idea that the IK of all learners should be brought to a science classroom. The knowledge brought to the class will serve as

a link in the teaching of school science. This should be a starting point for learners' understanding of concepts in science textbooks.

At the same time, Madinkonza (2019) takes it further by recommending that the IK of all learners and educators should be integrated into class so that their knowledge may enable them to survive; and they benefit from this particular practice. Madinkonza conducted a study to explore how the integration of IK could be done in an educator training classroom. The findings of the study reflected that it is essential to use methodological practices and approaches that learners are familiar with. Ahanonye (2021) conducted a qualitative study to explore teachers' views on the integration of IK in a life Sciences classroom. The problem identified was that although integration is clearly emphasised, the South African curriculum did not provide strategies on how it should be done. In the findings of that study, it was recommended that the department of basic education should clearly state and provide information for effective integration. The study concurs with Msimanga et al. (2017) and further implies that the integration of IK into westernised Science teaching and learning will make Life Sciences more meaningful to learners as it will be more culturally relevant.

She specifically conducted a study to integrate Indian IK (Ayurveda) into the South African curriculum. She used the former as a contributing factor towards the pedagogy of IK integration using short learning programs for Life Sciences educators. The outcome was that all educators who participated in the study agreed that IK and Ayurveda integration into the Life Sciences curriculum is of great value to South African learners. The short learning programs indicated that the integration of Indian IK is possible. I agree with Reddy (2019) on the fact that South African learners need to also know other cultures' IK and relate it to classroom science. As a result of the integration of IK, our learners will gain more knowledge and confidence so that they may be able to explore the world as better citizens.

In this study, I argue that the preparedness of learners to learn is motivated by the cultural interaction between indigenous and scientific ways of knowing. Integrating the day-to-day knowledge of learners from home is engaged in this study so that fermentation will be made relevant to learners' context.

2.4. IK integration as a hindrance to learners understanding of science concepts

Learners' progress towards achieving the learning goals depends upon the structure for appropriate action presented by the hindrance of the setting (Kennewell, 2001). The hindrances will relate to generic factors such as literacy, cognition and IK, which is also involved in this study. For instance, if learners are engaged in an activity to describe a process in Life Sciences by showing a video in class, the less gifted learners may display a hindered version if they were requested to fill the missing words on a hard copy of the same description of the process. In relation to this study, learners will display a hindered version of the understanding of fermentation if IK is not integrated properly into the learning of the fermentation process.

There is a drop in the number of learners registering for Life Sciences as they lack interest in the subject due to several contributing factors. One of the factors is the decontextualized way in which Life Sciences is learned (Manyana, 2020). Kibirige and Van Rooyen (2006) indicated that IK has been neglected in science for a long time, even though it has existed across the world for so many years. The negligence of its integration appears to be a hindrance.

Concurring with Kibirige, Van Rooyen and Khupe (2014) highlight the fact that the integration of IK into science is prejudiced by educators and learners. Life Sciences educators always ignore the curriculum involving the integration of IK as there is little expectation from the policies on the practicality of integration (Khupe, 2014). The major defence in this regard is that examinations have not singled out the importance of IK over many years (Mayana, 2020).

The omission and negligence of IK in past curricula in South Africa is regarded as the altered knowledge fault during the apartheid era (Regmi & Fleming, 2012). This altered knowledge fault is regarded as rote learning. Rote learning involves the acquisition of surface knowledge that is not learning-driven but examination and assessment-driven (Visagie, 2016). Posing the same idea, Ronoh (2017) regards the more western-centred pedagogy as formal education that opposes the constructed IK by learners. As a result of disregarding IK, learners will not be taken through the journey of inquiry to formulate a hypothesis, make careful observations and

communicate their findings (De Beer, 2019). I perceive the disintegration of IK as a scientific knowledge failure. If learners are not exposed to IK integration, we will end up producing a generation of learners who cannot be fruitful in their journey of learning.

2.5. Other issues surrounding the integration of IK as hindrance into the Science curriculum

Though IK should be integrated, some educators do not agree that there is IK that should be integrated, and others do not know how to do it (Bhudah, 2021). On that note, Ronoh (2017) conducted a study on two universities: one from South Africa and another from Kenya, with educators. The marginalization of IK in the school curriculum was identified. Ronoh proposed an inclusive education system but did not indicate which IK is to be integrated. Since Kenya has a broad IK as much as South Africa has a diversity of IK, the results of this study indicate a more generalized view which would bring a lot of benefit to the education system. While Ronoh generalizes the IK that should be integrated, Mayana (2020) conducted a study to find out which IK could be integrated into Sciences class from a different perspective. It was discovered that the idea that IK could be integrated is present but not relevant. Instead of IK influencing learning, it enhances argumentation and discussions.

In a different line of argument, Bhuda (2021) highlights that during Covid-19, educators were supposed to teach indigenous learners through methods that they were not familiar with. The teaching methods included online teaching that involved technology, which was not familiar. As a result, indigenous learners felt alienated and could not learn online during the period of the Covid-19 lockdown. Bhuda (2021) insists on the fact that Covid-19 has exposed the flaws of the South African curriculum by not benefiting rural learners and their cultural backgrounds, as rural and indigenous learners prefer to be taught and want to see science through the eyes of known concepts at their disposal. I agree with Bhuda (2021) that Covid-19 has brought a learning barrier to our indigenous learners. As an educator teaching in a school located in a rural area, it was not easy to reach out to learners especially if we needed to integrate IK through technological means. The most effective way to integrate IK is through hands-on activities where learners will be able to observe and touch the materials and not only learn online through technological means.

From the literature that I reviewed, most researchers focus on the views and conceptions of educators on the integration of IK. Furthermore, the focus is on how and which IK should be integrated into a science curriculum. Few researchers looked into the possibilities of integration on the side of educators. I have identified a gap in literature where there is not much literature based on how learners will receive the integration of IK in Life Sciences, hence I explore the affordances and hindrances of grade 11 learners' understanding of fermentation when integrating IK.

2.6 Role of theory in the study

The theory underpinning this study is situated learning theory (SLT) by Jean Lave and Etienne Wenger (1991). SLT is regarded as a learning model that is based on a community of practice. This learning model is a process of interaction and relations around a specific realm that takes place within a social, cultural and historical state of affairs, resulting in unforced (unintentional) learning (Lave & Wenger, 1991).

Lave and Wenger (1991) posit that the way people understand concepts is changing with the evolving of the social context; the authentic setting dictates how the understanding occurs. They further argue that the transfer of knowledge is not easy between disparate tasks and instructions in learning, and is obstructed. Their argument is based on the fact that learning should occur in a real social environment. In support of Lave and Wenger, Morteza and Osman (2021) argue that knowledge in schools and social practices should not be treated as separate knowledge to avoid the obstruction of learning.

On the other hand, Meriam (2018) posits that SLT is based on three factors in the setting in which learning takes place: the individuals involved in that context, the materials present in that activity, and the activity or the task itself. In the same line of argument, Lave (1988) says that learning takes place within a community of practice where learners engage with each other to share the same learning goals.

Lave and Wenger suggested the following: Firstly, situated learning is grounded in the sociocultural theory of development. The theory states that a learner's cognitive development is greatly influenced by the culture surrounding them (Vygotsky, 1978). Secondly, learning should take place in communities of practice. Learners engage

with each other to share the same learning goals. Thirdly, learners begin as legitimate peripheral participants (LPP) and gradually become members of the community of practice.

2.6.1 Sociocultural theory of development

The theory by Lev Vygotsky suggests that a child's learning is a social process, and that the mental functions are a result of the interactions with people who are more equipped with skills around a child. According to the sociocultural perspective, the individuals in our lives who have coaching roles guide our cognitive growth**.** On the other hand, learners' values and beliefs are developed through their interactions with social groups.

2.6.2 Communities of practice

Communities of practice are individuals in groups with the same interest or passion for a particular content, and who are learning how to do it better through interactions. However, individuals are converged by joint similar activities and by the lessons learned through their participation in the activities (Wenger, 1991)**.** Lave and Wenger (1991) argued that every learner is involved in communities of practice that they find themselves in. The situated learning model suggests that learning involves the engagement of individuals in a community of practice at either work, home or school. In this study, our community of practice was formed by a group of grade 11 learners learning the topic of fermentation through collaborative learning when integrating IK.

According to Lave and Wenger's (1991)'s theoretical point of view, learning is regarded as a component of a community of practice. They further emphasise that relationships in learning are situated in relationships of the community, and that the process of learning ensures the development of the individual's membership in the community and the shaped identity (Wenger, 1991).

2.6.3 Learners as Legitimate Peripheral Participants (LPP)

LPP is a learning process that takes place when a novice is introduced into the community of practice (Lave & Wenger, 1991). LPP expresses how the novices

become masters of collaborative activity. According to Lave and Wenger, learning is considered to be a contextual social situation that is accomplished through a community of practice. Novices become familiar with the performed tasks through peripheral activities. In this study, the educator and learners who master the art of IK assisted the learners who did not understand IK concerning fermentation. In this way, the less knowledgeable ended up being members of the community by imitating the skills learned from experienced participants. LPP proposes that membership in a community of practice is attributed to the physical and social participation of novices.

As the novices become more comfortable and knowledgeable, they engage gradually in the main activity and shift from LPP to full participation (Wenger, 1991). Learning is perceived as a social participation process rather than the acquiring of knowledge as individuals. Thus, the process is significantly impacted by the situation' nature (Tennant, 1995).

As much as I acknowledge the standpoint of the above-mentioned authors, I adopted SLT as proposed by Greeno (1994). Supporting Lave and Wenger, Greeno's (1994) SLT is grounded on the perception that the best way to learn is through social interactions, constructivism and authentic context. Greeno's (1994) idea of SLT is that the interpretation of learners' views and behaviours is a result of participation in cultural and social situated point of view. To this point, the implementation of SLT in this study will be based on the following tenets.

2.6.4 Tenets of SLT

The tenets of SLT as proposed by Greeno (1994) are constructivism, authentic context, and social interactions. This is a learning approach through constructivism within an authentic context involving social interactions (Bell, Maeng & Binns, 2013). SLT is based on the philosophy that one learns through social interaction, authentic (real-life) context, and constructivism (Greeno, 1994).

In this study, SLT holds that learners were interacting with each other through collaborative learning where they constructed their knowledge when learning fermentation in a real or normal classroom condition. Educators in ways that include

excursions, incursions, learning through doing as well as educators acting as mentors (Lave & Wenger, 1991) may use SLT.

2.6.5 Constructivism

Constructivism is an approach to learning where learners actively build their knowledge, and learning is actuality determined by the knowledge of the learners (Elliot et al, 2000). Constructivism does not only recognise the distinctiveness and difficulties that learners encounter but motivates learners, and is used as part of the process of learning. It is essential to remember that constructivism is not a type of pedagogy but a form or strategy that describes how learning takes place. It emphasises the construction of knowledge by learners based on their encounters. Nonetheless, in most cases, constructivism is associated with pedagogic approaches that encourage active learning, which is defined as the activity of learning in which learners take part or interact with the process of learning, contrary to absorbing the information passively (Zhou & Brown, 2015).

The necessity of constructivism is that it motivates the learners to arrive at their version of their truth and conclusions (Richards & Roberts, 1994). Moreover, the accountability of learning is highly bestowed upon the learners (Haneda, 2006). Thus, the importance of learners being actively involved in learning is emphasised by constructivism. Relating to my study, learners were allowed to learn the topic of fermentation by bringing up their prior knowledge and discussing it with other learners to arrive at conclusions.

2.6.6 The role of the educator and learners in constructivism

Since this study focused more on learning through IK integration, the roles of the learners and educators should be well understood. Constructivism is unlike the traditional method where the learning responsibility was only for the educator to deliver and the learners were just passive recipients of knowledge. During learning, through constructivism, learners gather their knowledge and understanding. They do not just replicate and reflect what they are taught (Taber, 2011; Zhou & Brown, 2015). Instead, the educator just observes and might initiate or direct the discussion. Hence, in this study, I just introduced the topic of fermentation and directed learners into the discussions. Learners mostly engage in discussion, collaboratively acting as

a team to ensure functionality (Brandon & All, 2010, p. 90). The aim is not to compete but to share responsibilities and goals.

The learners were orientated into the discussion world. They were divided into groups where they worked as teams to discuss the topic of fermentation. They were also allowed to share the knowledge they had about the IK revolving around the making of fermented food and beverages. Learners gained their knowledge without the educator imposing facts on their discussions. I emphasise the necessity for learner-centredness because the specific aim of the CAPS document encourages the learner-centred approach. Hence my study explored the affordances and hindrances on the learners' understanding of fermentation when learning through the integration of IK.

2.6.7 Authentic context

Authentic context focuses on participation in natural settings in communities of practice (Lombardi & Oblinger, 2007). The two mentioned authors posit that in education, this approach enables learners to meaningfully explore and discuss concepts in a real-life context that is learner-relevant. Similarly, Donovan, Bransford, and Pellegrino (1999) regard it as an instructional learning approach used to allow the exploration, discussion and construction of concepts and relationships involving project and real-world challenges relevant to the learner.

In this study, learners approached learning through the discussion of everyday practices and challenges they engaged in. Firstly, they were placed in their normal classroom with classmates that they were comfortable being with daily. This created a natural setting for them. Secondly, learners were allowed to discuss processes that they are familiar with, such as the making of bread, mageu, traditional beer, and other fermented food and beverages to drive the learning of fermentation. Hence Ezeanya, Mhakure and Otulaja (2017) suggested that learners should receive their learning in ways that make sense to them.

Authentic context is contrary to the traditional method where knowledge is regarded as a collection of aspects and methods that are transferred from the educator to the learners (Taber, 2011; Zhou & Brown, 2015). Thus, the main aim of learning is to

obtain a massive collection of these aspects and methods. This context also incorporates the constructivist approach where learning is taken as an active process (Ahanonye, 2021). Thus, learners put more effort into the learning process as emphasised by the CAPS document, which regards it as a learner-centred approach.

Educators allow learners to come up with their knowledge through self-directed exploration in a real-life context. The learners' prior knowledge and personal encounters greatly influence the construction of knowledge (Lee, 2011). Learning in this regard is learner-centred where learners' application of knowledge is grounded in real-life situations.

In this study, the authentic context was ensured by making learners understand that they were also able to learn fermentation from home. In other words, I tried, by all means, to bring the home experiences (IK) into a formal Life Sciences classroom so that learners may learn fermentation in that relaxed mood. The making of fermented food and beverages was the perfect example to learn in a real Life Sciences classroom and was good exposure for learning.

2.6.8 Social interactions

Social interaction is the process through which learners act and react toward other learners around them (Tuner & Nolen, 2015). I regard it as the source of development in learning. Social Interaction with others allows learners to relate themselves to the situations. According to Vygotsky (1978), learning and development is a process of traineeship and incorporation in which abilities and understanding are reshaped from the social into the cognitive plane. Vygotsky emphasised that social interactions among learners greatly promote the cognitive development of learners.

