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An exploration of how preservice teachers integrate indigenous knowledge pertaining to African foods and beverages in science lessons

By

CATHERINE W.N DAVID

Student No: 215000387

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Supervisor

PROFESSOR RONICKA MUDALY

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DECLARATION

1. I, CATHERINE W.N MUYONJO, know that plagiarism is a criminal and punishable offence as it is the use of somebody's work without acknowledging them.
2. Each significant contribution to and quotation in this study has been acknowledged and referenced.
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DEDICATION

In profound gratitude and unwavering devotion, this dissertation is dedicated to the guiding light of my life, Jesus Christ. His boundless strength and courage have been my steadfast companions, empowering me to overcome the myriad challenges encountered throughout this academic journey.

To my husband, Dr. James Ojochenemi David, you have been my unwavering support and the solid foundation upon which I could navigate the complexities of this study. Your encouragement and strength have been my refuge during the most challenging moments.

In the pages of this thesis, a special place is reserved for my son, Ekwuojo Kirabo Dominic David. Through your resilience, you have been a source of inspiration, teaching me to rise above the tumultuous waves and persevere against all odds.

To my cherished mother, Catherine Evelyn Muyonjo, your constant prayers and unyielding encouragement have been a beacon of hope. This work is a tribute to your unwavering belief in my capabilities and your enduring support.

To each of you, my heartfelt gratitude knows no bounds. May the blessings of the Lord God Almighty overflow in your lives, fulfilling the desires of your hearts.

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ABSTRACT

Indigenous knowledge is increasingly recognised as a valuable resource in people's lives, prompting calls for its integration into science teaching. However, it is often marginalised compared to Western knowledge and science. This study explores preservice science teachers' perspectives on incorporating indigenous knowledge about African foods and beverages into science lessons. By evaluating these perspectives, the study sheds light on the marginalisation of African indigenous knowledge and how this can be dealt with. The research also emphasises the importance of valuing and effectively incorporating indigenous knowledge into science education.

The study draws on the postcolonial indigenous theory (PIT), which aims to promote social change and decolonisation by leveraging indigenous philosophy, culture, and language. This theoretical framework enriches the understanding of how indigenous knowledge can be embedded in teaching about foods and beverages in science lessons. Accordingly, this highlights the potential benefits of integrating indigenous knowledge into science education, emphasising the importance of practical, learner-centred approaches in enhancing understanding and appreciation of both indigenous knowledge and science.

The study adopted a qualitative method, focusing on preservice science teachers' perspectives on integrating indigenous knowledge about African foods and beverages within science lessons. Semi-structured interviews were used for data collection, allowing participants to express their perspectives freely. In addition, document analysis of preservice teachers' lesson plans was used to ensure alignment with the Curriculum and Assessment Policy Statement (CAPS) and to evaluate how indigenous knowledge was integrated into science lessons.

The study draws on the postcolonial indigenous theory (PIT), which aims to promote social change and decolonisation by leveraging indigenous philosophy, culture, and language. This theoretical framework enriches the understanding of how indigenous knowledge can be embedded in teaching about foods and beverages in science lessons. Accordingly, this highlights the potential benefits of integrating indigenous knowledge into science education, emphasising the importance of practical, learner-centred approaches in enhancing understanding and appreciation of both indigenous knowledge and science.

The findings indicate that preservice teachers recognise the value of research in preparing them to teach effectively and understand indigenous knowledge. They emphasise the importance of

practical activities, such as experiments involving indigenous foods and beverages, to deepen conceptual understanding. Practical work is seen as a pedagogical approach to illustrate the scientific aspects of indigenous food practices, such as fermentation in the preparation of *umqombothi*.

Preservice teachers stress the significance of using familiar foods and beverages in practical lessons to help learners better grasp the connection between indigenous knowledge and science. They advocate for lesson plans that integrate indigenous knowledge and Western knowledge in science education, with a learner-centred approach that encourages learner participation and acknowledges the teachers' capacity to learn from their learners.

The study suggests that incorporating field trips and inviting indigenous knowledge holders and community members to science lessons can further enrich the learning experience, enhancing both teachers' and learners' conceptual understanding. Tapping into indigenous knowledge deepened teachers' conviction about the wisdom inherent in IK. It emboldened teachers to incorporate other knowledges, and leverage insights from IK holders. This is significant because it creates new pathways for teaching and learning Natural Sciences.

Keywords: Indigenous knowledge, Western science, Natural Sciences, Post Colonial Indigenous Theory, Preservice teachers.

CHAPTER 1
GENERAL INTRODUCTION

1 Background to study

It is widely acknowledged that interest in indigenous knowledge systems (IKS) among scholars and policy makers has been on the rise in recent times (Ankrah et al., 2021). This has been attributed to the growing appreciation of the valuable contributions that IKS, as sources of knowledge, can make in various human endeavours. Furthermore, the complementary nature of IKS alongside Western scientific knowledge is increasingly recognised across various research fields, such as climate change, biodiversity, and sustainable agriculture among others (Aworh, 2023; Chanza & Musakwa, 2022; Sanjigadu & Mudaly, 2023). In these endeavours, there is a growing emphasis on "culturally-responsive pedagogy" within science education research (Hattam, 2023; Savage et al., 2011). This pedagogical approach involves integrating local culture and knowledge into the science learning process (Mhakure & Otulaja, 2017). By incorporating IKS, researchers aim to create a more inclusive and relevant educational experience that respects and values the contributions of diverse knowledge systems (Kaya & Seleti, 2013).

This study also makes use of the terms ‘IK’(Indigenous Knowledge) and ‘IKS’ (Indigenous Knowledge Systems) interchangeably. This is done with the aim to illustrate the multifaceted nature of Indigenous knowledge and the systems through which it is transmitted, preserved, and applied within diverse cultural contexts. This approach illustrates the interconnectedness and dynamic nature of Indigenous knowledge, highlighting its adaptability and resilience in addressing contemporary challenges while remaining rooted in traditional practices and wisdom. Through this recognition, the study seeks to contribute to a more comprehensive understanding of the complexities inherent in Indigenous knowledge and its significance in shaping sustainable and culturally relevant solutions in various fields of inquiry.

In the context of Africa, for instance, this acknowledgement of IKS not only enriches scientific understanding but also promotes cultural diversity and fosters a more equitable and inclusive approach to education and research. Embedded in this is the appreciation of African axiology, which recognises Africa’s cultural values and the importance of contextualising this in science education, minding the cultural diversity present in non-Western nations, including sub-Saharan African countries. Besides, advocacy for IKS’s inclusion in the education system is

considered an issue of rights and social justice (Battiste, 2005; Kennedy et al., 2023). In this regard, recognising and valuing IK is considered essential for respecting the cultural rights and identities of indigenous communities (Taylor & Cameron, 2016). Both globally and in South Africa, various stakeholders such as academic institutions, non-governmental organisations, and individuals are actively working towards promoting the integration of IKS (Maila & Loubser, 2003; Taylor & Cameron, 2016). Among other benefits, is the promotion of cultural diversities.

Valuing and recognising IKS is also crucial from a pedagogical perspective since it can enhance teaching and learning, by bringing about diversity and culturally relevant content (Aikenhead, 1996; Taylor & Cameron, 2016). Acknowledging the significance of IK involves recognising its value beyond mere empirical data and embracing it as a source for shaping research methodologies, interpreting scientific findings, and formulating hypotheses (Bala & Gheverghese Joseph, 2007). Accordingly, various studies have engaged the issues of IKS incorporation in school curricula, including science curricula. South Africa has demonstrated eagerness and commitment to incorporating indigenous knowledge into the educational curriculum (Higgs & Van Niekerk, 2002). However, despite various educational policies in place, the worldviews and knowledge of indigenous South Africans continue to be marginalised. The South African education curriculum acknowledges the importance of formal Western education for acquiring essential skills. However, most individuals of African descent are not adequately represented or catered for within the curriculum. The literature suggests that the current curriculum draws heavily from dominant Westernised education systems, overlooking essential aspects that promote traditional-based communities (Henri et al., 2021).

The South African education system has undergone significant changes to promote education and empower learners. However, despite these efforts, elements of unequal power and privilege still exist (le Roux, 2016). The education policy in South Africa can be traced back to the Christian National Education (CNE) regime, which dominated during the apartheid era from 1948 to 1994. During this time, curriculum content focused on immediate economic needs, and cultural education was not considered important, especially in science education. When the new democratic government took office in 1994, the curriculum was designed to address the social, political, and economic divisions of the past (Botha, 2010). Curriculum 2005, which embraced

Outcomes Based Education (OBE), was adopted to bring about these changes (Rogan & Aldous, 2009).

The Revised National Curriculum Statement (RNCS) was introduced in 2002 as a simplified version of Curriculum 2005 (DoE, 2002). The RNCS adopted a humanistic perspective of science, incorporating societal and environmental issues and accommodating IKS (Naidoo, 2010). The Curriculum and Assessment Policy Statement (CAPS) was then developed based on the RNCS, emphasising the inclusion of cultural knowledge, including indigenous knowledge (DBE, 2011). The CAPS document for Natural Sciences aims to make learning meaningful by grounding knowledge in local contexts and valuing indigenous knowledge systems (DBE, 2011).

However, many South African teachers have reservations about the curriculum changes, because they feel that they lack support and resources for integrating IKS into their science lessons (Moyo, 2011). Teachers depend on university-related courses to learn about IKS, and there is a need for more comprehensive support in terms of content, pedagogic content knowledge, and teaching strategies for IKS integration (Òtúlàjà et al., 2011).

The Curriculum and Assessment Policy Statement (CAPS) document outlines the content and implementation of the curriculum in schools, in order to address past injustices and foster transformation (DBE, 2011). Meanwhile, the Department of Basic Education (DBE) tends to maintain a posture that suggests teachers cannot develop their teaching plans and strategies, leading to an approach where decisions and directives are imposed in a top down manner (Swart et al., 2014). This top-down approach restricts the freedom and creativity necessary for enhancing the recognition and integration of IKS. There is a concern about the lack of clear and detailed planning regarding how to implement and value IKS within the CAPS curriculum. Hence, it is crucial to address this issue, possibly by enabling teachers to improve this challenge in their practice, given that they directly contact and engage learners.

Some of the guidelines that teachers need to adhere to in order to incorporate IKS alongside the Curriculum Assessment and Policy Statement (CAPS) are the following:

1. Cultural sensitivity: Science teachers need to educate themselves about the different cultural cultures or norms that exist within their context, especially within their classrooms. If they are aware of the different cultural backgrounds in their classes, this will assist them to teach in a manner that does not violate or infringe on any of the learners' culture/(s) (Abacioglu et al., 2020).

2. Ethical considerations: Science teachers should practice the norm of making inquiries about the different cultures that exist in their context, especially the classroom. They should seek permission from learners to ensure that learners are comfortable and at ease about discussing their cultural practices within an educational setting. This will avoid any issues that may occur. If learners do research about their cultural practices and bring it to class, then science teachers should acknowledge such intellectual property rights (Alwahaby et al., 2022).

3. Respect and collaboration: Science teachers should illustrate a deep sense of respect and humility when approaching the different cultures that exist within the classroom and teachers should also collaborate with indigenous communities and the elderly so that they can provide valuable insights and guidance for the younger generation. This will make the community feel a sense of validation and recognition (Piatz, 2022).

4. Integration within the curriculum: Indigenous knowledge does not necessarily have to be limited to science subjects. Science teachers could also come up with creative ways to encourage other teachers to see which of their concepts in the various subjects can be linked to certain aspects of indigenous knowledge. When learners see a pattern in how indigenous knowledge is taught, this will aid them in appreciating indigenous knowledge even more (Khatoony & Nezhadmehr, 2020).

Meanwhile, for the effective and meaningful integration of IKS into the education system to be realised, the perspectives of the teachers themselves about IKS are of critical importance (Moyo, 2011). A few studies undertaken in this regard present a range of interesting findings that acknowledge the marginal position of IKS in Western-dominated curricula being used across Africa, including South Africa (Moyo, 2011; Trinos & Mudaly, 2020). The marginalisation of IKS in formal education remains a topical issue in these studies. For instance, some of these studies highlight how the curriculum continues to systematically undermine the contributions of IKS in the realm of knowledge production, dissemination, and application to social and ecological issues (Ezeanya-Esiobu et al., 2021; Kaya & Seleti, 2013). I will present an overview of the marginalisation that exists when it comes to IKS in formal education. This will then pave a way for a discussion of the research purpose and rationale.

1.1.1 The marginalisation of IKS in formal education

Within formal education, there is a tendency to regard Western knowledge as universally applicable, while non-Western knowledge is often overlooked or given little to no importance. This disparity in emphasis conveys the message that traditional or indigenous knowledge is dubious or inferior (Ezeanya-Esiobu et al., 2021). Several factors, including colonialism, commercialisation, and the erosion of traditional family structures, have contributed to the suppression of indigenous knowledge (Chadare et al., 2008). These colonial legacies continue to manifest in the national education systems of many African countries, where curricula were adopted without considering cultural practices and indigenous pedagogies (de F. Afonso Nhalevilo, 2013). For instance, the influence of colonialism led some educated Africans who had been schooled in the Western system to develop a condescending attitude towards indigenous knowledge, thereby perpetuating its marginalisation (Msila, 2009).

Moreover, since the early days of African states gaining independence, indigenous knowledge has been neglected within the education system, which prioritised the imposition of educational systems inherited from colonisers (Gumbo, 2016). There are instances where indigenous knowledge has been integrated in curricula previously dominated by Western knowledge. However, it has often been subjected to ridicule and portrayed as less important, while Western knowledge is privileged and is presented as superior (Owuor, 2008). This unequal treatment results in inadequate coverage of indigenous knowledge within education systems, granting greater power and dominance to Western methods while undervaluing traditional indigenous practices. This has had various implications in terms of the application of IKS to solving social

issues. For instance, despite its immense value, there has been a decline in the reliance on indigenous knowledge for survival in many households (Kamwendo & Kamwendo, 2014).

Le Grange (2016) observed that impoverished university students in South Africa face challenges such as academic unpreparedness, financial constraints, and a sense of foreignness in the university culture. By implication, indigenous students often feel out of place in the university culture, which is typically oriented towards Western values and norms. In addition, it is often the case that the Western-centric environment does not adequately recognise or incorporate indigenous knowledge systems, traditions, and ways of learning. Despite efforts to incorporate indigenous knowledge into curricula in some African countries, the challenge of dealing with diverse indigenous groups or ethnicities has hindered effective documentation and integration (Owuor, 2008). Yet, according to Freire's *Pedagogy Of The Oppressed*, curricula should relate to the lives of learners and avoid alienation, emphasising the need for a curriculum that is inclusive and relevant (cited in Ezeanya-Esiobu et al., 2021).

South African universities, influenced by their historical association with neo-colonialism and apartheid, are often seen as foreign institutions within an African context. This perception has been evident through movements like the *#RhodesMustFall# and #FeesMustFall#* that took place in 2015/2016 (Kwoba et al., 2018). These movements highlighted the discontent among students regarding the lingering symbols of colonialism on campuses, such as statues of colonial figures, and the inequitable access to education due to high tuition fees. These protests shed light on the need for decolonising education and creating a more inclusive and representative university environment that acknowledges and addresses the historical and ongoing impact of colonialism. The education sector, where indigenous knowledge systems have been undermined, is a critical area that requires this paradigmatic shift.

To address the pressing issue of food security in Africa, there is a need for a paradigm shift that recognises the importance of traditional knowledge in food security and preservation (Chipo & Tichaona, 2011). Africa, despite having vast arable land, still faces significant food security challenges (Asogwa et al., 2017). For example, South Africa is highly diverse in terms of both biology and ethnicity. It is known for its rich angiosperm species, estimated at around 21,817 (Mothwa, 2014). The country has ancient traditional medicinal systems derived from different cultural groups, dating back to Palaeolithic times. Indigenous knowledge and cultural practices in South Africa can serve as a valuable foundation for scientific learning, highlighting the

relevance of science in our daily lives (Mothwa, 2014). In the context of Natural Sciences pedagogy, not only is there a scarcity of research that explores preservice teachers' perspectives and reflections on IKS (Govender et al., 2016), but there is little to none that looks at the place of IK-related foods and beverages in the curriculum.