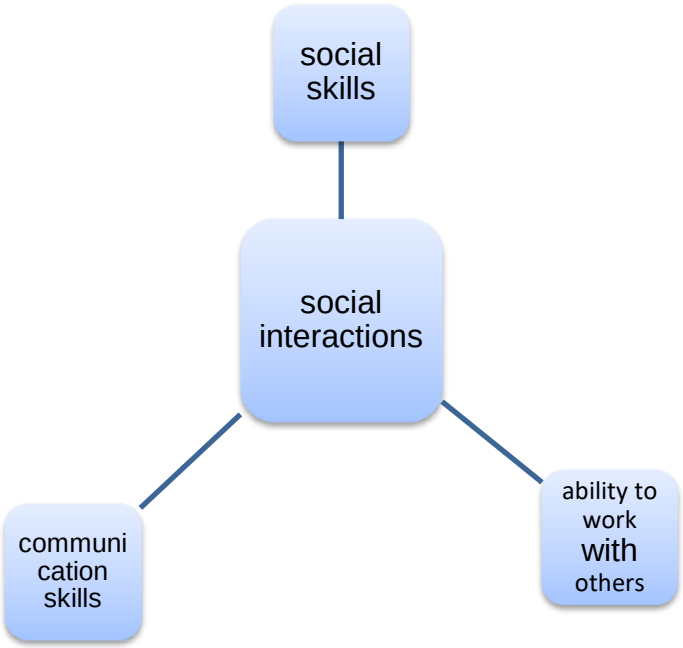
To this end, Nyika (2017) argues that whatever transpires outside the boundaries of a classroom embodies the culture of a society. Furthermore, Thaman (2009) affirms that education should not disregard the knowledge of culture because the scope of education has value underpinning a certain culture.

In this study, I used collaborative learning activities during lesson presentations to create an environment where the learners use their views in a natural setting (Crotty,

1998). In this case, the major bases of the Life Sciences classroom activity are the social interactions where formal learning is taking place among the social actors (learners) in a classroom in a social context.

2.6.9 Benefits of social interactions

Figure 2.2: The benefits of social interactions



Bruner (1983) suggested that learners who interact with their peers will cope well within social environments throughout their entire life. Social interactions will result in the development of the following life skills:

Firstly, social skills: these are the skills that a learner processes, knows how to interact with other learners, and is having the ability to interact successfully. It is through social interaction that learners may learn how to react to others. Learners learn how to display respect for other learners and how other learners expect them to treat them as well (Tuner & Nolen, 2015).

Secondly, communication skills: Communication skills are essential lessons that learners should learn during various social interactions. According to Vygotsky (1978), learning proper communication in class will develop communication skills and assist learners to express themselves properly among other learners.

Thirdly, the ability to work with others: Janse (2020) emphasises that group work always encourages teamwork. When learners are working together, they learn how

to work as groups and the groups are more effective. In social interactions, learners learn how to compromise, share and develop the skill of working together to achieve similar goals. Social interactions may allow learners to learn their lessons unintentionally or without force.

Relating to my study, the grade 11 Life Sciences learners were allowed to interact with each other. This acted as an expanded opportunity for them to develop the skills that will encourage good cooperation resulting from discussions and arguments that may have arisen. Learners could be able to work in groups to bring about effective learning.

In this study, the theory of situated learning allowed learners to construct knowledge among them using their IK on fermentation relating it to the process learned in class. For the constructed knowledge to make sense, it has to be integrated into the already existing knowledge (Ausubel, 1968). Emphasising the same idea, with constructivism and social interactions in mind, I considered what learners already know and allow them to put their knowledge into practice (Creswell, 1999). Driver (1986) and Naidoo (2005), who assert that it is expected that learners bring some prior knowledge (including traditional culture) or conceptions into the real-life learning environment, back up the above statement.

2.7 Chapter conclusion

In this chapter, I defined IK outside and within the borders of South Africa. I interrogated the relationship between western Science and IK. I shed some light into the comparison of the NOS and NOIK, and their tenets. IK is discussed in this chapter as it is integrated into a Life Sciences classroom and the impact of integration and disregard on learners thereof. The discussion on IK in this chapter is context-specific and is based on community knowledge. Due to the debate on the integration of IK into Science learning, I also discussed some issues around its integration. I last discussed the role of the theory underpinning the study. The next chapter will address the research methodology.

CHAPTER 3: RESEARCH METHODOLOGY

3.1. Introduction

In the latter chapter (chapter 2) of this study, I reviewed the literature that is relevant to the current study. In this chapter, I outline the research design and methods used to explore whether there are affordances and hindrances in the grade 11 Life Sciences learners' understanding of fermentation when learning through the integration of indigenous knowledge (IK). The discussion kicks off with an explanation of the research design focusing on the qualitative approach and the case study method. It is thereafter followed by sampling, data collection techniques, and analysis methods in detail. The ethical issues that were considered in this study are finally discussed.

3.2 Research design

3.2.1 Qualitative research approach

Qualitative research design is an approach that dwells much on data collection in a natural setting, and that particular data is gathered in words than in numbers (McMillan & Schumacher, 2010). This approach was chosen for a particular reason which, according to Creswell (2014), is used to explore the meaning and understanding that the groups can give to a social problem. This approach involves generally the searching and exploration with different methods until the researcher achieves a deep understanding of the phenomenon. Among the characteristics of qualitative research, natural settings were considered. The behaviour was explored as occurring naturally and the behaviour under study was not manipulated or controlled by the researcher (Creswell, 2007). This study was located in the qualitative research approach because the actual grade 11 Life Sciences classroom is referred to as a natural setting and no constraints from the outside environment were imposed.

The second characteristic among others that distinguish qualitative research is direct data collection (McMillan & Schumacher, 2010). In this study, I collected data directly from the research site acting as the observer. The aim was to see if there were affordances and hindrances to the grade 11 Life Sciences learners' understanding of

fermentation when integrating IK. As a qualitative researcher, I saw it necessary to spend enough time interacting with the learners to get information directly from the class that I am teaching as the source of data.

The third distinguishing characteristic as regarded by Berg (2004) is the participant perspective. The latter statement implies that as a qualitative researcher, I always tried to reconstruct reality from a participant's standpoint. As a researcher, I had a goal to understand the grade 11 Life Sciences learners' from their point of view, focusing on the events and actions taking place as the lessons were presented in a classroom setting.

3.2.2 Case study

The case study is a design that the researcher uses to deeply examine a bounded system over time using different data sources found in a setting (Creswell, 2007). A qualitative case study design was chosen because it provides the researcher with techniques to study complex phenomena in their natural setting (Baxter & Jack, 2008). This qualitative case study is an exploratory case study which its primary focus was on real-life context and situations. Research cases usually differ. It might be an activity or a group of people who are time and place-bound. Selecting a case is based on its uniqueness, or the case may be utilised to illustrate a concept (Stake, 1995). The focus of a case study depends on the choice of the researcher; the study might be done within a site or multi-site (McMillan & Schumacher, 2010). Locating this study as a case study was based on the fact that I wanted to deeply examine the case of the grade 11 Life Sciences' learning of fermentation through the integration of IK. The study was confined to the boundaries of a Life Sciences classroom in a school through the duration of three lesson presentations.

3.3. Sampling

Sampling is the process of selecting individuals as a representative (sample) of a large group (population) to predict the characteristics of a population (Jones, 1995). The population of this study was all the Life Sciences learners in a secondary school in the Dimamo circuit. Grade 11 learners who enrolled for Life Sciences were purposively and conveniently selected and therefore served as a sample. There

were 42 Grade 11 Life Sciences learners in a classroom, who were purposively selected because they were enrolled for Life Sciences and were in grade 11. Additionally, they were attending a particular school based within the Dimamo circuit. Furthermore, the class was eligible to be taught the topic of fermentation, which forms part of the grade11 syllabus as outlined in the Life Sciences CAPS teaching plan (DBE, 2011). Convenient sampling is a strategy of selecting participants that are readily available and accessible, or selecting participants until reaching a sample size (McMillan & Schumacher, 2010). They were also conveniently selected as I, the researcher working at the school, of which the selected grade 11 learners' (participants) class is part of the grades I teach. Thus, by conveniently selecting the participants, the data collection process was cost-effective for me

3.4. Data collection

Data collection is a systematic process that I used to gather and measure information on selected individuals to answer research questions and to evaluate outcomes (Creswell, 2017). In this study, data were collected on three occasions using observations, documents review and unstructured interviews. The rationale for using these instruments is deliberated below:

3.4.1. Observations

Observations are a technique used to systematically and significantly gather data by looking at events and behaviours of participants in the research site (Marshal & Rossman, 1998). As a participant-observer, I engaged in some of the activities at the research site (Creswell, 2014). For me to establish how the integration of IK in Life Sciences may hinder grade 11 learners' understanding of fermentation, I took field notes as a data collection tool. Field notes are records of what is observed or heard by the researcher (Creswell, 1999). These notes possessed literal descriptions, reactions and comments on the experiences of the observer during the session observed. In this study, learners' actual behaviour was observed as they worked collaboratively in their respective groups. The taking of field notes during the observation was done in the process of lesson presentation.

3.4.2. Interviews

Interviews are qualitative data-gathering techniques involving verbal communication between the researcher and the participant (Boyce & Neale, 2006). The researcher obtains relevant information through verbal responses given by the participants (Gubrium, 2001). In this study, learners were divided into 6 learners per group. Information was obtained from a group of 6 learners engaged in cooperative learning and from individuals belonging to the groups (Creswell, 2014). This study adopted focus group interviews (unstructured). The size of the group which was 6 learners in a group allowed the participants to be comfortable talking to me as the researcher and to each other (Corbin & Strauss, 1998).

In this study, I presented 3 cooperative learning activities which learners completed in their groups. The 3 activities took three sessions to be completed. They were practically based on fermentation through the integration of IK. In the process of each activity, I verbally ask questions concerning fermentation and allowed learners to communicate in a natural setting. I continually acted as a facilitator by asking clarity-seeking questions and redirecting conversations to the topic. My main aim was to engage learners and used the opportunity to get a better understanding of how the integration of IK afforded or hindered understanding and sense-making of the topic of fermentation. Participants were interviewed in their groups during a lesson presentation. I made sure that every participant was actively involved and picked up those who hesitated to open up for discussions by asking their opinions. I also used the reflective journal which used to keep a record of what I and participants did during the process of gathering data.

3.4.3. Document analysis

Document analysis is a form of data-gathering technique that allows the researcher to use documentary evidence to answer research questions in a systematic way (Bowen, 2009). The technique allowed me to examine and interpret data to get meaning and understanding of the topic of interest (Corbin & Strauss, 2008). To establish how the integration of IK hinders and affords the understanding of fermentation by grade 11 learners, learners were given three activities to write, and I collected the scripts for analysis. The scripts were regarded as documents to be

analysed to detect if there are any hindrances and affordances in the understanding of fermentation when IK is integrated into Life Sciences learning in class. According to Stake (1995), data collection and analysis can be done simultaneously. Therefore, the same activities (tests) were used for data collection and analysis.

3.5 Data analysis

Data analysis is the process of scrutinising collected data and impressions to give meaning and to arrive at conclusions (Stake, 1995). Stake (1995) suggests the use of categorical aggregation and direct interpretation as strategies for data analysis. Categorical aggregation is the process used by the researcher to draw meaning across multiple instances of data collected while direct interpretation refers to the process where the researcher draws meaning across parts of one instance of collected data (Creswell, 2005) This study employed a descriptive case study design and largely relied on qualitative data that was analysed through categorical aggregation (Stake, 1998). According to stake (1995), searching for meaning implies searching for pattern consistency. With categorical aggregation, patterns of meaning in a data set help the researcher to make sense of the content and to derive meaning from a particular content (Braun & Clarke, 2013). In this study, the categorical aggregation assisted me to draw meaning across the three instances (sessions) where data was collected. All the patterns came from naturally collected data, which in this case were from one group which was purposively sampled. The quality of the data gathered through the three sessions needed to be validated through quality criteria.

3.5.1. Quality criteria

Data validation is the state in research where the researcher assesses the credibility of the data collected (Creswell, 2014). In this study, quality criteria ensured that there was a common understanding between the researcher and the participants. Data collection processes and instruments used to collect data were verified by professionals, including teachers and supervisors. In other words, the instruments used for data collection were included in the application of ethics. This ensured that the rights of participants and the quality of the study were not compromised. Stake's view of the case study uses triangulation to validate data (Stake, 1995). This study

also employed data source triangulation, in which established themes are based on converging impressions from participants (Stake, 1995). In a qualitative study, confirmability, transferability, credibility, and dependability are ensured throughout the study (Gay, Mills & Airasian, 2014).

3.5.2. Credibility

According to Polit and Beck (2012), credibility is defined as the actuality of the findings of a research study and how the researcher interprets the finding. As highlighted above, in the context of this study, I used triangulation, where the supervisors and learners (member checking) checked the research to ensure credibility. Furthermore, data was collected through unstructured interviews, participative observations and the reviewing of documents to ensure triangulation. Hence, Casey and Murphy (2009) define triangulation as the means and a process whereby a researcher uses more than one method of data collection. Returning the collected data to the participants to check for precision is known as member checking (Carlson, 2010). Participants were allowed to confirm the themes noted during data collection, as participants' credibility was mirrored when they confirm that the findings were exactly what they said (Streuburt & Carpenter, 1995).

3.5.3 Confirmability and dependability

Confirmability is the criteria of trustworthiness that I established. The criteria had to do with the level of confidence that the findings of this study were based on the participants' words rather than my own biases as a researcher (Gay, Mills & Airasian, 2014). The rationale for confirmability was to verify that the findings were more shaped by participants than were shaped by me as the qualitative researcher. The strategy used to establish confirmability in this study was audit trial. Audit trial is when the researcher details the data collection, analysis and interpretation processes. I recorded the unique and interesting topics during data collection, wrote down my thought about coding, provided for why the codes were merged (creswell, 2005).

According to Tobin and Begley (2004), dependability is described as the uniformity of the research findings over similar conditions. In the context of this study, a reader was allowed to read the study to see if there was an establishment of

comprehension of the researcher's context, which assisted in the conclusion of the study. Furthermore, I ensured dependability by aligning the methods of data collection in a way that others can be able to use it.

3.5.4 Transferability

According to Polit and Beck (2012), transferability is the procedure of applying the findings of the research to other similar situations. In other words, transferability will help to determine the extent to which the research findings can be generalised or transferred to other similar contexts. In the context of this study, I used detailed and comprehensive descriptions of the results from unstructured interviews, participative observations, and document reviews to highlight how the findings can be applied in other settings.

3.6 Ethical considerations

3.6.1. Permission

The researcher firstly requested ethical clearance from Turfloop Research and Ethics Committee (TREC). Permission from the Limpopo Department of Education, Dimamo circuit and the principal of the school concerned was also requested. After permission was granted, I issued out consent forms to learners who were 18 years old and above while assent forms were given to learners who were under 18 years. Once the consent and permission from parents had been gained, all learners participated in the study.