Hence, I believe that incorporating indigenous knowledge into the curriculum, particularly concerning African indigenous foods and beverages, can help learners establish a meaningful connection with the subject matter. By creating a space for learners to share their own experiences and knowledge, the curriculum can become more relevant and engaging to them. However, various extant studies have demonstrated that this is hardly possible in the academic environment in most colonised nations, including South Africa, where the marginalisation of IKS still holds sway in the formation of teachers (de Beer & Kriek, 2021; Mashoko, 2022; Waghid & Hibbertimagemaqui, 2018). This study focuses on understanding the marginalisation of African indigenous knowledge in science education by specifically focusing on how preservice science teachers relate to food and beverages from an IKS perspective. I believe that the application of IKS by preservice teachers in science lessons regarding food and beverages can contribute to the overall effort at valuing IKS as envisaged in the CAPS document.

1.1.2 Who am I? Positionality

I am a Natural Sciences teacher and I have observed that there is a disconnect between learners and the science curriculum, which is perceived as more Eurocentric than Afrocentric (Khupe, 2014). My background study at the University of KwaZulu Natal also focused a lot more on Eurocentric curricula and less on African indigenous knowledge systems. However, during my study at UKZN, there was a constant effort to try and incorporate indigenous knowledge in the Natural Sciences method 1 and 2 modules. This was done to create awareness amongst students that there is more to science and our curriculum than meets the eye.

I believe it is extremely important to share parts of my life and research journey, as is commonly done in indigenous research studies, to acknowledge and embrace the influence of personal experiences in the research process. The purpose of providing my background and contextual information is to provide the reader with insights into the factors that have influenced my research framework, methodological choices, and data interpretation. I align with the perspective of (Swadener, 2004) who argues that research is not a neutral process but is shaped

by our sociocultural experiences and history. The acknowledgement of these dimensions is very important in culturally informed research such as this that advocates for the incorporation of IKS in science lessons.

Indeed, the emancipatory focus of the paradigm that underpins this research has implications for my teaching philosophy and career. Such social and professional positioning can be a potential source of biases. Thus, minding my positionality in this research is critical in helping me maintain transparency and accountability thereby allowing the reader and participants into my background. The discussion of positionality keeps me critically reflexive through the research processes with the view to identify, acknowledge and mitigate any subjectivity, potential biases, assumptions, or blind spots that could affect the trustworthiness of this study. As an African, my positionality undeniably influences how I interpret the data contextually, potentially providing a more profound understanding of its applicability or lack thereof in various contexts.

Moreover, the disclosure of my positionality is of importance to the ethical considerations that guide this research. For instance, it caters to the participants' rights to know my background, with the view to raise awareness on any potential power dynamics issues that can influence both the consultative process and the reporting.

I am a Black South African of Ugandan descent. This research will discuss the importance of incorporating indigenous knowledge within science lessons and as an African I feel that the curriculum has marginalised African indigenous knowledge. In as much as my view is well founded, I must be careful not to allow unnecessary sentiments to impair my judgement when dealing with literature or participants on this matter.

1.2 Purpose of the study

This study explores how preservice teachers in the Natural Sciences school subject intended to integrate indigenous knowledge about African foods and beverages within their science lessons. This study also focused on preservice teachers' views on integrating learners' cultures and science within Natural Sciences lessons.

1.3 Rationale for the study

The study's rationale is based on the requirement of the CAPS document for Natural Sciences, which expects teachers to embrace indigenous knowledge systems and deliver culturally inclusive lessons (DBE, 2011). However, research has illustrated that many schools do not practice the teaching of IKS due to teachers' inadequate knowledge, background, and training in this area. This lack of integration of IKS leads to conceptual gaps in learners' knowledge and poor performance in science (Hoppers, 2000; Mudaly & Ismail, 2013). In response to these issues, preservice teachers at The University of KwaZulu Natal, Edgewood campus are being taught to integrate IKS into their lessons to promote culturally inclusive science education.

1.4 Problem statement

Despite efforts to advocate for the inclusion of indigenous knowledge within science lessons, it is still perceived as inferior to Western knowledge (Chadare et al., 2008). This perception leads to disconnection and poor performance among learners studying science (Shizha, 2016). The limited coverage of African indigenous knowledge in the curriculum highlights a preference for Western knowledge, disregarding the importance of indigenous knowledge (Shizha, 2016). This study aims to explore preservice science teachers' perspectives, plans, and reflections on integrating indigenous knowledge related to food and beverages into science lessons. By evaluating this, the study addresses the marginalisation of African indigenous knowledge and its relevance in addressing food insecurity. Despite the intention of the CAPS document to rectify past injustices, it lacks guidance for valuing indigenous knowledge (DBE, 2011). This absence of clear pedagogical direction underscores the need to comprehend the perspectives of prospective science teachers regarding the appreciation and incorporation of Indigenous Knowledge (IK) - this is the main problem. Gaining insight into the viewpoints of preservice science teachers is essential for the effective integration of Indigenous Knowledge (IK) into the curriculum. They play a pivotal role in realising the vision of not only preserving but also transmitting IK to future generations.

South Africa's past was marked by human rights violations linked to cultural and racial backgrounds, resulting in widespread inequalities across various aspects of society, notably impacting indigenous communities, holders of Indigenous Knowledge (IK), and women. Practitioners of Indigenous Knowledge Systems (IKS) faced discrimination and marginalization within this historical context. In 2004, the South African Government

introduced the IKS Policy, aimed at addressing the exclusion of these groups, integrating African perspectives into national knowledge systems, and honouring cultural identities rooted in Indigenous Knowledge practices. The policy aimed to rectify past injustices and acknowledge the diverse knowledge heritage of South Africa. (Mudaly, 2018).

The South African education system underwent significant changes in its curriculum after the democratic elections in 1994. This necessitated the curriculum to adopt outcomes-based education (OBE) to ensure a more inclusive and high-quality learning experience for all learners. This shift aimed to move away from content-based teaching towards an emphasis on achieving specific outcomes. The new curriculum aimed to empower learners to reach their full potential by defining clear outcomes for the educational process, promoting a learner-centred and activity-based approach. Learning Outcome 3 of Natural Sciences as well as Life Sciences expected teachers to integrate indigenous knowledge within the science curriculum. This was necessary as it would reflect the wisdoms and values of indigenous people that have been acquired over centuries. This is wisdom that is believed to have been lost or marginalised in the last 300 years of colonisation (Ahanonye, 2021)

This study seeks to evaluate the marginalisation of indigenous knowledge (IK) in science education persists despite its recognised value in people's lives, creating a pressing need for its integration into teaching practices. While calls for incorporating IK, particularly concerning African foods and beverages, into science lessons have emerged, there remains a gap in understanding how to effectively implement this integration. (Ezeanya-Esiobu et al., 2020)

Preservice science teachers, as key stakeholders in shaping future educational practices, require support and guidance to navigate the incorporation of IK within the constraints of existing curriculum frameworks. Additionally, there is a lack of empirical research examining preservice teachers' perspectives on integrating IK into science lessons, particularly within the context of African foods and beverages. This gap hinders efforts to address the marginalisation of IK and hampers progress towards more inclusive and culturally relevant science education. Therefore, this study seeks to evaluate preservice science teachers' perspectives on integrating indigenous knowledge about African foods and beverages into science lessons, aiming to inform strategies for promoting the integration of IK and fostering a more equitable and culturally responsive approach to science education (Mji et al., 2020).

1.5 Research Aim

As Babbie and Mouton (2001) observed, the aim of research is a foundational element. It is crucial to clearly define the primary aim of the research, ensuring that it is well-phrased and represents the central focus of the entire study (Cooper & Schindler, 2020). Accordingly, this research aims to evaluate preservice science teachers' perspectives, plans, and reflections on incorporating indigenous knowledge about food and beverages in science lessons.

1.6 Research objectives

1. To explore preservice science teachers' perspectives about the integration of indigenous knowledge related to foods and beverages in science lessons.
2. To explore preservice science teachers' methods and plan on integrating indigenous knowledge about foods and beverages in science lessons.

1.7 Research Questions

1. What are preservice teachers' perspectives about integrating African foods and beverages with indigenous knowledge, in science lessons?
2. What methods do prospective teachers view as most effective for integrating indigenous knowledge pertaining to food and beverages in science lessons?

Sub – questions:

1. What are preservice teachers' perspectives about the wisdom embedded within indigenous knowledge relating to foods and beverages?
2. How do preservice teachers plan to incorporate IK about foods and beverages in science lessons?

1.8 Significance of the Study

Creswell and Creswell (2017) suggest the importance of highlighting the contribution of research to scholarly literature in the field, its potential to enhance practical applications, and the rationale for its potential to influence policy or decision-making. In this regard Bernard (2018, p. 151) underscores that research is a mechanism for producing knowledge, and knowledge holds the potential for empowerment. Thus, the significance of this study lies in the

insights and the empowerment it provides through the exploration of the integration of indigenous knowledge as it relates to African foods and beverages within the science classroom. By focusing on the perspectives, plans, and reflections of preservice science teachers, the study addresses the marginalisation of African indigenous knowledge. The study brings more attention to the undervaluing and side-lining of IKS in favour of Western knowledge, leading to disinterest among learners and poor academic performance in science subjects. The findings of this study will inform teachers as well as curriculum designers on the experiences of preservice Natural Sciences teachers who work towards linking culture and school science. The study also provides insights into the challenges, opportunities, and potential strategies for integrating indigenous knowledge within the science classroom, as revealed through the experiences of preservice teachers.

The adoption of the postcolonial indigenous theory helps in bringing about social change and decolonisation in science education. By applying this framework, the study contributes to ongoing efforts at shifting away from Eurocentric perspectives and recognising the underdevelopment of indigenous wisdom and its contributions to knowledge in science classrooms. It aligns with the broader efforts to promote inclusive and culturally relevant education.

This study's significance also lies in its potential to inform policy and practice in science education by highlighting the importance of integrating indigenous knowledge, specifically related to African foods and beverages, into the science curriculum. Overall, it contributes to ongoing discussions on decolonising education and fostering a more inclusive and empowering learning environment for students, especially regarding the natural sciences.

1.9 Scope and Limitations or De[limitation] of study

The study recognises that certain limitations have affected its design and scope. One significant limitation is related to resource constraints and other factors that prevented the inclusion of a larger population sample. Originally, the plan was to involve a broader range of participants, but due to various limitations, the study focused solely on new preservice science teachers from the University of KwaZulu Natal. This decision was made to ensure the logistical feasibility and manageability of the study within the available resources. However, it is important to note that this limited scope may restrict the generalisability of the findings. The specific characteristics and circumstances of this group of preservice science teachers may not be representative of all preservice teachers or other contexts. Despite these limitations, the study

still holds value in providing valuable insights and understanding within the specific context and population under investigation. The findings can contribute to the existing knowledge base and serve as a foundation for further research. It is essential to interpret and apply the findings cautiously, considering the specific limitations and contextual factors of the study.

1.10 Brief Break Down of Chapters to follow

To address the objectives of this study, the research is structured as follows:

Chapter 1 – General Introduction and Background to Study*:* The first chapter of the research thesis serves as an introduction to the study, setting the context and providing the necessary background information. It begins by establishing the general background and motivation for the research as it pertains to the values of IKS, its marginalisation, and the advocacy for inclusion in the science classroom. Further, this chapter, outlines the research problem, rationale, aim, objectives, questions, and the significance of the study. Additionally, the chapter identifies the scope of the study.

Chapter 2 – Literature Review and Theoretical Framework: The second chapter presents a critical review of existing literature that is relevant to the research topic. The initial part of this chapter focuses on exploring literature related to IKS in promoting quality education and contributing to national development goals. In the second part of the chapter, the theoretical framework that underpins the study is outlined. Specifically, the Postcolonial indigenous theory is introduced and its relevance to the research objectives is emphasised.

Chapter 3 – Methodology: This chapter addresses the methodological approach employed in the research study. It provides a comprehensive overview of the research design and methodology, with a specific focus on the qualitative method utilised. The chapter discusses the chosen research paradigm and explains the data collection methods employed. It also elaborates on the process of sample selection and provides insights into how the data was analysed. Ethical considerations are addressed, and the chapter concludes by outlining the limitations of the study.

Chapter 4 and 5 – Data Presentation, Analysis, and Discussion: These chapters of the thesis involve the presentation, analysis, and discussion of the data. Chapter four begins by presenting the data obtained from interviews, providing a clear and organised presentation. Subsequently, the data are critically analysed and discussed based on the identified themes derived from the interviews. Throughout the analysis, relevant citations from the interview narratives are

incorporated to support the interpretation of the findings. The discussion highlights the significance of the findings to the research objectives and their relation to previous studies and the postcolonial indigenous theory, which underpins the research.

CHAPTER 2
LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.0 Introduction

This chapter presents a comprehensive literature review that establishes the significance of the research topic by situating it within the existing literature on Indigenous Knowledge Systems (IKS). Following Randolph's (2009) definition, this literature review involves a thorough analysis of previous scholarly works that are relevant to the research study. It not only showcases my understanding and familiarity with the topic but also evaluates and synthesises existing studies to contribute to the current knowledge. This review encompasses several key areas: providing a brief overview of IKS, emphasising the significance of IKS concerning food security, exploring African indigenous knowledge on food and beverages, discussing the marginalisation of IKS within the formal education system, and evaluating the role of IKS in science education. By doing so, this review highlights the body of knowledge concerning the marginalisation of African indigenous knowledge in science education, specifically in the context of food and beverages, despite the recognised value of IKS in this regard. (KenechukwuOkoro, 2023; Mustakim et al., 2023; Sharma & Pradhan, 2023). The aim is to shed light on the current situation and provide insights into how preservice teachers can contribute to improving their lessons by tapping into IKS as a repository of legitimate knowledge. The second part of this chapter outlines the theoretical framework that underpins the study, specifically the postcolonial indigenous theory (PIT).

2.1 Conceptualising Indigenous Knowledge Systems (IKS): An Overview

The understanding and application of IKS exhibits significant variations among different geographical regions and individuals. This knowledge system is characterised by its dynamic nature, constantly evolving through internal creativity, experimentation, and interactions with external systems (Khupe, 2014; Sentina et al., 2018). The observable diversity in the interpretations of IKS in literature arguably stems from the inherent complexities and definitional challenges associated with the term 'indigenous knowledge' (Bohensky & Maru, 2011). Within the discourse of IKS, the term "indigenous knowledge" is often used interchangeably with local or traditional knowledge. For instance, Indigenous knowledge has been described as local knowledge that is acquired through experiences (Battiste, 2016), and remains open to outside influences to address new environmental challenges. Other authors see

IK as encompassing a cumulative body of knowledge, beliefs, practices, and other components (Henri et al., 2021). Indigenous knowledge is transmitted from one generation to the next, representing knowledge that has been passed down by a society based on its cultural beliefs (Ankrah, Kwapong, & Boateng, 2021). According to Skroblin et al. (2021, p. 587), “indigenous knowledge systems contain detailed information about current and past environments, which can contribute to ecological understanding and contemporary environmental management.” Additionally, IK incorporates spiritual elements, economics, and local politics, all of which are shaped by ideological, social, and geographic contexts (Orlove et al., 2010).

The term 'indigenous' introduces an additional challenge that relates to power dynamics. In some cases, the use of 'indigenous' is rooted in a Western knowledge framework, which reinforces power imbalances between different knowledge systems. This can result in negative perceptions and stereotypes associated with the concept. For instance, 'indigenous' may be linked to notions of being 'primitive,' 'wild,' 'naïve,' 'unscientific,' or representing 'old' and unchanging information. These connotations can evoke ridicule and undermine the worth and credibility of indigenous knowledge (Battiste et al., 2005; Khupe, 2014). It is important to recognise these power dynamics and challenge the stereotypes and biases associated with the concept of 'indigenous.'