3.6.2. Potential risks to participants

When the researcher introduced the study to the participants, they were informed of their rights to withdraw if they somehow felt uncomfortable during the process. They were assured that there were no scores for the activity and the activity was not to be used for any school-based assessment. Privacy and confidentiality of the participants was assured as they were doing some activities in the form of writing. It was ensured that participants were not exposed to any physical, mental, emotional and social harm (Van Eeuwijk, 2017).

3.6.3. Anonymity

Participants were not allowed to use their real names when engaging in learning activities. They were only allocated pseudonyms and codes. The purpose of the pseudonyms and codes was for easy recording, analysis and grouping. The completed responses were kept safe and secured by the researcher. Neither educators nor the school management had access to the information. All the responses were destroyed after the completion of the study.

3.6.4. Bias

There were no specific selection criteria for participants based on performance. That is, participation was voluntarily. Voluntary participation is the participation where participants were not forced, coerced or compelled to take part. An equal opportunity on learning fermentation through the integration of IK was given to all the learners in the class though. Thus, even if some learners decided not to take part in the project, the educator still conducted a class apart from the project to make sure that all learners in a grade 11 class were taught the topic of fermentation. Since the researcher was collecting data from the school in which she was working, there was a need to ensure that there was no bias or coercion/ influence to the participants, who were also not forced into participating in the study (McMillan & Schumacher, 2010). To ensure that the participants did not feel coerced into participation, the researcher engaged a neutral colleague such as the HOD who was not teaching the class to explain how the research was to be conducted. Informed consent forms were also signed as evidence that they were participating in the study voluntarily. The researcher requested the supervisors to review her conclusions. This was done with the hope that the two supervisors would see the things that the researcher missed, or gaps that needed to be addressed would be identified in the arguments. The supervisors affirmed that the research conclusions were reasonable.

3.6. 5. Reliability

The same group of participants from one locality and school will participate in the study to maintain consistency and to ensure the quality of results (Creswell, 2005)

3.7. Chapter conclusion

This chapter discussed the research design, approach, and generally how the research was conducted. The kind of report and data-gathering methods were discussed in detail and the intentions for the use of sampling purposively and conveniently were vindicated. Ethical considerations regarding this study were also outlined. In the next chapter, the presentation, analysis and discussion of findings will be done in response to the two research questions.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND DISCUSSION.

4.1. Introduction

The previous chapter presented the methodology of the study where the research design, sampling technique, data collection methods, data analysis ethical considerations and quality criteria were discussed in details. This chapter in particular will focus on the presentation and discussion of the results. The main aim of this study was to explore the affordances and the hindrances to grade 11 learners' understanding of fermentation, through integrating IK in the class. The chapter begin by outlining the research question the study intended to answer.

Table (table 4.1) indicates the codes that were used in the discussion of findings. The above is followed by the mini biographical information of grade 11 Life Sciences learners of a Secondary School in Limpopo province who participated in this study (table 4.2).

Learners in the grade 11 Life Sciences classroom were divided into seven groups of six learners each. Each group were given a pseudonym and a code as follows: apple (APP), orange (ORA), banana (BAN), watermelon (WAT), pear (PE), lemon (LEM) and avocado (AVO). Due to the nature of the combination of the groups, individual learners were also given pseudonyms and codes as follows: The letter G representing a girl learner, for an example Girl1 (G1), while letter B represents a boy learner for an example Boy2 (B2) and so on until number 42. Table 4.1: Keys used in the discussion of findings

Table 4.1: showing the codes and pseudonyms in the groups

Pseudonym	**Code**
Boy/Girl 1-42	G/B 1-42
Apple	APP
Orange	ORA
Banana	BAN
Watermelon	WAT

Pear Lemon Avocado	PE LEM AVO

I also indicated the biographical information of learners. The reason for showing this information was to have a better understanding of the learners' backgrounds. This background was very essential as it allowed the researcher to determine the influence of their background on IK. The biographical information was presented in a table (4.2) below. The information was presented in the following criteria; age, gender and caretaker. According to the information, 20 learners were at the age 16 years, 15 learners at the age 17 years and 7 learners at the age 18 years. The groups were a combination of males and females, 18 males and 24 females. Lastly, the information on the learners' caretakers reflected that 25 learners stayed with their parents, 14 with their grandparents and 3 had no elderly person to stay with (child headed-household). The caretakers in this regard are the elderly people who stay with the learners on a daily basis. This elderly people have an influence on the prior knowledge that learners bring to class as their IK.

Table 4.2: showing the biographical information of learners.

Biographical information	**Category**	**Code**	**Total**
	16	G4, G5,G6,B7,G10, G17, B16, B18, G11,G13, B14, G19, G20, G26, GL29, B31,B33, G34,B37, G39	20
	17	G21, B22, B23, B27,G28,G30, B32, G35, G36, B38,B40, G41,G42, B24,	15

Age		G25,	
	18	G1, G2, G3, B8, B9, G12, B15	7
Gender	Male	B7, B16, B18 ,B14, B31,B33, B37, B39, B22, B23, B27, B32, B3, B40, B24, B8, B9, B15	18
	Female	G4, G5,G6, G10, G17, G11,G13, G19, G20, G26, G29, G34,G39, G28, G35, G36, G41,G42, G25, G1, G2, G3, G12, G21	24
Caretaker	Parents	B39, B22, B23, B27, B32, B38, B40, G28, G35, G36, G41,G42, G25, G1, G2, G3, G12, G19, G20, G26, G29, G34,G39, B15	25
	grandparents	B7, B16, B18 ,B14, B31,B33, B37, G4, G5,G6, G10, G17, G11, B9	14
	Child headed-household	B24, G1, G30	3

Learners were divided into 7 groups of six each (mixture of boys and girls) as indicated in figure 4.1. The three activities were presented on different occasions. During the three occurrences of lessons, learners were working on activities that integrated IK. To ensure the relevancy of the findings of this study, learners were given questions to answer in all three activities.

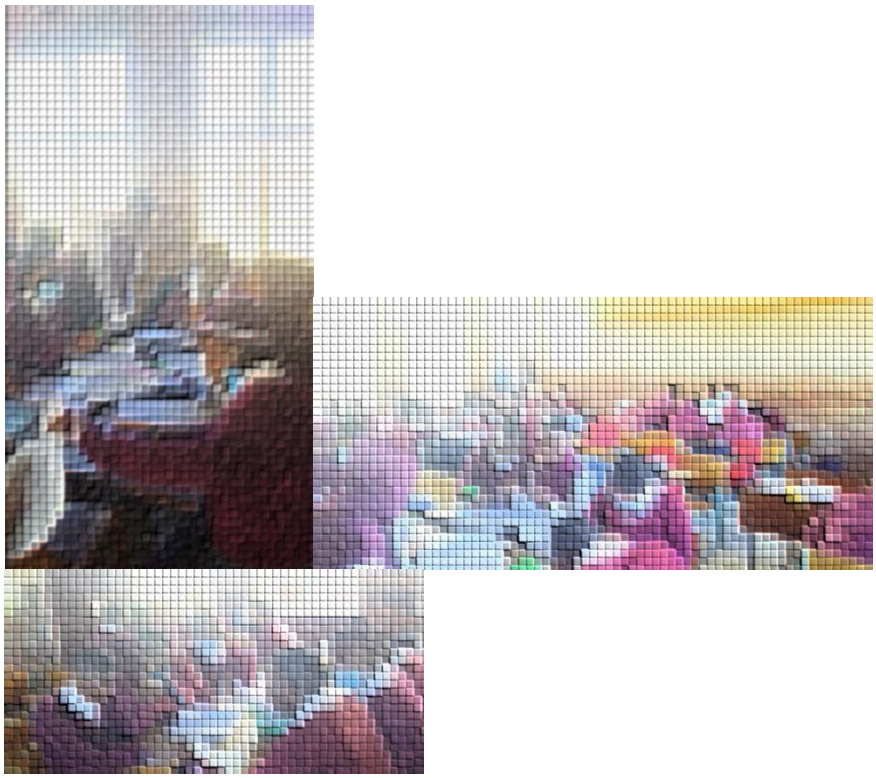


Figure 4.1: shows learners discussing in their groups.

The findings of this study were analyzed and presented for the three lessons in succession. I acted as a participant observer in this regard. Observations and unstructured interviews were conducted simultaneously. I was compelled by the nature of the study, which allowed me to observe learners as they interacted and also interviewed them during the lesson presentation. As the lesson was presented, the reactions of the learners stimulated me to ask questions that came from unstructured interviews. This implied that the reactions of the learners towards the lesson prompted me to ask verbal clarity-seeking questions that will be outlined later in this chapter. There was no way that I could wait until the end of the lesson to ask the questions, as the interview was unstructured.

Learners were given activities for each lesson to complete and write down the responses in their groups. The responses from each group were collected and analyzed and the findings were presented.

The findings presented here were aimed at addressing my two research questions:

- How does the integration of IK in the grade 11 Life Sciences afford for learners' understanding of fermentation?
- How does the integration of IK in the grade 11 Life Sciences hinder learners' understanding of fermentation?

4.2. Representation of findings

Integration of IK into Life Science learning is an essential tool for constructing knowledge and breaking the gap between classroom science and the knowledge which learners get from the community (Handayani, 2018). IK integration is also a useful source of bringing education to all learners that are responsible and will improve how people associate all-around communities (Jacobs et al, 2018). In this study, learners used the prior knowledge to connect to the learning of fermentation. That is connecting scientific knowledge and real situations (Anazifa & Hadi, 2017). IK integration is also the putting in place of Life Sciences teaching and learning in two ways: firstly, as a strategy to enhance learners' opinions on the relevance of western science learning. Additionally, IK integration is a way to contextualize science teaching and learning to sustain education development.

To respond to the two research questions, I presented three lessons and observed the behavior and responses of learners as the lessons continued. The rationale behind the presentation of three lessons was to ensure reliability of the results. The three lessons were based on the topic of fermentation using cooperative learning approach. The necessity of Cooperative learning is that it motivates the learners to arrive at their version of the truth and conclusions (Richards & Roberts, 1994). I did the observations and unstructured interviews simultaneously and then the learners were given the activities to complete. This process was done throughout the three lessons presented in three separate lessons.

Fermentation in food processing is the process where carbohydrates (sugars) are converted to alcohols and Carbon dioxide by yeast, bacteria, or a combination of the two (Hanisi, 2016). CAPS for Life Sciences by the Department of Basic Education (DBE, 2011) Specific Aim 3, which relates to understanding the applications of Life Sciences in everyday life, require the learners to understand the relationship

between IK and science". Thus, it is expected from Life Sciences educators to integrate IK in their classrooms to help learners' experience meaningful learning.

Lesson 1 (Day 1)

I presented the first lesson based on fermentation. Traditional technology to produce beer and bread was the topic treated for that day's lesson. The main objective of the lesson was that the learners would be able to know the importance of fungi (yeast) in the process of bread and beer making. The strategy used for learning was cooperative learning.

The topic was introduced by the discussion indicating what fermentation is, showing the involvement of fungi and bacteria in the process of fermentation. I explained fermentation in food as the process used to produce probiotic-rich food and beverages. I also highlighted that fermentation is the process where carbohydrates are converted to alcohol under anaerobic conditions. Learners were given an activity to discuss and write in their groups. I, as the researcher moved around listening and observing the discussions of different groups. This ensured that learners were indeed discussing the topic. Additionally, I needed to observe the reactions and responses coming from the learners. Lastly, I also wanted to conduct interviews based on the conduct of learners throughout the activity.

The activity that was given focused on four concepts:

- Explanation of fermentation in words.
- The presentation of the fermentation process through an equation.
- The importance of yeast in beer brewing and bread making.
- Integration of IK in bread making in cases where industrial yeast is not present.

Observation

As I walked around the classroom, facilitating the discussions and making my observations, I noticed that learners in the six groups communicated cooperatively. Group 'ORA' was an exception; I noticed that learners B9 and G30 were arguing. Their comments based on the explanation of alcoholic fermentation were as follows:

B9: *"alcoholic fermentation is only for the production of traditional beer and nothing else"*.

G30: "*fermentation is used to produce any food that is sour"*

The analysis of the observation of the first lesson displayed interest in the lesson and at the same time confusion among some learners as the lesson continued. These reactions displayed that the attitude that the learners had towards learning through IK may influence how they received the content. A misconception could be spotted from this argument. Both the two learners regarded fermentation as the process to manufacture or produce food.

Despite the cooperation of learners in the groups, unfortunately, there were some learners in their groups who were confused as the lesson continued. The confusion during the lesson displayed that the learners were not able to learn. Learners were continually raising their hands for my attention. The main question that they were asking was "*What is fermentation about?*" this clarity-seeking question made me move around each group, clarifying what fermentation was. It was very clear that learners did not grasp the introduction well.

Unexpectedly a learner in the AVO group (B40) just raised a hand to ask a question. This was based on the last part of the lesson:

B40: "*Is it possible that we may learn fermentation without referring to the books?*"
G11: "*yes we also learn from our culture through teaching from home*"

G11 acknowledges IK as referred to by Rankoana (2017) as 'the knowledge that is accumulated through informal experiments and understanding of their environment'. The benefit of this kind of knowledge for learners was that they were free to bring forward any knowledge they had from home into classroom learning (Hoppers, 2002).

From the observation, it was noticed that most of the groups were struggling when they had to discuss how to make bread without industrial yeast. Kibirige, Van

Rooyen, and Khupe (2014) highlighted the fact that educators and learners prejudice the integration of IK into science. This reaction among learners displayed that learners were not yet comfortable voicing out their IK in class.

Only group PE displayed knowledge of IK as the whole group ended up agreeing on the use of foam from traditional beer in the place of yeast.

Unstructured interview

During the introduction of the lesson, I generally asked learners to mention any fermented food or drink that they knew. The responses from different learners were "umxhombhothi, mageu, pine drink, thothotho". These responses allowed me to move forward with the lesson based on the fact that learners had an idea or prior knowledge about fermented food and beverages.

Upon realising the argument in group 'ORA' I had to intervene. I asked the question:

Educator: 'what does the others think about what alcoholic fermentation is?'
G4: '*Ma'am, I think it is the production of alcoholic drinks*
Educator: 'Do we agree with her?'
B7: '*No I do not agree; I think is the process of production of alcohol of any form.*

The above comments were an indication that some learners in the class may regard alcoholic fermentation as the making of alcohol. Handayani (2018), and Anazifa and Hadi (2017) have shown that the integration of IK assists in the relevancy of the science curriculum. Learners in this regard relate better with the alcohol from the drinks because they were exposed to the environment of alcohol drinking. This implied that the only alcohol that the learners could recognise was the alcohol in beverages and not any other type of alcohol. What learners understand better is what is happening around them and they are also part of it (Mayana, 2020)

Learners were requested to discuss the process of making bread at home without using industrial yeast. Analysis of this aspect revealed that the influence of

caregivers plays an important role in the learning of alcoholic fermentation. I just randomly asked the questions:

Educator: ‘what will you do at home if you needed to make bread?'