2.1.1 IK and IKS

While Indigenous Knowledge (IK) and Indigenous Knowledge Systems (IKS) are often used interchangeably (Vhurumuku & Mokeleche, 2013), it is important to understand the slight distinction that exists between them. On the one hand, IK refers to the knowledge, practices, and beliefs held by Indigenous peoples and local communities. It encompasses the accumulated wisdom, skills, and understanding developed over generations through observation, experience, and interaction with the natural and social environments (Ellen & Harris, 1997; Masoga & Shokane, 2019; Musinguzi et al., 2011). Indigenous Knowledge is deeply rooted in specific cultural contexts and reflects the unique ways in which Indigenous communities perceive, interpret, and engage with the world around them (Kaya & Seleti, 2013; Oguamanam, 2008). It encompasses diverse fields such as traditional medicine, ecological management, agriculture, navigation, storytelling, and more. Indigenous knowledge is often embedded in oral traditions and passed down through storytelling, rituals, ceremonies, and intergenerational learning (Vhurumuku & Mokeleche, 2013). Indigenous Knowledge System on the other hand, refers to the broader framework or system within which Indigenous Knowledge operates. Indigenous Knowledge Systems encompass the interconnected elements that support the

development, transmission, preservation, and application of Indigenous Knowledge within a community or group (Henri et al., 2021; Wallace et al., 2022). It includes not only the knowledge itself but also the values, beliefs, practices, social institutions, and cultural norms that underpin the knowledge system (Hall & Smith, 2000). IKS provides a holistic understanding of how Indigenous peoples organise, interpret, and utilise their knowledge in their daily lives. It recognises the dynamic and interactive nature of IK, influenced by factors such as spirituality, social relationships, land stewardship, and community governance (Hall & Smith, 2000). Essentially, IK represents the specific knowledge held by Indigenous peoples, encompassing their deep understanding of the world and their ways of life, which is often rooted in cultural contexts and embodies the unique perspectives and experiences of Indigenous communities. Indigenous Knowledge Systems however refer to the broader framework and interconnected elements that sustain and give meaning to IK (Mkhize & Ndimande-Hlongwa, 2014).

Understanding the distinction between IK and IKS is crucial for appreciating the richness and complexity of Indigenous knowledge systems, and for fostering respect, recognition, and collaboration with Indigenous communities in various fields, including education, research, policy-making, and cultural preservation. While this study mainly focuses on IK, it acknowledges its embeddedness in IKS, as described above. Indeed, embracing a more inclusive and respectful understanding of IK requires acknowledging its richness, complexity, and relevance within its cultural contexts (Vhurumuku & Mokeleche, 2013; Zidny et al., 2020).

Accordingly, IKS refers to comprehensive worldviews with their own ontology and epistemology, while IK specifically pertains to the individual elements of knowledge or knowing that are encompassed within IKS (Khupe, 2014; Vhurumuku & Mokeleche, 2013). A differentiation can also be applied to the worldview that forms the foundation of what is commonly known as Western Modern Science (WMS) and the specific components of scientific knowledge. Indeed, some distinctive sets IK aside from Western science, without rendering IK any less of scientific values (Taylor & Cameron, 2016).

2.2 IK and Western Modern Science: Are they different?

The concept of scientific knowledge is predominantly associated with Western Modern Science (WMS), due mainly to the dominance of the Western culture in scientific endeavours across the globe (Khupe, 2014; Taylor & Cameron, 2016). This has often meant that WMS has been universalised, with the implication that other forms of knowledge are perceived as only

local and relevant within a culture (Siegel, 2002). This is observable in the very varied description of IK itself, especially as can be seen in its interchangeable use with local, cultural, community-based or traditional knowledge among its other designations (Taylor & Cameron, 2016; Zidny et al., 2020). Consequently, some distinctions are often being made between IK and WMS that often result in questionable conclusions regarding the predominant universalisation of the latter. For instance, while Western is often seen as stemming from systematic observation, experimentation, and analysis conducted within the framework of the scientific method, IK is predominantly presented as only stemming from traditional practices, beliefs, and experiences of indigenous peoples (Mudaly, 2018; Siegel, 2002). In line with this, IK seems to seek holistic and experiential ways of knowing, which incorporate spiritual, cultural, and ecological dimensions (Kaya & Seleti, 2013). These features are however often contrasted with scientific knowledge because IK is seen as lacking objectivity, logical reasoning, reproducibility, and peer review and empiricism that are questionably believed to be preserves of Western scientific knowledge (Siegel, 2002; Taylor & Cameron, 2016). In this regard, the methodologies of scientific knowledge are often believed to be more rigorous than those of IKS, considering, for instance, the latter's reliance on oral traditions (Kaya & Seleti, 2013).

Furthermore, distinctions have also been drawn along the lines of the scope and authority of both knowledge systems. For instance, while IK is understood as local to geographical or cultural contexts, scientific knowledge is often postulated as universal and generalisable beyond a given context (Kaya & Seleti, 2013; Msila, 2009). In other words, unlike IK, scientific knowledge is often considered as being premised on universal laws and principles that are applicable across diverse contexts. For instance, as Wang et al. (2019) observed, scientific knowledge often revolves around formal research centres and private entities, following a process of experimentation, validation, and subsequent application at regional, national, or international levels (Bohensky & Maru, 2011; Msila, 2009). By this logic, IK derives its validity and authority within the community or culture where such knowledge applies, whereas Western scientific knowledge derives its authority from the scientific community based on its standards, including reliance on rigorous validation processes, peer-reviewed publication, replication or reproducibility (Bohensky & Maru, 2011). Accordingly, IK is often seen as informal, whereas scientific knowledge is considered more formal and rigorous. This differentiation, which sometimes raises concerns about the fallacy of scientism (the belief that scientific methodology is the only valid way of acquiring knowledge), has contributed to the ongoing marginalisation of IK (Kaya & Seleti, 2013).

Notwithstanding the above arguably questionable distinctions, a growing body of literature, has brought attention to the complementary value of both knowledge systems, through integrations, especially in the face of growing complex issues which require a holistic approach in education (Henri et al., 2021; Onwu & Mufundirwa, 2020). Central to this complementarity is one of the important distinctions between IK and Western science that suggest that IKS is not inferior to the latter. That distinction is IK's rootedness in interconnectedness, harmony with nature, and the well-being of the community and future generations – a central issue of sustainability (Onwu & Mufundirwa, 2020). Such is hardly fully attainable through the materialist and reductionist framework upon which Western science is often based. Herein lies the importance of the interdisciplinary approach, often referred to as 'Two-Eyed Seeing' (Reid et al., 2021, p. 243). This approach acknowledges the strengths and perspectives of both knowledge systems but also fosters a holistic and sustainable approach to the knowledge production and application to a range of social and environmental challenges. Meanwhile, such synergy is yet to be realised, due to various reasons including the underreporting of IKS.

The underreporting and marginalisation of IKS within mainstream education have garnered attention from scholars and policymakers alike. This disregard has resulted in the undervaluing of IKS in formal education systems. Many argue that this is due to the dominance of Western knowledge systems, which have led to biases and hypocrisy in the Western world (Maxwell, 2011). For instance, Maxwell (2011) suggests that the West has appropriated and expanded upon indigenous knowledge without proper recognition, while Le Grange (2016) highlights the failure of those who appropriate African knowledge to acknowledge its true origins. This appropriation not only marginalises African knowledge but also unjustly claims superior knowledge about African indigenous knowledge compared to its rightful owners (Amechi, 2018; Wilson, 2021). These arguments shed light on the power dynamics and cultural biases inherent in the recognition and utilisation of indigenous knowledge. The dominance of Western knowledge especially in science disciplines often leads to the dismissal or belittlement of traditional and local knowledge (Govender & Mutendera, 2020). This not only perpetuates inequality but also inhibits the full potential of incorporating diverse knowledge systems into educational curricula and policy frameworks (Risiro, 2019).

It is against this backdrop that calls for decolonisation and inclusivity of education systems have gained traction, especially in recent times (de Beer & Kriek, 2021; Santana & Akhurst, 2021). In particular, there is advocacy for formal education to improve on its effort in the integration of the IK, in science education, considering its value and respecting its origins and contributions to whole scientific endeavours (Mhakure & Otulaja, 2017; World Bank, 1998). Embracing a more inclusive and culturally diverse approach to education is seen as a viable way to bridge the gap between different knowledge systems and foster a more equitable and comprehensive understanding of the world (Mhakure & Otulaja, 2017). One notable area where this is relevant is in the field of food security, particularly within the context of Africa's education system, which is primarily influenced by Western science orientation. The contributions of IK to food security are significant, and the reflections thereof in the science curriculum within the mainstream educational framework are of interest.