G39: “*we do not make bread at home, so I do not know what to do*”

Educator: ‘Is there anything that we may use instead of yeast in the making of bread at home?’

B24: “*I think that one is learned at home, there is no one to teach that in my house. This means I don’t know*”

Educator: ‘Applying the knowledge from home, what can we use as a raising agent in bread making?’

G10: “*We may use foam from the traditional beer in the place of yeast”*.

Educator: ‘Who taught you the skill?’

G10: “*I saw my grandmother doing it”*

G41: “we use the dried foam from traditional beer and the dough will rise perfectly”

Educator*: ‘Where is this knowledge written?’*

G41: (smiling slightly) “I saw my mother doing like that”

The above responses indicated that learners’ prior knowledge was influenced by their parents or caregivers. Handayani (2018) defines IK as people's knowledge and skills that are possessed in a particular locality which makes the people benefit from their environment. Referring to the biographic information of learners in table 4.2 learner B39 was taken care of by the parents. It could be deduced that the learners in grade 11 are having parents that are also young people and do not have the IK that is requested in this regard. Hence, the response was that they did not make bread at home.

In addition, learner B24 was a learner with no parents nor grandparents (child-headed household), the response was not surprising because the knowledge requested there was supposed to be taught by parents or elders. G10 who stayed with her grandparents highlighted that she learned the knowledge from the grandmother while G41 learned from her mother. According to Ronoh (2017), learners already possess knowledge from home before they attend school, though not documented but transferred orally and through observations of traditional practices. This implies that the involvement of parents or caregivers is very essential in learning, especially if we have to integrate IK.

Lesson 2(Day 2)

The second lesson was introduced by revising the previous lesson. The explanation of alcoholic fermentation in words and equation were briefly outlined. I briefly recapped the making of traditional beer and mageu.

The topic for the second lesson was the comparison of the process of making traditional beer and industrial beer and the process of making mageu. The main objective of the lesson was for learners to know the similarities and differences between the process of making traditional beer and industrial beer. Additionally, learners would describe how fermentation took place during the process of making mageu. Learners were taught the topic of fermentation basically on the sub-topic micro-organisms and traditional biotechnology. Learners were expected to know and discuss and write on the following aspects:

- ***Similarities between the making of traditional beer and industrial beer processes.***

  On the aspect of similarities, they both use the carbohydrate source which is sorghum, maize or barley (dried grains). The grains that are soaked in warm water to be fermented release Carbon dioxide. In both the beers the added yeast converts the sugar in the grains into alcohol.
- ***The differences between the making of traditional beer and industrial beer.***

Learners were expected to know that the only difference between the making of traditional beer and industrial beer is that: sorghum is used to make traditional beer while barley is used to make traditional beer.

- ***How fermentation is taking place during the making of mageu (either homemade or industrially made).***

  Learners were expected to know that: the traditional maize mageu is processed by spontaneous lactic acid bacterial fermentation of cooked maize meal. Wheat flour is added and the sugar in the maize meal is converted into alcohol and carbon dioxide is released.

Observations

As I observed the learners interacting, I noticed that the grouping sparked a lot of interest among the learners. Alkholy et al (2017); Jacobs et al (2018) posit that IK is a useful source of bringing education to all learners that are responsible and will improve how people associate with all-around communities. According to the theory underpinning this study, Situated Learning theory (Lave & Wenger, 1991), learners become part of the community of practice, whenever they engage collaboratively with others they learn better and understand scientific concepts. Similarly, in this study, good learner communication suggests that the integration of IK allowed learners to gain confidence in the knowledge that they had concerning fermentation.

Learners in groups showed an interest specifically in the aspect when they were asked to compare the procedures on how to make traditional beer and industrial beer. Mateus and Ngcoza (2020) found out that in Namibia the Avawambo people held a cultural practice where only elderly females were allowed to teach young girls how to make clay pots while the males can only watch. This implies that IK is passed on from generation to generation among the female gender. The IK in this regard is gender-based. Similarly, in this study, most of the girls took the lead in explaining how fermentation was involved in the making of mageu and traditional beer. The involvement of mostly the girls implied that most of the girls were exposed to the making of traditional beer. It is the norm in the community where the school is located that women mostly prepare traditional beer and transferred the knowledge to the young girls; hence the girls were taking the lead.

The findings of this study reflected a pattern where I could realize that learners who were raised by mostly their grandparents were more actively involved in the group activities. Abah, Mashebe, and Denuga (2015) found out in their study that the elders in the community were practically teaching culture and the environment. During the second lesson, some learners significantly stood out among their groups to lead the discussions. Referring to the biographic information in table 4.2 learners B7, B37 and G6 were raised by their grandparents. B7 took the lead in the discussion of how fermentation was taking place during the making of mageu and he perfectly knew the procedure of homemade mageu. The above-mentioned reaction suggested that the involvement of the grandparents contributed to the learner's understanding of fermentation.

On the other hand, learners B37 and G6, both raised by their grandparents used the term *'mapoto'* referring to mageu. The term is usually used by elderly people in the area in which the school is located. This implied that using familiar terms enabled learners to understand fermentation so easily. South African curriculum aims at making the Life Sciences classroom a culturally relevant place, as recommended by Msimanga et al., (2017) that all learners should be given equal opportunity to learn in a Life sciences class including the language of teaching and learning. The findings of this study revealed that when learners were given the opportunity to use their home language or the terms taught from home, the topic of fermentation was more understandable.

When B39 in the group (BAN) lead the group on the procedure of making mageu and traditional beer, in another group (WAT), the learners (G5 & G26) who led the discussion used the term '*mapoto*' referring to mageu. In those groups, learners agreed by the nodding of their heads and making agreeing sounds as a sign of interest. Hence Madinkonza (2019) reflected that it is very essential to use methodological practices and approaches that learners are familiar with. In this case, learners were familiar with the term '*mapoto'* as used in their homes and it made it easy to learn fermentation.

Unstructured interview

During the second lesson, I just wanted to test the knowledge of learners by asking questions and breaking the ice.

Educator: 'why is barley used in the making of industrial beer and sorghum in the making of traditional beer?

G11: "*the two grains serve the same purpose as long as they are given yeast to grow".*

B14: "*Any grain may be used during fermentation and the presence of yeast will release carbon dioxide and alcohol"*

G21: *"They both contain carbohydrates"*

B2*: "it doesn't matter which grain is used, what matters is the presence of yeast"*

The above response reflected a positive reaction, which indicated that learners were able to learn effectively in that kind of setting.

Group BAN was having a nice time with B39 leading the discussion. The questions asked by the researcher were;

Educator: 'Do you find the differences between the two types of beer making processes (traditional and industrial)?'

B22: *"There is not much of the difference in the two processes"*

Educator*: 'Any similarities spotted?'*

G36: "the two processes are similar, it is just that industrial beer is produced in industries through machines and the traditional beer is made by hands at home"

From this group, I could detect that learners were able to compare the two processes of beer making. Handayani (2018); Anazifa and Hadi (2017) discovered from two separate studies that there are similarities between western science classes and Javanese IK. They both indicated that the integration of IK into science learning is an

essential tool for constructing knowledge and breaking the gap between classroom science and the knowledge that learners get from the community. The findings of this study also revealed that there are more similarities than differences between the process of making traditional beer and industrial beer. Another contributing factor towards positive learning was that the more the learners had their peers explaining the science concepts, the easier it becomes to learn.

After realising the isolation of B18 from the group WAT, I attended to the learner and asked the questions to seek clarity:

Educator: 'Why are you withdrawn from the group?'

B18: *"I am a Christian"*

Educator: 'what does that mean?"

B18: *"My religion does not allow me to be involved in activities relating to traditional beer"*

The withdrawal of learner B18 was due to the religious belief of the learner which was supposed to be accommodated. The response indicated that religious beliefs hindered the learner from participating in the learning activity. On the other hand, some learners in groups AVO and LEM were quiet and passive but they did not withdraw from the groups. I attended to their cases;

Educator: 'how is the lesson going?'

G25: *"ma'am, I can't relate to any of the things discussed here"*

Educator: "Are we not here to learn fermentation"

G1: "*Yes, we are here to learn but I do not have any basic knowledge from home regarding the making of fermented food. This is very confusing*"

The above responses displayed an element of confusion from G25 and G1. The fact that some learners could not relate to anything discussed and learned in class implied that it was difficult to understand fermentation.

Lesson 3 (day 3)

The topic for the third lesson was the effect of sugar on the rate of fermentation. The objective of the lesson was for learners to know how sugar affects the rate of fermentation. The introduction of this lesson was a background of the past two lessons. I further addressed the factors affecting the rate of fermentation. An activity was given where the learners had to discuss in their groups and write the responses. The facts about IK can be gathered through observation and testing. Specific aim 2 of the CAPS (Department of Basic Education [DBE], 2011) emphasises the investigation of phenomena in Life Sciences. Learners are expected to be able to solve problems that require practical ability. The ability to solve problems is underpinned by the attitude of curiosity and an interest in wanting to how the natural world and living things in the world live. On that note, an investigative activity was involved in a natural setting and observed by learners through the third lesson so that they could make their conclusions (Le Grange, 2007; Dei, 1993). The learners were allowed to investigate the effect of sugar on the rate of fermentation.

Observation

The observation I made was that the third lesson was very different from the previous two lessons. Learners were more focused as they were used to the arrangement of the grouping. The groups that were used for the past two lessons were the same groups used in the third lesson. This was done to maintain the stability of the groups.

On the first aspect of identifying the variables, I observed a disciplined cooperation in all the groups. Learners who had an idea of how to identify variables were guiding the others in each group. In all the groups no learners were idling. Identification of the variable was very easy for all the groups since it is done in most of the topics in Life Science. Thus it is an investigative skill that every Life Sciences learner should have. This kind of reaction from learners displayed a positive response towards learning. My attention was caught by a learner (G34) in the LEM group who standing up to show that yeast cells got energy from the sugar with excitement. “*Sugar gives you energy*," said G34. The impression I got was that fermentation gets energy from the sugar so that fermentation may be fast.

The aspect of the increase in the sizes of the balloon to different sizes was accounted for and no learner showed a sign of not understanding. This indicated that the demonstration in the scenario by the use of a balloon was relevant. Learners usually refer to the use of balloons as a fun activity.

When learners were discussing the conclusion for the investigation, the group PE was a bit confused and asked the researcher if they were to write the conclusion for the activity or the conclusion for the investigation given in the scenario. I then clarified them and they were back on track. On the other hand, other groups were fine with concluding.

Unstructured interview

As I was observing the learners, some of the behaviour and conduct of the learners caught my attention and I had to ask some questions during the observation process. As I moved around from one group to the other, I was caught up by the laughter from one group (AVO). I asked the questions

Educator: 'what is so funny?'

B40: ''W*e are laughing at ourselves because we did not know this simple staff that we are learning today''.*

Educator: 'what do you find simple in this activity?'

G11: ''*we were not aware that the gas that is released in the bubbles formed in the dough when we make bread at home is Carbon Dioxide''*

(G19): (added) ''*I did not know that I didn't know''.*

This kind of reaction by learners suggested that the learners suddenly developed an interest in the topic of fermentation. Learners were able to relate the gas released from the test tubes to the gas released when making bread. Such reactions and comments implied that learners were able to identify the border crossing between the separate processes during the second and third lessons. Similarly, Anazifa and Hadi (2017) in their study, they revealed that the integration of IK built a link between science and IK that showed the similarities between IK and scientific knowledge.

As the lesson continued I just asked other groups to test if they have the same understanding as the AVO.

Educator: ‘what caused the balloons to expand?’

B7: *“Carbon Dioxide”*

Educator: 'why was the sugar not added to the first test tubes?'

G1: *“so that they may starve the yeast from carbohydrates and that carbon dioxide won’t be released”*

Educator: ‘why were the sizes of the balloon not equal at the end of the investigation?’

B16: *"more sugar caused more bubbles in the yeast solution. Hence, more carbon dioxide is released and increased balloon sizes."*

These responses reflected a common understanding among all the groups. The responses given above were from learners belonging to the different groups. The impression here is that the understanding of the gas that caused the balloons to expand was across the groups. Learner B16 could account for the increase of the sizes of the balloons in different test tubes. This implied that the group which learner B16 was able to know the effect of sugar on the rate of fermentation and furthermore they were able to show the relation between the size of the balloon and the amount of sugar added to the yeast solution. On the other hand, learner G1 had an understanding of the controlled variable, though she could not call it the control but for the mere fact that knew that if the yeast solution was not having sugar, carbon dioxide would not be released

4.3. Discussion of findings through tenets of SLT as a lens

The findings of this study are discussed using the situated learning theory tenets as the lens. Situated learning theory is a learning approach through constructivism within an authentic context involving social interactions (Lave & Wenger, 1991). SLT is based on the philosophy that one learns through the following tenets: social interaction, authentic (real-life) context, and constructivism (Greeno, 1994). This

study adopted SLT proposed by Greeno (1994). Supporting Lave and Wenger, Greeno's (1994) SLT is grounded on the perception that the best way to learn is through social interactions, constructivism, and authentic context. Greeno's (1994) idea of SLT is that the interpretation of learners' views and behaviours is a result of participation in cultural, and social in a situated point of view. To this point, the discussion of findings will be presented based on the above mentioned tenets.

Constructivism is an approach to learning where learners actively build their knowledge and that actuality is determined by the knowledge of the learners (Elliot et al, 2000). In this study constructivism held that it was expected that learners bring some prior knowledge (including traditional culture) or conceptions into the real-life learning environment (Driver, 1986; Naidoo, 2005). Social interaction is the process through which learners act and react towards others around them (Tuner & Nolen, 2015). Social Interaction with others allowed learners to relate themselves to situations they were in. Collaborative learning activities were used during lesson presentations to let the learners use their views in a natural setting (Crotty, 1998). Authentic context focuses on participation in natural settings in communities of practice (Lombardi & Oblinger, 2007). In this study the theory of situated learning allowed learners to construct knowledge among them using their IK on fermentation relating it to the process learned in class. For the constructed knowledge to make sense, it has to be integrated into the already existing knowledge (Ausubel, 1968). Emphasising the same idea, with constructivism and social interactions in mind, I considered what learners already knew and allowed them to put their knowledge into practice (Creswell, 1999).

The discussion of findings is guided by the tenets of SLT as a lens, which are social interactions, authentic context and constructivism. This discussion of the findings drew data from the observations, unstructured interviews and document analysis conducted through the three lessons presented.

4.4. The integration of IK in the learning of fermentation in grade 11 Life Sciences: The affordances.

It is a mandate by the CAPS for Life Sciences that IK should be integrated into teaching and learning. However, the learners respond to display different possibilities

that afforded the understanding of fermentation. The analysis done from observations and unstructured interviews revealed that learners were able to learn fermentation through the integration of IK.