The challenge lies in the recognition and validation of indigenous knowledge by both teachers and learners, despite efforts to include it within the science curriculum (Onwu & Mosimege, 2013). Some researchers acknowledge the similarities between Western science and indigenous knowledge systems, while others emphasise their differences and perceive them as competing with each other (Vhurumuku & Mokeleche, 2013).This creates tensions that make it difficult for science teachers to effectively integrate indigenous knowledge into the science classroom, especially when students hold different worldviews (Botha, 2012).

The current curriculum in many educational systems fails to adequately recognise and incorporate the real-life experiences of learners within their immediate environment. This results in significant gaps between the curriculum and the lived realities of students. Asante (2020) highlights that little to no reference is made to learners' actual experiences, which can lead to a disconnection between what is taught in the classroom and the students' everyday lives. One of the underlying issues is that the curriculum is often designed without taking into consideration the specific environmental, political, and ideological contexts in which teachers and learners operate. The curriculum is typically formulated by external bodies or experts who may not have a deep understanding of the local circumstances and cultural diversity of the students (Asante, 2020). This can lead to a disconnection between the content being taught and the immediate realities of the learners.

It is important to recognise that educational curricula are not neutral but are shaped by power dynamics and societal influences (Ezeanya-Esiobu et al., 2021) argue that curricula inherently prioritise certain forms of knowledge or systems, whether intentionally or inadvertently. This can perpetuate existing power imbalances and marginalise indigenous knowledge and perspectives. In the context of science education, for example, Western scientific knowledge tends to be given more prominence and seen as superior to indigenous knowledge systems. Hence, scholars have emphasised the need to reassess education curricula, particularly in historically colonised countries, to ensure a greater representation of African indigenous knowledge (Mkhize & Ndimande-Hlongwa, 2014; Waghid & Hibbertimagemaqui, 2018). The aim is to move away from a curriculum that primarily promotes a colonial agenda and instead embrace a more inclusive approach that recognises and values indigenous knowledge and traditions. By incorporating indigenous knowledge into the curriculum, learners can gain a deeper understanding of their own cultural heritage, and their knowledge and experiences can be validated and respected (de Beer & Kriek, 2021; Mashoko, 2022). I therefore chose to explore the incorporation of indigenous knowledge within science lessons through foods and beverages.

In 1997, the school curriculum established that teachers should incorporate indigenous knowledge systems into the school science curricula. This has been emphasised in the Curriculum Assessment and Policy Statement (CAPS) in 2011 (Mudaly, 2018). One of the reasons behind this inclusion is to ensure that learners can apply indigenous knowledge within their environment and society at large. However, it has been a challenge for this to be effectively implemented due to inadequate teacher training, among other factors. This means that tertiary institutions have a lot of work to do in this area in equipping teachers in training with this knowledge (De Beer & Petersen, 2016). Democracy has assisted South Africa in undergoing significant transformation, especially in social justice. However, these changes have not been able to bring about massive improvement (Mudaly, 2018). There has been a societal shift when it comes to including indigenous knowledge in the school curriculum, however more shas to be done to achieve greater results. Most of the Western epistemologies within the South African education system are a reflection of the historical power dynamics and patterns of the apartheid era which are difficult to eradicate (Govender et al., 2016; Mudaly, 2018).

The failure to challenge the current status quo pertaining to indigenous knowledge will have severe consequences on our education system. This will continue to perpetuate imbalance where certain knowledges will be considered as more important as opposed to others. Failure to enhance our education system where we decolonise the education system will restrict us from unlocking our full potential on a global scale, especially when it comes to intellectual and academic contributions (Lebakeng & Dalindjebo, 2006). Higher education institutions in the South African context need to ensure that they work tirelessly to reshape epistemic traditions. This means that knowledge from different roots/sources must be acknowledged and given its rightful place within the country. When our education system becomes more inclusive and we adhere to a more decolonised system, this will contribute to a more transformed society.

Decolonisation is a long process that not only affects policies and curricula but also affects social processes that may impact on human rights. This is especially true when it comes to bringing about or creating an education that is inclusive of indigenous knowledge (Kennedy et al., 2023). When dealing with indigenising the curriculum we need to treat ourselves as pioneers and think of the challenges we may encounter in the process because this will impact also impact indigenous communities (Khumalo & Baloyi, 2017). Our cultural estrangement must be replaced with cultural engagement in the pursuit of an education that dignifies and edifies African education. We need to develop African theoretical prisms and perspectives which will account for our lived experiences and our rationality and these must be rooted in our heritage, cultures and histories (Dei, 2023). Foods and beverages should be integrated within the science curriculum and incorporated with indigenous knowledge systems. Science concepts and indigenous foods and beverages should not be alienated from each other (Benitez et al., 2022).

2.3 Food [In]Security and IKS in [South] Africa

According to the Food and Agricultural Organisation (FAO) of the United Nations (FAO et al., 2022), food security is defined as the state in which a household or community has reliable access to enough, affordable, and nutritious food. Considering the projected exponential population growth, it is estimated that there will be a 70% increase in global food production needed by 2050, particularly in developing countries (Bruinsma, 2009). On the other hand, food insecurity is described as a condition in which individuals lack secure access to enough safe and nutritious food for normal growth, development, and active and healthy lives (FAO et al., 2015, p. 56). It is important to note that food insecurity should not be confused with hunger, although they are related. Hunger specifically refers to the physical sensation caused by

insufficient food and energy consumption. Food insecurity, however, encompasses a broader concept of inadequate access to food that is not only nutritious and safe but also able to meet specific dietary needs (Wagner et al., 2015). Food security is often measured through four pillars: food availability, economic and physical access to food, food utilisation, and stability over time (Dzikunoo et al., 2021). These dimensions reflect the multifaceted nature of food insecurity and highlight the importance of considering not only the availability of and accessibility to food but also the utilisation and sustainability aspects. These distinctions and dimensions around food insecurity discourse may also have implications for IK given the multidimensional cultural meanings often attributed to food (Antin & Hunt, 2012). For instance, among the Inuit, an indigenous group in Canada, food holds a spiritual connection that emphasises respect for life, land, water, and animals. It is a significant aspect of culture, involving the careful handling of animals, the celebration of the first catch, and the preservation efforts led by women (Inuit Circumpolar Council-Alaska (ICC-Alaska), 2015). A similar worldview is shared in the African culture. Meanwhile, literature has highlighted the severity of food insecurity in Africa, including South Africa, relative to other regions of the world, despite Africa's biodiversity and rich indigenous knowledge heritage.

2.3.1 Food Insecurity in Africa

Africa faces a unique set of challenges when it comes to food security, likely due to a combination of factors such as climate, economic development, and political instability, poor governance and corruption. Some reports have suggested that more than 330 million people in Africa have suffered from malnutrition especially those in the rural areas (FAO, 2017). In recent years the population has increased rapidly since many countries received their independence and food insecurity has also been on the rise. Research has shown that even though food insecurity is a growing challenge world-wide, it has affected the African continent the most (FAO, 2017). Even though Africa has done a lot to export agricultural products, many countries within the continent are still struggling with food insecurity. According to Fox and Jayne (2020), sub-Saharan Africa's import bill was $43 billion in 2019 and projected to reach $90 billion by 2030, which is considered a worrisome trend considering that global warming is becoming more prevalent and is affecting food production.

Africa's food insecurity can largely be attributed to the fact that indigenous people are abandoning their farming for many reasons including stringent food policies, predominance of technology and the dominance of Western culture, among others identified in the literature (Aworh, 2023; Bjornlund et al., 2022; Parawira & Muchuweti, 2008; Tlhompho, 2014). For

instance, large scale farming tends to receive more resources and support while small holder farmers are marginalised, hence local food production and security is impacted on negatively. Research has shown that smallholder farmers tend to lack access to modern inputs, the necessary infrastructure and credit. This in turn affects their agricultural productivity which remains low, and this perpetuates food insecurity at a local level (Bjornlund et al., 2022; Kuyu & Bereka, 2020).

2.3.2 State of Food Insecurity in South Africa

Based on the Household Food Insecurity Access Scale (HFIAS), in 2022, which assesses households' food accessibility, there has been a slight reduction in the percentage of South African households experiencing insufficient or severely inadequate access to food (Ningi et al., 2022). According to Statistics SA (Stats SA, 2023), this figure decreased from 23.9% in 2010 to 22.3% in 2016. It is important to recognise that the persistent poverty and food insecurity in South Africa have been attributed to the historical legacy of colonialism and apartheid policies, deliberately designed to create unfavourable conditions for the well-being of black individuals (Masekoameng & Molotja, 2019).