Social interactions

Social interaction is the process through which learners act and react toward other learners around them (Tuner & Nolen, 2015). The findings that are related to social interaction emanated from the observations made throughout the three lessons presented. From the observations that I made, social interactions brought about good communication among the six groups. That was an indication of a positive attitude and interest of learners towards the lesson. If the learners are interested in the lesson, it implies that the learning of that particular content will be easy. According to the theory underpinning this study, SLT (Lave & Wenger, 1991), learners become part of the community of practice; whenever they engage collaboratively with others they learn better and understand scientific concepts. The seventh group (ORA) reflected an argument where two learners B9 and G30 could not agree on what fermentation is during the first lesson.

B9: *"alcoholic fermentation is only for the production of traditional beer and nothing else"*.

G30: "*fermentation is used to produce any food that is sour"*

This reaction indicated that social interactions allow learners to talk their minds even if they don't agree they still interact and come to conclusions. In social interactions, learners learn how to compromise, share and develop the skill of working together to achieve similar goals. Social interactions may allow learners to learn their lessons unintentionally or without force (Janse, 2020).

The groupings that were arranged throughout the three lessons promoted peer learning which afforded he understanding of the topic at hand. Social interactions in this case sparked a lot of interest. During the third lesson where learners were engaging in an investigative activity, they got used to the groupings and were comfortable in communicating with each other. Therefore, the learners who had the knowledge were free to assist those who do not have knowledge. Thus some

learners started as novices while educator other learners were more knowledgeable. As the novices become more comfortable and knowledgeable they engage gradually in the main activity and shift from LPP to full participation (Wenger, 1991). Learning is perceived as a social participation process rather than the acquiring of knowledge as individuals.

Authentic context

Authentic context in learning focuses on participation in natural settings in communities of practice(Lombardi & Oblinger, 2007). In education, this approach enables learners to meaningfully explore and discuss concepts in a real-life context that is learner-relevant. In this case, learners were allowed to discuss processes that they were familiar with, such as the making of bread, mageu, traditional beer, and other fermented foods and beverages to drive the learning of fermentation. Hence Ezeanya, Mhakure, and Otulaja (2017) suggested that learners should receive their learning in ways that make sense to them. The grade 11 learners who were participants in this case were allowed to learn fermentation in a way that seemed to be more natural to them. Allowing the making of traditional beer into a formal Life Sciences learning appeared to have allowed learners in their groups to help each other come up with their conclusions as suggested by SLT.

When B39 in the group (BAN) lead the group on the procedure of making mageu and traditional beer, in another group (WAT), the learners (G5 & G26) who led the discussion used the term '*mapoto*' referring to mageu. In those groups, learners agreed by nodding their heads and making agreeing sounds as a sign of interest. Hence Madinkonza (2019) reflected that it is very essential to use methodological practices and approaches that learners are familiar with. In this case, learners were familiar with the term '*mapoto'* as used in their homes and it made it easy to learn fermentation. The use of the term '*mapoto'* brought more of a usual setting to the learners and learning was effective. It took some learners who had the IK to assist in making fermentation understandable. On the making of bread without industrial yeast, some learners were comfortable in discussing the replacement of industrial yeast by foam from traditional beer. The discussion from other learners made those without IK to become part of the community of practice and this lead to the affordance of the understanding of fermentation.

It was also observed that the care givers of the learners also had an influence on their learning. The reactions and responses provided by the learners reflected that their day to day activities from home lead to the easy learning of fermentation. This was evident when comparing the process of traditional beer making and industrial beer making. Most girls took the lead in discussing the making of traditional beer. Nevertheless, B7 and B37 raised by their grandparents also took the lead in the making of mageu. The confidence in these learners indicated that the making of mageu and traditional beer were very natural and familiar to these learners and as a result it afforded the understanding of fermentation learned in class.

The findings from the unstructured interviews reflected that learners who were able to relate well with the making of traditional beer and bread without industrial yeast were the learners learned from caregivers. From the responses given by G10 and G14, it was clear that their experiences from home influenced how they responded to the question of 'how to make bread without the use of industrial yeast?' G10 and G14 possessed the knowledge that the use of dried foam from the traditional beer instead of industrial yeast was the way to go. The evidence from their responses was that G10 learned from the mother while G14 learned from her grandmother. Bringing this context to class afforded these learners to transfer the knowledge to other learners and the understanding of fermentation was possible.

Constructivism

Constructivism is an approach to learning where learners actively build their knowledge and learning is actuality determined by the knowledge of the learners (Elliot et al, 2000). Constructivism emphasises the construction of knowledge by learners based on their encounters. To show that constructivism promotes the understanding of fermentation, the conduct and responses of learners displayed in the third lesson conducted in this study. Learners in all groups displayed the spirit of helping each other find knowledge on the investigative activity given.

When learners were asked about the name of the gas released from the test tubes during the third lesson, they were able to identify the gas as carbon dioxide. They also displayed the ability to relate the first lesson and the third lesson. This was mentioned by G11 and G19 in the group AVO. The findings from unstructured

interviews reflected that learners could know that the use of barley and sorghum served the same purpose in making beer. This ability to construct knowledge were displayed by the responses from G11, B14, G21 and B2. Other responses included the following:

G11: ‘‘*we were not aware that the gas that is released in the bubbles formed in the dough when we make bread at home is Carbon Dioxide’’*

(G19): (added) ‘‘*I did not know that I didn’t know”.*

The reactions from the AVO group indicated the ability of the learners to construct knowledge among them. Still on the third lesson, 5 groups out of 7 were able to identify the dependant and the independent variables on their own. All groups were able to account for the sizes of the balloon in the investigation, thus being able to account for the results of the investigation. The construction of knowledge brought forward the ability of learners to understand the effect of sugar on the rate of fermentation.

4.5. The integration of IK in the learning of fermentation in grade 11 Life Sciences: The hindrances

The integration of IK into the learning of Life Sciences may be a hindrance to learners’ understanding of concepts and processes. Mayana (2020) found out that the IK that could be integrated was present but not relevant. Instead of IK influencing learning, it enhanced argumentation and discussions. Similarly, in this study the IK to be integrated was irrelevant in some cases as learners did not possess any prior knowledge as their IK. To respond to this research question, data was collected from the same lesson presented to answer research question 1. Data for both research questions was collected simultaneously as indicated in the introduction of this chapter (4.1)

Social interactions

It was also found out that the isolation of B18 from the group WAT and the passive behaviour of learners in groups AVO and LEM (G25 and G1) did not promote learning in this case. Looking at the response of B18 when asked

‘Why are you isolated?’

B18 said “I am a Christian; I don’t want to be involved in the making of beer”

The comments given by the above mentioned learners indicated that the social, cultural and religious background of learners may affect how they relate with other learners. Thus, inhibiting social interactions in this case. The religious believe of learner B18 appeared to be a hindrance because the learner did not even attempt to engage in the social interaction with other learners. This particular learner held the conception that he will not learn anything in Life Sciences that is related to alcohol and that in it acted as a hindrance.

Authentic context

The making of bread at home was also a usual activity that I thought would allow learners to understand fermentation. Looking at the area where the school is located I thought all learners will possess the IK of making bread at home but it was discovered that some learners do not make bread at home. Below are the responses from learners when they were asked about making bread without industrial yeast.

Educator: ‘what will you do at home if you needed to make bread?'

G39: “*we do not make bread at home, so I do not know what to do*”

Educator: ‘Is there anything that we may use instead of yeast in the making of bread at home?’

B24: “*I think that one is learned at home, there is no one to teach that in my house. This means I don’t know*”

This indicated that most of the learners were not exposed to the IK regarding the making of bread at home. The majority of the groups preferred using a baking powder which is also an industrial raising agent. Referring back to the biographic information of learners, it is clear that the caregivers also do not have IK. This implied that IK from home is gradually fading away. IK is referred to as "wisdom in action" IK engage the accumulation of knowledge through practical experiences of

local people using the trial and error method. This knowledge engages in imitating, repeating, and cultural activities which allows indigenous people to keep and emphasise ideas (Zindny, 2021). Learners were supposed to copy from their elders but did not have the practices to copy from.

When the groups were discussing the making of mageu and how fermentation took place during the process. The responses from the unstructured interview indicated a confusion among learners in the group AVO and LEM as follows:

G25: *“ma’am, I can’t relate to any of the things discussed here”*
G1: “*Yes, we are here to learn but I do not have any basic knowledge from home regarding the making of fermented food. This is very confusing"*

The fact that learner G1 acknowledged that she did not have any person at home that she could learn from displayed a hindrance to the integration of IK. This meant that she only relied on the knowledge that was transferred from the educator or from other learners. G25 and G1 reflected an element of confusion, not relating to any of things discussed indicated that the authentic context of these learners was misplaced. A misplaced authentic context implies a misplaced IK in this case, therefore learners were not able to learn effectively in this regard.

The above responses indicated that what was regarded as real-life practices to one learner are not real-life practices to the other. The responses in this regard indicated that the lack of IK from the caregivers acted as a hindrance to the understanding of fermentation.

4.6. Discussions of findings from lesson activities (written tasks)

To establish how the integration of IK hinders and affords the understanding of fermentation by grade 11 learners, learners were given 3 activities to write and I collected the scripts for analysis. The main purpose of giving the three activities was to check whether the learners understood the topic of fermentation as taught through three lessons. In this study, learners' scripts were regarded as documents to be analysed to detect if there were any hindrances and affordances in the understanding of fermentation when IK is integrated into Life Sciences learning in

class. According to Stake (1995), data collection and analysis can be done simultaneously. Therefore, the same activities (tasks) were used for data collection and analysis.

Lesson Activity 1 (day1)

After all the discussions made, learners were requested to write down their responses to the questions they were discussing. The responses were submitted to the educator to be analysed. The first document consisted of 4 questions to respond to:

- **Briefly explain fermentation in words?**
- **Present fermentation process through an equation.**
- **What is the importance of yeast in beer brewing and bread making?**
- **From the knowledge that you have from home (IK) how can you make bread even if you do not have industrial yeast?**

➢ ***Briefly explain alcoholic fermentation in words***.

Vhurumuku (2010) acknowledged the truth that science is made up of theories, facts, and laws together with processes, beliefs investigations, and attitudes as human activities. For learners to understand scientific concepts, they needed to understand the processes, including the process of alcoholic fermentation.

From all the 7 groups, the responses differed and reflected that fermentation is the breaking down of glucose, and the production of alcohol and some groups included the making of bread in their explanations. Three themes emerged from the group responses. Two groups could explain that alcoholic fermentation involves the breaking down of glucose (WAT and APP). APP could further able to indicate that the breaking down of glucose resulted in the formation of alcohol.

The findings in this regard indicate that most groups refer to alcoholic fermentation as the production of alcohol only. On the contrary, the making of bread was given as an explanation for alcoholic fermentation.

Table 4.3: showing analysis of findings of explanation of fermentation.

Theme	Groups
Breaking of glucose	WAT, APP
Production of alcohol	APP, BAN, AVO, ORA and WAT
The making of bread	ORA, PE and LEM

Analysis of the findings indicated that the majority of learners did not know exactly what alcoholic fermentation was. The mentioning of the production of alcohol only by the majority of the groups was an indication that learners still had a problem of understand what alcoholic fermentation was by just an explanation.

Only one group could explain alcoholic fermentation as the breaking down of glucose to form alcohol. No group mentioned the release of carbon dioxide. The responses given by all the groups raised a concern that there should be more strategies used other than mere explanations. If IK and western science can be combined in one setting, the learners will acquire a new approach and as a result, they will understand the world around them Carter (2011). Learners could not explain the process in words, equations and also in writing. This indicated that there was a challenge on the side of the learners to understand the process in the beginning.

- ***Using an equation showing how the process of fermentation takes place.***

Learners were requested to use the equation to present the process of fermentation. The main purpose of this aspect was that learners could be able to apply the knowledge that they had through an equation.

Analysis of the response towards this question was presented as follows:

Table 4.4: showing analysis of findings on the use of the equation to present fermentation

Correct equation	Partially correct equation	Incorrect equation
ORA	PE	AVO

APP	WAT	
	LEM	
	BAN	

The question was just straightforward forward as they were testing whether learners could present the process of alcoholic fermentation through the use of an equation. Only two groups (ORA and APP) could give the correct equation. The majority of the groups gave partially correct equations and only one group (AVO) had no clue about the equation. The response from the AVO group was very irrelevant and not understandable. The group did not even write the equation. The findings in this regard were an indication that learners in this group were not able to learn and present what fermentation was in the form of an equation.

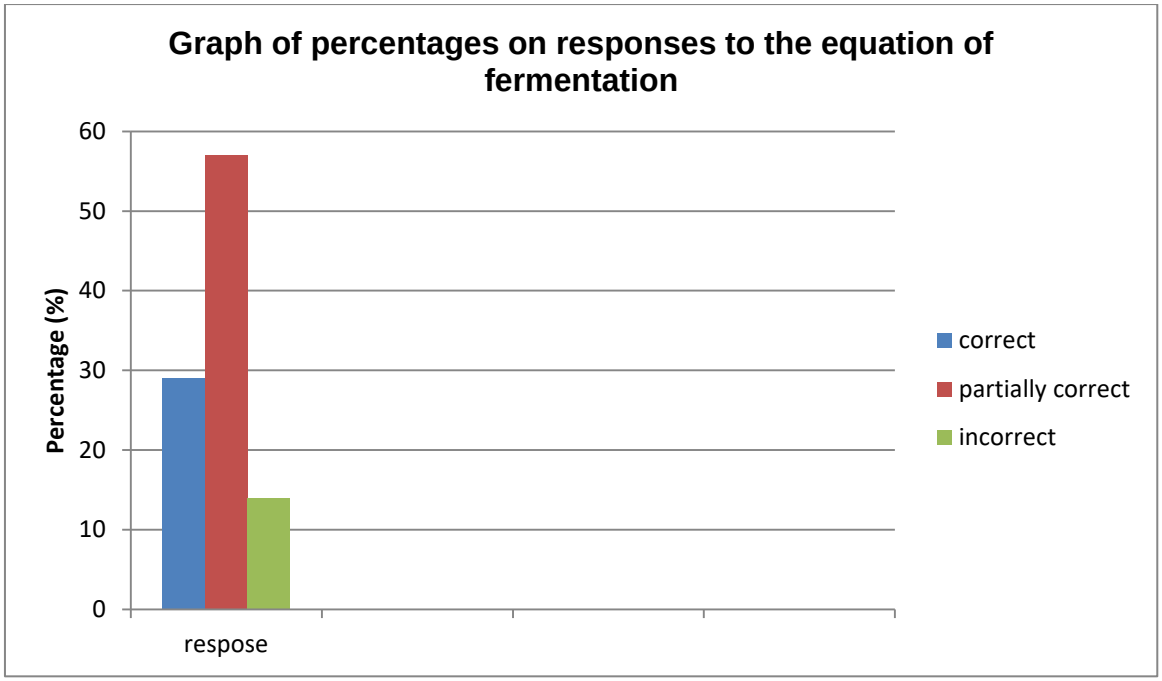


Figure 4.2: the graph showing the percentage of responses on the presentation of fermentation by the equation.

The above analysis indicates that a high percentage of learners were not certain about presenting fermentation through an equation. While 14% did not write the correct equation. This was not surprising because they were not able to explain fermentation in words. One of the factors that made learners misunderstand is the decontextualized way in which Life Sciences are learned (Manyana, 2020). A more understandable strategy was needed because learners were not comfortable with equations and direct explanations. The knowledge brought to the class will serve as a link in the teaching of school science and that should be a starting point for learners' understanding of concepts in science textbooks (Ramirez & Ross, 2019). Mhakure and Otulaja (2017) suggested that African children should be taught in a way that science will make sense to them. On the other hand, 29% of the responses gave the correct equation.

Looking at the small percentage of learners who were able to write the correct equation, the implication was that requesting learners to write the equation directly served as a hindrance to learning.

- ***The importance of yeast in beer brewing and bread making***

The third question on the activity was that learners were required to indicate the importance of yeast in beer brewing and bread baking. The objective of this question was to check if learners understood the importance of yeast in fermentation. The mentioning of beer brewing and bread baking was a way of making this aspect familiar and taking it very close to learners' daily experiences.

*T*he responses were grouped and analysed as follows:

Table 4.5: showing analysis of findings on responses on the importance of yeast in beer brewing and bread making.

Response	**Group**
Yeast breaks down the sugar to form Pockets of air and make the dough rise with the help of heat	WAT, ORA, PE, APP and BAN
Convert starch to maltose	LEM
Breaks down sugar to produce ethanol	BAN, APP
Irrelevant response	AVO

The analysis of these findings displayed that the majority of the groups had an idea about the importance of yeast. This is because the question mentioned beer brewing and bread making, not just alcoholic fermentation. The integration of IK here ignited a spark of understanding among the groups (Madinkonza, 2019). The findings suggest that the familiar processes should be used on many occasions so that learners may grasp the content taught in class. Zindny et al (2021) viewed the putting in place of Life Sciences teaching and learning through IK as a way to contextualise science teaching and learning to sustain education development. The two groups, BAN and APP were able to indicate that the importance of yeast in fermentation is that it breaks down sugar to produce ethanol. This indicated how only two groups out of seven held the correct view. Four (4) groups were partially correct in this regard, mentioning that yeast help in the breaking down of sugar to produce pockets of air with the help of heat. The responses from these four (4) groups indicated that the learners were further able to state heat as a factor affecting the rate of fermentation. Only one group gave an irrelevant response to this question.

This revealed a view that lacks an understanding in the importance of yeast in fermentation.

Looking at these findings, a reflection of understanding was portrayed based on the fact that majority of learners could relate to the yeast that they use at home. The findings indicate that the majority of learners in their groups were able to learn and understand the importance of yeast in fermentation.

- ***The making of bread without industrial yeast.***

Learners were lastly asked how they could make bread at home without industrial yeast. This question was focused on the prior knowledge of learners. The main objective here was that learners could be able to use their home experiences to learn fermentation. The achievement of this objective could indicate whether the IK that learners possessed was useful in learning or not.

Analysis of the findings displayed two themes emerging. Learners' responses were the use of baking powder and the use of traditional beer foam as indicated below.

Table 4.6: showing responses on how to make bread without industrial yeast.

Response	**Group**
The use of baking powder	PE, WAT, APP, BAN, LEM and AVO
The use of traditional beer foam	WAT and BAN

The majority of the groups displayed a lack of prior knowledge as the question emphasised the use of knowledge from home. The findings of the study conducted by Alkholy et al, (2017) suggest that it is very much important to expose learners to IK through cooperation between indigenous science educators and western-trained science educators. Only two groups (WAT and BAN) were able to indicate the use of foam from traditional beer to make bread in the absence of industrial yeast. This response reflects that the learners in the two groups were informed and had prior knowledge from home. Though the two (2) groups WAT and BAN reflected the knowledge of the use of the foam from traditional beer, they also presented the second raising agent which is baking powder. The mentioning of backing powder

indicated that learners were not aware that baking powder is an industrial raising agent. The remaining groups, PE, APP, LEM and Avo mentioned the use of baking powder only. The group ORA mentioned a different and irrelevant answer, '*putting the dough on the sun until it rises'.* The response by group ORA reflect that learners were not able to learn using IK. Even if group ORA did not use their IK, the responses for groups WAT and BAN indicate that it is still possible for learners to understand and integrate IK into the learning of fermentation in class.

Lesson Activity 2 (day 2)

After the second lesson was presented learners were required to complete the written activity in their groups so that the educator may assess their understanding of fermentation. This activity consisted of only two (2) aspects set as questions as follows:

- **Show the similarities and tabulate the differences between the process of industrial and traditional beer making**
- **Shows how fermentation takes place during the making of mageu.**

Analysis of the findings was as follows: ***Show the similarities and tabulate the differences between the making of traditional beer and industrial beer.***

Learners were supposed to display their understanding of fermentation through the comparison of the fermentation at home and fermentation in class. The comparison of the two beer making processes was aimed at bringing the two knowledge together as a way of reaching the common ground of the understanding of fermentation.

The two responses (similarities and differences) were analysed and grouped to arrive at the themes as indicated in the table below;

Table 4.7: showing analysis of findings on the comparison of the making of traditional beer and industrial beer.

Theme	**Group**
Able to give the correct similarities	ORA, WAT, PE, BAN and AVO
Unable to give similarities	APP and LEM
Able to tabulate the difference	WAT, ORA, PE,BAN, LEM and APP

Unable to tabulate the differences	AVO

Analysis of the findings revealed that the majority of the learners (5 groups) were able to show the similarities between the process of industrial beer making and traditional beer making. I just became aware that some of the learners (minority) didn't know about the making of traditional beer. The findings in this regard indicated that learners from the same context displayed different prior knowledge. The participants in this study were different learners with their different backgrounds which needed to be accommodated in enhancing learning (Madinkonza, 2019). Although the learners resided in the same locality, their opinions were not the same.

Allowing the making of traditional beer into a formal Life Sciences learning appeared to have allowed learners in their groups to help each other come up with their conclusions as suggested by SLT by Lave and Wenger (1991).

Six groups were able to write down the differences. The ability to differentiate emanated from the knowledge built from the knowledge that other learners have from home. Only one group (AVO) couldn’t show the differences. The findings in this regard displayed that the majority of learners were able to integrate their prior knowledge which is referred to as their IK into learning.

- ***How is fermentation taking place during the making of mageu?***

The last question in this activity required that learners should be able to indicate the involvement of fermentation during the process of mageu making. This question aimed at testing if learners could relate the process of fermentation to the real process of making mageu.

Table 4.8: shows the analysis of findings on the involvement of fermentation during the mageu-making process.

Theme	**Group**
Sugar converted into alcohol	WAT
Description of the process of making mageu	APP, LEM

The analysis of the findings displayed a lot of misunderstanding among the groups. Unfortunately, the three (3) groups (ORA, PE and PE) did not write anything. This implied that learners did not attempt to answer the question. Thus learning was ineffective when we use the making of mageu as the guide towards understanding fermentation. Similarly, APP and LEM just misinterpreted the question and responded by describing the process of mageu making.

On the other hand, only one group (WAT) was able to describe that the sugar in the maize meal is converted into alcohol and that fermentation is temperature dependant. A little percentage of learners did well on this question and this called for concern and implied that learners sometimes misunderstand the question and give wrong responses due to the context that the questioning was done.

Lesson Activity 3 (day 3)

The activity was investigative based on the effect of sugar on the rate of fermentation. A scenario was given as follows (see appendix A3):

A group of grade 11 Life Sciences learners investigated to determine the effect of sugar on the rate of fermentation. They used the same amount of yeast and water in the 4 test tubes. Different amounts of sugar were added into the 4 test tubes and covered with balloons at the same time.

This activity was based on the following aspects:

- **Identification of the dependent ad independent variables.**
- **The reason why sugar was not added to one of test tubes 1?**
- **Observation of the trend from the results of the investigation.**
- **Giving an account for the increase in the size of the balloons from the second test tube to the fourth**
- **Writing a suitable conclusion for the investigation.**

After all the discussions learners had to submit what they have written concerning the lesson. This activity was not meant to score marks but to check the learners' understanding of fermentation. Analysis of the findings was as follows:

Table 4.9: showing the findings of the document analysis

Theme	Criteria	No. of groups	Percentage
Identification of variables	Two correct variables	5	71
	One correct variable	2	29
Reason for not adding sugar in test tube 1	Able to give a reason	7	100
	Unable to give a reason	0	0
Reporting of observation from the results	Able to report	7	100
	Unable to report	0	0
Accounting for the sizes of the balloons	Able to account	6	86
	Unable to account	1	14
Writing the conclusion for the investigation	Suitable conclusion	4	57
	Unsuitable conclusion	3	43

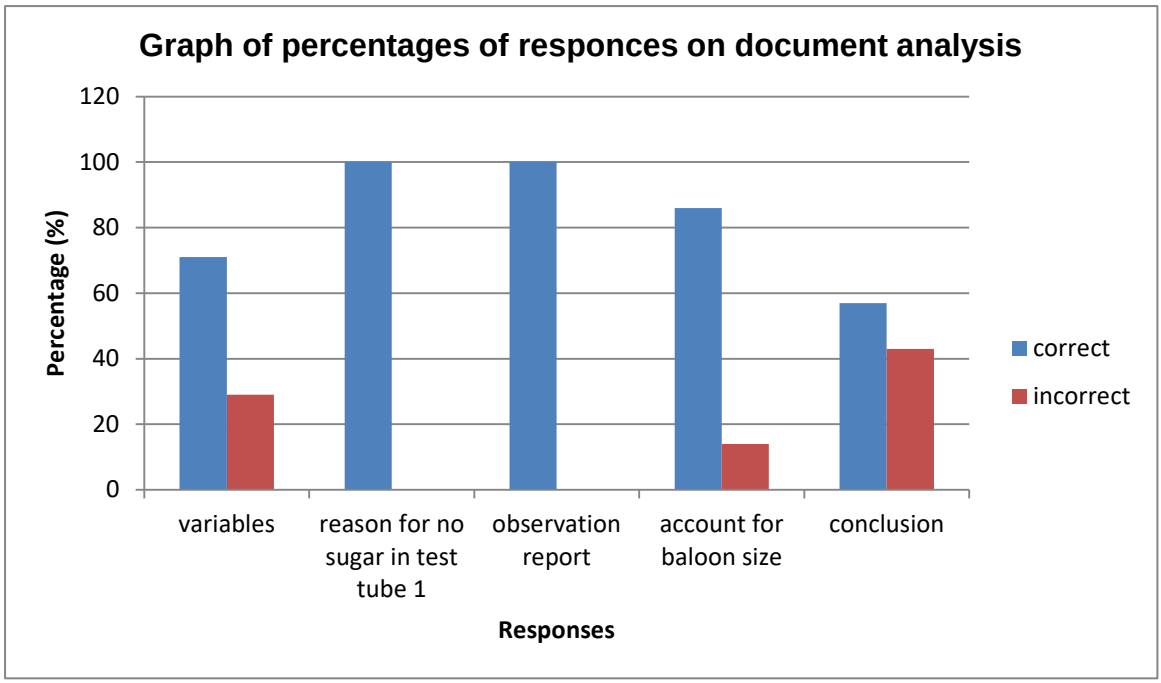


Figure 4.10: showing analysis of document review findings in percentages.

The analysis of the findings from the documents in the third and concluding lesson revealed a much-improved understanding of the topic of fermentation. Osman (2021) argues that knowledge in schools and home practices should not be treated as separate knowledge to avoid the obstruction of learning. From all the groups, learners provided correct responses at a percentage of above 50%. That was a good impression especially the two aspects: the reason for not adding sugar in the first test tube and the interpretation of the results of the investigation. All seven (7) groups were able to give reasons and interpreted the results. This indicated that the use of balloons as the demonstration was very relevant. SLT involve a process of interaction and relations around a specific realm that take place within a social, cultural, and historical state of affairs, resulting in unforced (unintentional) learning (Lave & Wenger, 1991). Learning in this regard was unintentional as the activity was fun.

Although the learners were able to give mostly correct responses, only one (1) group was not able to account for the balloon sizes, two (2) groups were not able to identify the two variables, instead they managed to identify one variable. Four (4) groups were able to write the suitable conclusion while three (3) groups displayed the inability to write the suitable conclusion for the investigation. These responses from

such groups indicated that some learners were still not able to relate IK with Life Sciences in class. The findings in this regard reflect a higher percentage (majority) of the groups being able to relate IK with Life Sciences in class. Therefore the learners in this case showed understanding of fermentation through the integration of IK.

Findings of the study: in relation to the research questions.

- **How does the integration of IK in the grade 11 Life Sciences afford for learners' understanding of fermentation?**

The finding regarding this research question revealed that the integration of IK afforded learners' understanding of fermentation. This was evident when the use of traditional beer, mageu and bread making were involved. The other factor that displayed and affordance was the use of the terms used at home regarding fermentation. Lastly, the influence of caregivers acted as an agent to bring about an affordance to the understanding of fermentation.

The use of traditional beer, mageu and bread making

As the educator, I created a setting that will integrate the IK that I expected that the learners were familiar with. The use of traditional beer sparked an interest among learners, especially the girls who were supposedly exposed to the making of traditional beer as per the culture of learners. Even the less abled learners seemed to be familiar with the process. The effective learning brought about the understanding of fermentation and as a result, the integration of IK afforded learners' understanding.

The making of mageu was also a familiar process to learners. The created setting afforded learners the opportunity to share their knowledge and experiences. Thus allowing the less knowledgeable learners to learn and understand the process of fermentation as involved in the making of mageu (Madinkonza, 2019).

Integration of IK into bread making also brought forth an affordance as most learners could relate to the process from home. At first some couldn't relate but they finally understood fermentation as presented and involved in the bread that they make at home.

The use of the terms used at home regarding fermentation.

Learners usually learn better when they are engaged in activities through the authentic context (Greeno, 1998).The use terms usually used at home by learners was allowed into the setting and it afforded the easy learning of fermentation among the grade 11 Life Sciences learners. Learners found it easy to relate to the term '*mapoto'* when referring to mageu. It was clear that the setting that arose as the lesson continued could afford the indigenous learners an opportunity to learn fermentation with ease (Mayana, 2020).

The influence of caregivers.

The way learners learn is influenced by their culture and the influence of people around them (Vygotsky, 1978). This influence might come as a formal or informal learning. Most of the learners who are taken care of by their grandparents displayed more understanding of fermentation when IK is integrated. Learners that possessed the skills learned from their caregivers could transfer the skills to other learners so as to bring effective learning (Hewson & Ogunniyi, 2011). This positive influence from caregivers afforded learners the opportunity to understand fermentation even before they could be taught in school.