In addressing these challenges, scholars have acknowledged that indigenous foods and Indigenous Knowledge Systems (IKS) play a crucial role in enhancing household food security within rural communities (Aworh, 2023; Borona, 2019; Kuyu & Bereka, 2020). “Indigenous food plants provide various social functions; they are crucial to food supply diversification efforts, and they improve food and nutrition security” (Nxusani et al., 2023). Their adaptability, nutritional value, and cultural significance make them invaluable resources for sustainable and resilient food systems. Recognising the significance of this, the promotion of indigenous foods and IKS becomes imperative in tackling food insecurity among rural populations (Mbhenyane, 2017).

Furthermore, it is essential to document and integrate IKS with modern knowledge to ensure that both systems complement each other in contributing to household food and nutrition security. This is particularly crucial as there is a risk of indigenous knowledge gradually disappearing over time (Masekoameng & Molotja, 2019). Van der Walt (2004) asserts that Africa's plant biodiversity is extensive, making it the continent with the greatest plant variety. The importance of dietary diversity for food security is emphasised, highlighting the limitations of relying on a few major crops for the global food supply. Africa's rich biodiversity includes numerous lesser-known indigenous crops and wild food plants that are integral to traditional

diets. These "orphaned" or "lost" crops have received limited attention from international science and research (Aworh, 2023). However, they play a critical role in ensuring food and nutrition security, particularly in rural communities, due to their availability and affordability (Aworh, 2023). To support rural communities with limited resources, there is need for collaboration between policymakers and scientists to promote the cultivation of traditional African vegetables in subsistence farming. This initiative would have multiple benefits, including improved dietary diversity, enhanced health outcomes, and the creation of new markets in urban areas where these vegetables, referred to as "morogo," are in high demand.

2.3.3 IKS in Food and Beverages

Food security has become a concern at local, national, and international levels, prompting the need to document indigenous food consumption and the role of indigenous knowledge systems (IKS) in achieving food security. The use of indigenous knowledge systems (IKS) has historically played a role in ensuring food security, particularly in rural communities. However, modernisation has brought changes to the utilisation of IKS in adapting to a changing environment and addressing the limited access to modern technology among subsistence farmers with low incomes (Tlhompho, 2014). Despite the potential of IKS to contribute to food security, there has been limited research studies exploring their extent of contribution (Kamwendo & Kamwendo, 2014). Yet as Kalumikiza (2018) correctly observes, science and indigenous knowledge both converge in their pursuit of a common goal regarding food security: providing sustenance for the population. Therefore, they should be complementary, with indigenous knowledge informing scientific research and application, and science scrutinising and validating IKS.

Indigenous knowledge systems (IKS) offer valuable local solutions to address food insecurity, particularly in rural areas. These traditional knowledge systems play a crucial role in improving the quality of life, especially during times of seasonal food shortages. In regions like Northeast India, indigenous communities have long relied on traditional practices like fermenting beverages using yeast, showcasing the practical application of their knowledge (Nath et al., 2021). Similarly, Africa is renowned for its diverse range of traditional food preservation methods, including fermentation, smoking, salting, and pickling, which have been instrumental in ensuring food availability and reducing waste (Dzikunoo et al., 2021) .

Indigenous food preparation and preservation in many African communities has been highly developed (Nxusani et al., 2023). There are many indigenous foods that are preserved for years, and they lose very little nutritional content. Research has found that a lot more studying in the area of indigenous knowledge needs to be undertaken (Nxusani et al., 2023). It is recorded that Zimbabwe as a country is rich in indigenous knowledge but lacks academic research in this area (Nxusani et al., 2023).

Furthermore, as far as the role of IK in food security is concerned, it is necessary acknowledge the way gender dynamics intrinsically influence the knowledge system that is local. In many African communities it is the women that are expected to do most of the household chores, including being the chefs in the home (Ibnouf, 2012). This is the reason that many believe contributes to women having more knowledge about indigenous knowledge and food as compared to their male counterparts. Researchers who have attempted to study indigenous knowledge have found that women across different communities tend to have more expertise when it comes to cooking and dealing with fresh and dried vegetables (Nxusani et al., 2023). In what follows I highlight a broader perspective which portrays the way IK positively impacts or interacts with food security in Africa.

Sustainable Agriculture: Indigenous communities in Africa possess traditional knowledge and practices that promote sustainable agricultural methods. These methods often emphasise the importance of soil conservation, crop diversification, water management, and pest control without relying heavily on chemical inputs (Kuyu & Bereka, 2020). Incorporating and revitalising indigenous agricultural practices can enhance food production while preserving natural resources and maintaining ecological balance. For instance, Govender et al. (2016) argue that the ethno-botanical knowledge of the *izinyanga* (African traditional healers) together with the knowledge of the natural elements of *izangoma* (African traditional healers) can contribute to the establishment of sustainable environmental practices such as community gardens, adding credence to IKS. The use of indigenous foods, particularly wild vegetables that were once primary sources of food, has been marginalised in favour of exotic vegetables (Bvenura & Afolayan, 2015).

Crop Diversity and Resilience: **IKS** emphasises the cultivation and preservation of diverse local crop varieties. Indigenous communities have developed a wide range of resilient and locally adapted crop varieties, capable of withstanding diverse environmental conditions and

pests (Kuyu & Bereka, 2020). This biodiversity not only ensures a stable food supply but also contributes to the conservation of genetic resources and the resilience of agricultural systems in the face of climate change and other threats (Chinsembu et al., 2015).

Traditional Food Processing and Preservation Techniques: Indigenous communities in Africa have developed innovative and effective techniques for processing, storing, and preserving food (Ibnouf, 2012; Okoye & Oni, 2017). These methods include fermentation, drying, smoking, and other preservation techniques that extend the shelf life of food products without the need for modern energy-intensive technologies. Reviving and integrating these traditional practices into food systems can enhance food security by reducing post-harvest losses and improving food availability throughout the year.

Local Knowledge on Wild Foods and Medicinal Plants: Indigenous communities possess extensive knowledge about wild edible plants and medicinal plants found in their local environments (Ezeanya-Esiobu et al., 2021). This knowledge contributes to diversifying diets, improving nutrition, and providing alternative food sources during periods of scarcity (Dzikunoo et al., 2021). Recognising and promoting the consumption and sustainable management of these nutritious resources can enhance food security, particularly in remote or marginalised areas where access to conventional food sources may be limited.

Community-Based Seed Systems: Indigenous Knowledge Systems often involves community-based seed systems, where farmers save, exchange, and distribute traditional seed varieties. These systems promote local control over seeds, ensure seed security, and foster agricultural resilience. Supporting and strengthening community-based seed systems can contribute to preserving indigenous crop varieties, promoting agrobiodiversity, and maintaining farmers' autonomy over their agricultural practices (Assaye et al., 2015).

Traditional Food Knowledge and Cultural Identity: Indigenous food knowledge is deeply intertwined with cultural practices, ceremonies, and rituals. These practices not only contribute to food security but also play a crucial role in preserving cultural heritage and fostering community cohesion (Robin & Cidro, 2020). Recognising and valuing the cultural dimensions of food can enhance the well-being of indigenous communities while promoting sustainable food systems.

The examples provided above highlight the seriousness of food insecurity in Africa, including South Africa, and underscore the need to effectively incorporate IKS to address this issue. Various studies have emphasised the significance of integrating IKS into food security initiatives, which require respectful engagement with indigenous communities, their active participation, and the recognition of their rights and knowledge systems. However, the limited or insufficient integration of IKS can be attributed, in part, to the influence of Western education heritage inherited by postcolonial states, including South Africa. This is particularly evident in the curriculum maintained within Africa's education system.

The continuation of a curriculum that predominantly reflects Western perspectives has hindered the full recognition and integration of IKS. The education system, inherited from the colonial era, often neglects or marginalises the knowledge systems and practices that have sustained indigenous communities for generations (Sharma, 2021). As a result, there is a lack of awareness, appreciation, and understanding of the valuable contributions that IKS can make in ensuring food security.

2.3.4 Teachers, Curricula, and IK

Studies conducted in South Africa have revealed the near absence of IK and relevant teaching in the science curriculum, highlighting the need for its integration. These studies have also identified that some teachers lack indigenous knowledge themselves, which can contribute to the limited incorporation of IK in the classroom (Seehawer, 2018).