- **How does the integration of IK in the grade 11 Life Sciences hinder learners' understanding of fermentation?**

The findings related to this research question revealed that the integration of IK might be a hindrance to the learners' understanding of fermentation. Reactions such as withdrawal and passiveness during the activities displayed some hindrances towards learning. The fact that some learners could not relate to the IK that was intended to be integrated and some did not possess it at all was a hindrance. Religious beliefs also acted as a hindrance in that regard as displayed by the responses given by learners.

Withdrawal and passiveness

The observed withdrawn and passive behaviour of learners displayed a negative attitude towards the lesson or the integration of IK. This kind of reactions posed a hindered version of learning and learners were not able to understand fermentation. Some learners did not show interest at all. The lack of interest implied that learners could not even pay attention and did not learn in that regard.

Learners not relating to the IK

Some learners did not relate to the IK that was intended to be integrated. According to the responses given by learners, it was indicated that learners did not have the IK requested and even their parents did not have that particular IK. As a result of the lack of IK, learners were not able to relate to the lessons presented through the integration of IK and thus they did not learn effectively (Ahanonye, 2021). The lack of IK from learners and their parents, specifically young parents or caregivers in this case posed a hindered version towards achieving the goals of learning. I may confidently say that the integration of IK hindered grade 11 Life Sciences learners' understanding of fermentation in one way or another.

Religious beliefs

Learners' religious beliefs displayed and brought forth a hindrance in this case. Learners who declared that according to their Christian belief they were not allowed to do any activities relating to the making of traditional beer or anything to do with alcohol were not free to learn in the kind of setting created by the educator. The fact that those learners were hindered by their religious belief meant that they did not even have the skills required to integrate the IK requested in class (Gibson, 1986).

4.7. Chapter conclusion.

In this chapter data gathered through observations, unstructured interviews and document analysis were presented, analysed and interpreted and discussed. The key issues that emerged from the findings were discussed. The next chapter will be focusing on the limitations of the study, conclusion based on the research questions and recommendations will be made.

CHAPTER 5: LIMITATIONS, CONCLUSION AND RECOMMENDATIONS

5.1. Introduction

In the previous chapter the findings were presented and interpreted and discussed. This chapter presents the overview of the findings on the affordances and hindrances on the grade 11 Life Sciences learners' understanding of fermentation through the integration of indigenous knowledge (IK). The study's limitations and recommendations for further research are discussed in this chapter.

5.2. Overview of the study

The aim of the study was to explore the affordances and hindrances of the learners' understanding of fermentation when integrating IK. The study was conducted in a secondary school in a rural area in Limpopo province. This study required the researcher to integrate IK in the learning of fermentation. Data collection was done through observations, unstructured interviews and document analysis.

It is mandated by the CAPS document for IK to be integrated in Life Sciences teaching to assist learners in the understanding science concepts (DBE, 2011). It is emphasised by the CAPS document that the IK should be linked to the Life Sciences content (DBE, 2011). I was the facilitator of the learning in this regard (Vygotsky, 1978). To achieve the aim of the study as mentioned in the first paragraph, the following research questions were presented:

- How does the integration of IK in the grade 11 Life Sciences afford for learners' understanding of fermentation?
- How does the integration of IK in the grade 11 Life Sciences hinder learners' understanding of fermentation?

A qualitative case study design was adopted so that the credible and trustworthy answers to the two research questions were achieved.

How does the integration of IK in the grade 11 Life Sciences afford for learners' understanding of fermentation?

The finding regarding this research question revealed that the integration of IK afforded learners' understanding of fermentation. This was evident when the use of traditional beer, mageu and bread making were involved. The other factor that displayed and affordance was the use of the terms used at home regarding fermentation. Lastly, the influence of caregivers acted as an agent to bring about an affordance to the understanding of fermentation.

How does the integration of IK in the grade 11 Life Sciences hinder learners' understanding of fermentation?

The findings related to this research question revealed that the integration of IK might be a hindrance to the learners' understanding of fermentation. Reactions such as withdrawal and passiveness during the activities displayed some hindrances towards learning. The fact that some learners could not relate to the IK that was intended to be integrated and some did not possess it at all was a hindrance. Religious beliefs also acted as a hindrance in that regard as displayed by the responses given by learners.

5.3. Recommendations

The observations that were aimed at answering research question 1 brought forth the findings that reflected that learners who had knowledge from home (IK) were able to learn effectively. In this case integration of IK afforded grade 11 Life Sciences learners the understanding of fermentation. It is recommended for future research that more studies of this nature should be done so that learning should be effective. The findings of research question two (2) revealed that the IK intended to be integrated in this study was not relevant to some learners as they did not have prior knowledge from home. This outcome reflected a hindrance to the understanding of fermentation. The recommendation for future research is that more relevant IK to the time and age of learners and the caregivers should also be considered. Even though the findings were presented, the findings of this study cannot be generalised for all grade 11 Life Sciences learners. The results presented were collected from one (1) class (1) in one school. The recommendation for future research is that more learners from different schools and the whole Further Education and Training (FET)

band may be included. It is further suggested that participants be from different geographical areas so that different cultural practices may be involved.

5.4. Limitations of the study.

Limitations were taken into consideration and acknowledged. The data collected for this study was qualitative. All learners who participated in this study were Sepedi speakers. Thus all the participants were using English as first additional language (FAL). Language was identified as a limitation to this study as all the questions on all the activities were conducted in the learners' FAL. The participants of this study could have experienced a language barrier when engaging in the activities. The learners in this regard could not express themselves clearly especially during the unstructured interviews. In other instances the participants would ask for explanation of some words in the activities. Thus, requesting the researcher to explain some words and phrases in their home language. Nevertheless some of the participants could switch a little bit into Sepedi during their discussions. Switching languages may perhaps dilute the information especially where a person had to interpret. The researcher could have explained same phrases differently in each group and thus the meaning were not the same from one group to the other.

Secondly, the theory underpinning this study requires learners to be part of the community of practice. According to SLT by Lave and Wenger (1991) the more knowledgeable members of the community introduce the less knowledgeable into the community of practice. The assumptions by the researcher that all learners will bring knowledge from home were an oversight in this study. The findings of this study indicate that some of the learners did not have knowledge on the IK involved in the process of fermentation. The lack of prior knowledge from some of the participants affected the findings of this study in a way that less IK knowledge was brought to class by few participants. This means that the findings of this study would not provide any evidence that is conclusive.

Finally, the study only sampled learners from one school. If there were more participants from different schools, the findings would have been different.

5.5. Conclusion

Stake (1993) indicates that the case study findings are not generalizable due to the size of the sample and the context character that is unique. Nevertheless, findings of this research portray the relatedness of prior knowledge and the way learners understand fermentation when learning through IK integration. To this point I drew a generalised conclusion that the IK of learners need to be explored fully if educators are to integrate IK into the learning of Life Sciences concepts. In this case I found out that things were not as I expected from the beginning of the study. I had the perception that IK and scientific knowledge were different but the findings reveal that they are interrelated as they relate to the day to day experiences. This brought me to a conclusion that utilising IK as prior knowledge might help learners to value their IK.

The aim of this study was to explore the affordances and hindrances of grade 11 learners' understanding of fermentation when integrating IK. McKnight (2015) suggests that science learning will be made interesting and meaningful through the active involvement of learners in the learning process and mostly considering experiences in real life. Agreeing with McKnight (2015)'s view, the current study indicated that meaningful learning was experienced by learners due to the fact that they were actively involved. The active involvement motivated learners to partake in the study and as they continued being involved they were more interested and excited about this idea. Home practices regarding fermentation were considered in this study; this activity assisted in fostering learner to learner interactions so that learners may be able to better communicate their IK with confidence.

The qualitative data from observations, unstructured interviews and document analysis revealed that when IK is integrated into Life Sciences learning, there are some affordances as much as there are hindrances on learners' understanding of fermentation. The lesson observations reflected that learners were able to learn fermentation through social interactions

The findings of observations of the three lessons reflect that the co-operative learning motivated the learners and sparked the interest among learners. Moreover the attitude that learners showed when discussing issues of the making of traditional

beer and mageu making process implied that learners were able to learn when using processes that were familiar to their day to day practices.

In addition, analysis of findings from the unstructured interviews reflected an affordance of understanding of fermentation. When learners were asked questions on making bread at home without industrial yeast, some learners who had an experience of the practice responded positively towards the questions. The findings of this study also reflected the procession of IK as prior knowledge as the key contributing factor towards learners' understanding. The learners who participated in the unstructured interview, there were some in their groups who displayed confidence in the procession of their IK. Thus the possession of IK as prior knowledge made it possible for the learners to understand fermentation in their groups. Some learners were hindered by their religious background and lack of IK from home.

Finally, it was noted that the findings from document analysis indicate that all the groups were already geared into the integration of IK. Majority of the groups were able to answer the questions. Most of the groups were able to write down the importance of yeast in beer brewing and in bread making. The force behind this positive response was the information that the learners gained from the discussions and being led by learners who possessed the IK. The integration of IK simplified a complex process of fermentation in this regard. The fact that six out of seven groups were able to write down the differences between the making of traditional beer and industrial beer indicated the affordance of learners' understanding of fermentation. The qualitative data gathered from observations, unstructured interview and document analysis highlighted that the integration of IK into the learning of Life Sciences affords as much as it hinders the learners' understanding of fermentation.

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ANNEXURES

ANNEXURE A: Letter to the Limpopo Department of Basic Education

P.O BOX 3111

SOVENGA

0727

25 MARCH 2022

The head of department

Limpopo Department of Basic Education

Corner 113 Biccard & 24 Excelsior Street

POLOKWANE

0700

Request for permission to conduct research study at Dimamo circuit

Dear Sir/ Madam

Herewith I would like to request from the HoD of the provincial (Limpopo) Department of Basic Education permission to conduct an academic research at a school operating in Dimamo circuit. Currently I am a registered Master of Science Education student at University of Limpopo. As part of the requirements for the fulfilment of the degree I am required to conduct a research and produce a dissertation.

The title of my research is: **Integrating indigenous knowledge in a Life Sciences class: Affordances and hindrances to grade 11 learners' understanding of fermentation**

The aim of the study is:

- To explore the affordances and hindrances to grade 11 learners' understanding of fermentation when integrating indigenous knowledge (IK).

- To determine how the integration of IK in the grade 11 Life Sciences afford for learners' understanding of fermentation?
- To determine how the integration of IK in the grade 11 Life Sciences hinder learners' understanding of fermentation?

The study will involve grade 11 Life Sciences learners. The learners who are 18 years and above will be sent letters to request them to participate in the study while parents of the learners who are below 18 years old will be sent letters to request that their children participate. The researcher will present three lessons where learners will be observed, interviewed and be given activities to write. The researcher will keep a journal to record the response and actions of the participants. Participation is voluntarily and if any one wishes to withdraw anytime he/she will be allowed to do so. I am going to adhere to all the ethical procedures. Lastly, participants' identity and research site will be protected, thus, pseudonyms will therefore be used in the research study.

Any queries regarding the research project may be directed to Mrs M.C Mogashoa at 079 863 1467 or catheymogashos@gmail.com

Supervisor: Mr. K.J Chuene at 015 268 3888 or karabo.chuene@ul.ac.za

Co-supervisor: Dr. Masha M.F at mmapake.masha@ul.ac.za

Kind Regards

M.C Mogashoa

ANNEXURE B: Letter to the circuit manager

P.O BOX 3111

SOVENGA

0727

25 MARCH 2022

The Circuit Manger

Dimamo circuit

DIKGALE

0721

Request for permission to conduct research study at Lekota Secondary School in Dimamo circuit

Dear Madam

Herewith I would like to request from the circuit manager of the aforementioned circuit permission to conduct an academic research at a school operating within the circuit. Currently I am a registered Master of Science Education student at University of Limpopo. As part of the requirements for the fulfilment of the degree I am required to conduct a research and produce a dissertation.

The title of my research is: **Integrating indigenous knowledge in a Life Sciences class: Affordances and hindrances to grade 11 learners' understanding of fermentation**

The aim of the study is:

- To explore the affordances and hindrances to grade 11 learners' understanding of fermentation when integrating indigenous knowledge (IK).
- To determine how the integration of IK in the grade 11 Life Sciences afford for learners' understanding of fermentation?
- To determine how the integration of IK in the grade 11 Life Sciences hinder learners' understanding of fermentation?

The study will involve grade 11 Life Sciences learners. The learners who are 18 years and above will be sent letters to request them to participate in the study while parents of the learners who are below 18 years old will be sent letters to request that their children participate. The researcher will present three lessons where learners will be observed, interviewed and be given activities to write. The researcher will keep a journal to record the response and actions of the participants. Participation is voluntarily and if any one wishes to withdraw anytime he/she will be allowed to do so. I am going to adhere to all the ethical procedures. Lastly, participants' identity and research site will be protected, thus, pseudonyms will therefore be used in the research study.

Any queries regarding the research project may be directed to Mrs M.C Mogashoa at 079 863 1467 or catheymogashos@gmail.com

Supervisor: Mr. K.J Chuene at 015 268 3888 or karabo.chuene@ul.ac.za

Co-supervisor: Dr. Masha M.F at mmapake.masha@ul.ac.za

Kind Regards

M.C Mogashoa

ANNEXURE C: Letter to the school principal

P.O BOX 3111

SOVENGA

0727

25 MARCH 2022

The Principal

Lekota Secondary School

P.O Box 31

DIKGALE

0721

Request for permission to conduct research study in a grade 11 Life sciences classroom at Lekota Secondary School

Dear Sir

Herewith I would like to request from the principal of the aforementioned school permission to conduct an academic research in a grade 11 Life Sciences classroom. Currently I am a registered Master of Science Education student at University of Limpopo. As part of the requirements for the fulfilment of the degree I am required to conduct a research and produce a dissertation.

The title of my research is: **Integrating indigenous knowledge in a Life Sciences class: Affordances and hindrances to grade 11 learners' understanding of fermentation**

The aim of the study is:

- To explore the affordances and hindrances to grade 11 learners' understanding of fermentation when integrating indigenous knowledge (IK).

- To determine how the integration of IK in the grade 11 Life Sciences afford for learners' understanding of fermentation?
- To determine how the integration of IK in the grade 11 Life Sciences hinder learners' understanding of fermentation?

The study will involve grade 11 Life Sciences learners. The learners who are 18 years old and above will be sent letters to request them to participate in the study, while parents of the learners who are below 18 years old will be sent letters to request that their children participate. The researcher will present three lessons where learners will be observed, interviewed and be given activities to write. The researcher will keep a journal to record the response and actions of the participants. Participation is voluntarily and if any one wishes to withdraw anytime he/she will be allowed to do so. I am going to adhere to all the ethical procedures. Lastly, participants' identity and research site will be protected, thus, pseudonyms will therefore be used in the research study.

Any queries regarding the research project may be directed to Mrs M.C Mogashoa at 079 863 1467 or catheymogashos@gmail.com

Supervisor: Mr. K.J Chuene at 015 268 3888 or karabo.chuene@ul.ac.za

Co-supervisor: Dr. Masha M.F at mmapake.masha@ul.ac.za

Kind Regards

M.C Mogashoa

ANNEXURE D: Letter to the parent

INFORMED CONSENT TO CONDUCT A RESEARCH WHILST YOUR CHILD IS ATTENDING THE LESSON

TITLE OF THE RESEARCH STUDY: Integrating indigenous knowledge in a Life Sciences class: Affordances and hindrances to grade 11 learners' understanding of fermentation

PROJECT SUPERVISOR: Mr. Chuene K.J

CO-SUPERVISOR: Dr. Masha M.F

ADDRESS: University of Limpopo, Turfloop campus

CONTACT NUMBER: 0152683888

POST GRADUATE STUDENT: Malemaishago Catherine Mogashoa

ADDRESS: P.O BOX 3111

SOVENGA

0721

CONTACT NUMBER: catheymogashos@gmail.com or cell: 0798631467

Please take some time to read the information presented here, which will explain the details of this study. Please ask the researcher or person explaining the research to you any questions about any part of this study that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research is about. This study has been approved by the Turfloop Research and Ethics Committee and will be conducted according to the ethical guidelines and principles of Ethics

What is this research study all about?

This research study is designed to help grade 11 Life Sciences learners in understanding the process of fermentation. The purpose of this study is to explore the affordances and hindrances to grade 11 learners' understanding of fermentation when integrating indigenous knowledge. This study will be conducted by Mrs Malemaishago Catherine Mogashoa who is a Master of Science Education student at the University of Limpopo, turfloop campus and is supervised by well-trained researchers in the field of Science education. This study will be conducted in Lekota secondary school in Dimamo circuit (mainly in a grade 11 Life Sciences classroom)

How does this study affect your child?

Your child's Life Sciences class have been selected to take part in the study. The focus of the research is not on your child in particular as a Life Sciences learner in the class, but on the whole grade 11 Life Sciences class. For the reason that your child takes Life Sciences as a school subject and will be present in the class when his/her Life Sciences teacher offers the lessons as the researcher. Consequently, your child will be an active participant of the study. The researcher will have contact with your child, and will expect your child to fully participate, as the only focus as a researcher will be on the learning of grade 11 Life Sciences learners.

What will be expected of your child?

The lessons which will be offered will focus on learners understanding of fermentation.. As such, your child will be expected to participate and to behave the way a learner behaves during a Life Sciences lesson. The only difference is that the researcher will be writing down the learners' reactions and responses to the activities given during the lesson presentations.

Will your child gain anything from taking part in this research?

There are no direct gains for your child, however the findings of the study may promote and improve his/her Life Sciences knowledge and understanding.

Are there any risks involved for your child by being present in the classroom when his/her teacher presents the lessons?

Your child's presence in the classroom during the Life Sciences teacher's lesson presentation poses no conceivable risks to your child or his/her classmates.

How will we protect your child's identity?

Communication will take place between the researcher and your child and **no video recordings will be made** during the lesson presentation. No marks will be recorded for promotion purposes. Your child's identity will not be revealed in any way by the researcher in the research report.

What will happen with the findings?

The findings of the research will be predominantly being dedicated to obtaining a Master of Science Education degree. Nonetheless, the research results will also be used for presentations at academic conferences and for the publication of articles in scientific journals. The researcher will still maintain confidentiality and protect the identities of participating individuals by not using any descriptors or names that could lead to the identification of participants.

Will you or your child be paid to take part in this study and are there any costs for you or your child?

The presentation of Life Sciences lessons will take place during school hours as scheduled on the school's timetable. Consequently, you and your child will not be paid as there are no costs involved for you or your child.

Is there anything else that you should know or do?

Kindly be at ease to contact the researcher involved in the research should you have any questions, or if you encounter any difficulties understanding this letter or need more information concerning the research. I will be happy to answer your questions.

You are also welcome to contact the principal of the school, who is fully aware of this research.

- You can contact Mr. K.J Chuene at 015 268 3888 or **karabo.chuene@ul.ac.za** if you have any further questions or have any problems.
- You can contact Malemaishago Catherine Mogashoa at 079 863 1467 or catheymogashos@gmail.com if you have any further questions or have any problems.

Kindly specify/indicate below whether you give your child permission to be present in the classroom when the researcher conducts the research through Life Sciences lessons.

_____

Yours sincerely

Mrs Malemaishago Catherine Mogashoa Principal Investigator

Declaration by the parent/guardian

Hereby I (*name and surname)* ……..……. give my permission that the researcher presents the lessons in the research titled: **Integrating indigenous knowledge in a Life Sciences class: Affordances and hindrances to grade 11 learners' understanding of fermentation**

while my child is present in the classroom.

Signed at (*place*) .....…….. on (*date*) ……..…….. 20....

…….. ……..

Signature of parent/guardian **Signature of witness**

Declaration by person obtaining consent

I *(name)* ……..…… declare that:

- I clearly and in detail explained the information in this document to

  …….
- I did/did not use an interpreter.
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I gave him/her time to discuss it with others if he/she wished to do so.

Signed at (*place*) .....…..…….. on (*date*) ……...…….. 20....

.....
Signature of person obtaining consent

Declaration by researcher

I *(name)* ……..…… declare that:

- I explained the information in this document to …….. **or** I had it explained by …… who I trained for this purpose.
- I did/did not use an interpreter

- I encouraged him/her to ask questions and took adequate time to answer them

  or I was available should he/she want to ask any further questions.

- The informed consent was obtained by an independent person.
- I am satisfied that he/she adequately understands all aspects of the research, as described above.
- I am satisfied that he/she had time to discuss it with others if he/she wished to do so.

Signed at (*place*) .....…….. on (*date*) ……..…….. 20....

.....
Signature of researcher

ANNEXURE E: Assent form

Dear participant

My name is Malemaishago Catherine Mogashoa student number 9731848 and am currently studying towards a Masters in Science Education. As a part of my study I am required to carry out research titled: **integrating indigenous knowledge in a Life Sciences class: Affordances and Hindrances to grade 11 learners' understanding of fermentation.** The purpose of this study is to explore the affordances and hindrances to learners' understanding of fermentation through the integration of IK.

I am requesting you to be in a research study. Research is a way to test new ideas. Research helps us learn new things. Whether or not to be in this research is your choice. You can say Yes or No. Whatever you decide is OK.

Why are you requested to be in this research study?

You are being requested to be in the study because you are in a grade 11 Life Sciences class.

What is the study about?

The researcher seeks to find out what are the affordances and hindrances on the learners' understanding of fermentation when Indigenous knowledge is integrated in a Life Sciences class.

What will happen during this study?

If you agree to be in this study, you will

· Have to be observed, interviewed and write some activities during lessons presented.

Are there any conditions that may exclude you from participating in the study?

- ❖ You must be a learner in grade 11 registered for Life Sciences in Lekota Secondary School in Dimamo circuit.
- ❖ You must be below 18 years old to participate in this research.

What will be required of you in the study?

Should you decide to partake in the study, you should expect the following:

- To sign the assent form
- Your parent/ guardian should give consent
- To be observed for three lessons by the researcher during the lesson participation.
- To be interviewed by the researcher during the lesson participation.
- To write the activities during the 3 lessons participation.

What are the possible benefits that may arise from the study?

The benefits of participating in the study are as follows:

- The research will help you express your views regarding your knowledge from in a Life Sciences class.
- The research will help you to relate your indigenous knowledge with science learned in class.

Will you receive any financial compensation or payments for participating in the study?

Please be informed and note that you will not receive any form of payment for taking part in the study.

What are your rights as a participant in the study?

You have the right to withdraw from participating in this study at any given time as your participation is voluntary. Should you wish to withdraw you will not be penalised or have any future disadvantages. You do not have to provide a reason for your decision to withdraw from participating in the study. You may also be excused from participation if you do not comply with the researcher's requirements as this may temper with the authenticity of the outcomes of the study.

How will confidentiality and anonymity be ensured in the study?

Confidentiality of the data will be kept and your identity will only be known to the researcher. Your identity will not be revealed during or after the study even when the study is published.

Signatures

Before deciding if you want to be in the study, ask any questions you have. You can also ask questions during the time you are in the study.

If you sign your name below, it means that you agree to take part in this research study.

Your Name (Printed) _____

Age_____

Your signature_____

Date_____

Signature of Person Obtaining Consent_____

Date_____

Signature of Witness_____

Date_____

ANNEXURE F: Informed Consent Form

Dear participant

My name is Malemaishago Catherine Mogashoa student number 9731848 and am currently studying towards a Masters in Science Education. As a part of my study I am required to carry out research titled: **integrating indigenous knowledge in a Life Sciences class: Affordances and Hindrances to grade 11 learners' understanding of fermentation.**The purpose of this study is to explore the affordances and hindrances to learners' understanding of fermentation through the integration of IK.

These observations and interviews are designed to explore:

- The affordances and hindrances to grade 11 learners' understanding of fermentation.

I would appreciate it if you would allow me to spend little of your time with you for observations, interviews and written activities. Please bear in mind that this is an academic endeavour, anonymity will be compulsory and the data collected will be used only for research purposes, and all responses are confidential and will be treated as such.

As a participant selected and agreed to partake in the study you will then be observed, interviewed and be given activities to write in your class for three lessons.

ARE THERE ANY CONDITIONS THAT MAY EXCLUDE YOU FROM PARTICIPATING IN THE STUDY?

- You must be a learner in grade 11 registered for Life Sciences in Lekota Secondary School in Dimamo circuit.
- You may be below or over 18 years old to participate in this research.

WHAT WILL BE REQUIRED OF YOU IN THE STUDY?

Should you decide to partake in the study, you should expect the following:

- To sign the consent form

- To be observed for three lessons by the researcher during the lesson.
- To be interviewed by the researcher during the lesson presentations.
- To write the activities during the 3 lessons presented

WHAT ARE THE POSSIBLE BENEFITS THAT MAY ARISE FROM THE STUDY?

The benefits of participating in the study are as follows:

- The research will help you express your views regarding your knowledge from in a Life Sciences class.
- The research will help you to relate your indigenous knowledge with science learned in class.

WILL YOU RECEIVE ANY FINANCIAL COMPENSATION OR PAYMENTS FOR PARTICIPATING IN THE STUDY?

Please be informed and note that you will not receive any form of payment for taking part in the study.

WHAT ARE YOUR RIGHTS AS A PARTICIPANT IN THE STUDY?

You have the right to withdraw from participating in this study at any given time as your participation is voluntary. Should you wish to withdraw you will not be penalised or have any future disadvantages. You do not have to provide a reason for your decision to withdraw from participating in the study. You may also be excused from participation if you do not comply with the researcher's requirements as this may temper with the authenticity of the outcomes of the study.

HOW WILL CONFIDENTIALITY AND ANONYMITY BE ENSURED IN THE STUDY?

Confidentiality of the data will be kept and your identity will only be known to the researcher. Your identity will not be revealed during or after the study even when the study is published.

ANNEXURE G: Consent Form

I _____ agree to participate in the research study named (**integrating Indigenous knowledge in a Life Sciences class: Affordances and hindrances to grade 11 learners' understanding of fermentation).**

The temperament and rationale of the study has been explained to me in writing and I am therefore participating voluntarily.

I give permission for my participation, observation and interview with (researcher's name) _____

I understand that no financial compensation will be made for participating in the study.

I understand that I can withdraw from the above stated research study, without any penalties, at any time, either before it commences or while I am participating.

I understand and accept all my rights as a participant.

I understand that anonymity will be ensured in the write-up by disguising my identity.

Signed: _____ Date: _____

ANNEXURE H: ACTIVITY 1
DAY 1 ((LESSON 1)

ACTIVITY 1

1. Briefly explain what alcoholic fermentation is in words

   _____
   _____
   _____
   _____
   _____

2. Using an equation show how the process of fermentation takes place.

   _____
   _____
   _____
   _____

3. Discuss the importance of yeast in beer brewing and bread making.

   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____

4. From the knowledge that you have from home (indigenous knowledge) how can you make bread even if you do not have an industrial yeast?

   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____
   _____

DAY 2 (LESSON 2)

ACTIVITY 2

1. Some fungi are an important part of human food. Alcoholic drinks such as Traditional beer, wine and industrial beer can be made through the process of alcoholic fermentation.
Show the similarities between the making of traditional beer and industrial beer processes.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

2. Tabulate the differences between the making of traditional beer and industrial beer processes.

3. How is fermentation taking place during the making of mageu? (either home-made or industrially made)

_____
_____
_____
_____
_____
_____
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_____
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_____
_____

DAY 3 (LESSON 3)

ACTIVITY 3

A group of grade 11 Life Sciences learners conducted an investigation to determine the effect of sugar on the rate of fermentation. They used the same amount of yeast and water in the 4 test tubes. Different amounts of sugar were added into the 4 test tubes and covered with the balloons of the same size.

The data below represents the results of the investigation conducted.

bottle	Sugar (ml)	Size of the balloon (mm)
1	0ml	100 mm
2	5ml	200 mm
3	10ml	400 mm

4	15ml	600 mm

1. Name the dependant variable in this investigation.

_____

2. Name the independent variable

_____

3. Why is sugar not added in balloon 1?

_____
_____
_____

4. What trend do you observe from the results?

_____
_____
_____
_____
_____

5. Account for the size increase in balloon 2 to 4

_____
_____
_____
_____
_____
_____

6. Using the information on the table, write a suitable conclusion for this investigation.

_____
_____
_____
_____
_____
_____
_____
_____

ANNEXTURE I: ETHICAL CLEARANCE CERTIFICATE

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: **23 May 2022**

PROJECT NUMBER: **TREC/88/2022: PG**

PROJECT:

Title:	Integrating Indigenous Knowledge in a Life Sciences Class: Affordances and Hindrances to Grade 11 Learners' Understanding of Fermentation.
Researcher:	MC Mogashoa
Supervisor:	Mr KJ Chuene
Co-Supervisor/s:	Dr MF Masha
School:	Education
Degree:	Master of Education in 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

ANNEXTURE J: EDITORIAL CERTIFICATE

Stand 507 Caledon Village, Cell +27794848449, Email: kubayijoe@gmail.com

15 December 2022

Dear Sir/Madam

SUBJECT: EDITING OF DISSERTATION

This is to certify that I have edited Chapters 1-3 of the dissertation entitled 'Integrating indigenous knowledge in a Life Sciences class: Affordances and hindrances to Grade 11 learners' understanding of fermentation' by Mogashoa Malemaishago Catherine, and that unless further tampered with, I am content with the quality of the said chapters in terms of their adherence to editorial principles of consistency, cohesion, clarity of thought and precision.

Kind regards

Prof SJ Kubayi (DLitt et Phil)