Furthermore, there is a lack of research exploring teachers' perspectives on and the application of IK in the science classroom, particularly regarding the preparation of food and beverages (Mashoko, 2022). The study suggests that learners often have different knowledge from their communities compared to the Western science taught in schools, creating a gap that needs to be addressed (Mashoko, 2022). Teachers' attitudes towards the application of IK in science teaching have been described as critical, pessimistic, or dismissive, which limits our understanding of how teachers apply IK in the classroom (Ogunniyi, 2007; Taylor & Cameron, 2016).

This lack of understanding and negative attitudes towards IK in science education may stem from teachers' ignorance, which is not surprising given the marginalisation of IK in mainstream science education (Seehawer, 2018). Consequently, there is limited research on how science teachers plan to incorporate IK in the teaching of food and beverages, highlighting the importance of further investigation in this area (Mashoko, 2022).

Several studies have emerged that focus on in-service teacher education related to IKS (Mudaly, 2018). For instance, (Jautse et al., 2016) conducted a study at the North-West University, where they utilised human and material resources from the Mphebatho Museum in Pilanesberg to enhance teachers' knowledge of IKS. The museum provided an immersive space that fostered creative and critical thinking about the Bakgatla-ba-Kgafela culture. The findings indicated a growing interest among teachers to learn about diverse cultures and an increasing awareness of the importance of integrating IKS into the science education curriculum (Jautse et al., 2016, p. 442).

2.4 Theoretical framework: Postcolonial indigenous Theory

This study employs the postcolonial indigenous theory (PIT) as variously operationalised by scholars (Battiste, 2000; Brant, 2014; Hanson, 2012; Patnaik, 2006) to explore the indigenous knowledge embedded in the science of food and beverages. The postcolonial theory can be understood as an emerging indigenous critical theory that promotes commitment to social change and decolonisation, guided by indigenous philosophy, culture and language (Hanson, 2012; Khudu-Petersen & Chilisa, 2019). It is a theory employed by indigenous scholars in the effort to provide a meaningful transition from the dominant Eurocentric view, considering the adverse effect of the latter in the underdevelopment of indigenous wisdom and contribution thereof to knowledge (Brant, 2014; Thondhlana & Garwe, 2021). Battiste explains how the PIT is used and envisioned by indigenous scholars, noting its fundamental tenets, which arguably sets it apart from general postcolonial theory. These tenets include: [1] that indigenous knowledge not only exists but it is a legitimate research issue [2] that indigenous knowledge including oral tradition is "vital, integral and a significant process for indigenous educators and scholars"; [3] that research must emphasise both a dialogue with, and the participation of, indigenous communities as the foundation for transformation; and [4] that indigenous knowledge arises from "a need to comprehend, resist, and transform the crises related to the dual concerns of the effects of colonisation on Indigenous people and the ongoing erosion of Indigenous languages, knowledge and culture" (Battiste, 2000, p. xx).

The PIT challenges the assumption that Western knowledge is inherently superior to indigenous knowledge systems (Heleta, 2016). Adherents of this theory reject an essentialist view and instead emphasise a unique approach to engaging with reality that transcends cultural differences. This approach is characterised by open-mindedness and open-endedness encouraging a broader understanding of the world (Brydon, 2003). Additionally, proponents

of the theory advocate for a commitment to the wellbeing of humanity based on a revised understanding of what it means to be human. In the context of decolonisation, the theory conceptualises it as an intellectual, economic, and political process aimed at restoring life and dismantling the historical legacy of colonialism (Ashcroft et al., 2006). Decolonisation involves challenging and transforming the structures, ideologies, and power relations that perpetuate inequality and marginalisation. In this regard such a quest encompasses a re-evaluation of knowledge production, validation, and dissemination, with an emphasis on recognising and valuing indigenous knowledge systems. While doing so, PIT does not seek to establish a hierarchical binary between Western and indigenous knowledge. Instead, it encourages an inclusive and respectful approach to knowledge that recognises the diverse ways of understanding and engaging with the world. By embracing this theory, societies can move towards a more equitable and just future, where indigenous knowledge is acknowledged, valued, and integrated into broader intellectual and cultural discourses.

The PIT is suitable for my study because it allows me to place the ongoing criticism of the dominance of Eurocentrism in the education system of most colonised societies within the context of the science classroom. The theory enabled me to demonstrate how an insufficient representation and sparse integration of indigenous knowledge in the science classroom tends to minimise relevance of school science to students. The theory is used to understand how IK can be better deployed in the teaching of science, with reference to the production of food and beverages. Thus, beyond critiquing the existing reality characterised by the dominance of Eurocentric worldview in science education, the postcolonial sense of the theory emphasises a symbolic strategy for a future that is desirable, in the sense of transiting from the prevailing epistemic marginalisation of IK. In other words, 'postcolonial' here is understood as an aspirational practice, goal, or idea to imagine a new form of society where indigenous knowledge is given due representation in the science classroom. Such a future is vital to the goal of self-determination that can promote indigenous science.

2.5 [Preservice] teachers and the incorporation of IKS

The incorporation of Indigenous Knowledge (IK) into science education requires teachers to be trained and equipped with the necessary skills to bridge the gap between IK and school science teaching. Several studies have emphasised the importance of integrating IK into science education to maximise its sociocultural relevance (Òtúlàjà et al., 2011; Seehawer, 2018; Zinyeka et al., 2016). However, these studies also acknowledge the challenges involved in this

integration, particularly the epistemological differences between scientific knowledge and indigenous knowledge (Mashoko, 2022; Shizha, 2016). Knowing these differences and knowing how to deal with the challenges will make it easier for teachers to be better prepared to tackle the issues they encounter daily.

2.6 Application of Postcolonial Indigenous Theory in curriculum matters

The deployment of PIT in this study is primarily geared towards highlighting a crucial gap that demands further attention to transform the curriculum and integrate African indigenous knowledge, based on the transformative impetus of the paradigm (Khudu-Petersen & Chilisa, 2019). Specifically focusing on the realm of food and beverages, this study emphasises the importance of African indigenous knowledge and its potential to contribute significantly to curriculum transformation efforts, with extended implication for improving food security (Parawira & Muchuweti, 2008; Van der Walt, 2004; Walingo, 2009). The aim of this study is to incorporate African indigenous knowledge into the science curriculum, thereby making a valuable contribution to the much-needed curriculum transformation. At the core of applying the Postcolonial Indigenous theory in this context is the imperative to decolonise and indigenise the curriculum (Langenhoven & Stone, 2013). In other words, there must be a reasonable balance in the curriculum. Western knowledge should be well aligned with indigenous knowledge. Western knowledge should not be made superior and indigenous knowledge marginalised. While this pursuit is noble and essential, scholars have rightfully recognised that it is not without its challenges. The process of decolonising and indigenising the curriculum involves grappling with complex issues and obstacles that need to be navigated and overcome. As shall be delineated subsequently, some of the challenges in incorporating African indigenous knowledge into the curriculum include addressing power dynamics, overcoming Eurocentric biases, and ensuring respectful engagement with indigenous communities (Oguamanam, 2008; Whitt, 2010). It requires re-evaluating and restructuring the existing curriculum, as well as acknowledging and dismantling the colonial legacies and structures that perpetuate inequality and marginalisation (Dingle, 2020).

2.6.1 Indigenisation/ decolonising the curriculum and challenges.

In integrating IK with other forms of knowledge, the process can be viewed in six steps, as recognised by the World Bank (World Bank, 1998). The first step involves the recognition and identification of IK from various other knowledge systems. The second step focuses on validating and affirming IK, considering its significance, relevance, reliability, functionality, effectiveness, and transferability (Ocholla, 2007). It is important for IK to be tested and proven

to support problem-solving, as seen in the context of HIV/AIDS in Africa. The third step entails the codification, recording, and documentation of IK, acknowledging the benefits of explicit knowledge in terms of tangibility, share ability, transferability, and storability. However, concerns exist regarding the recording of IK and the potential loss of ownership by the original knowledge holders. The fourth step involves the storage of IK in repositories, requiring the establishment of taxonomies, databases, indexing, and preservation for easy access and use. Examples of IK databases, such as the one developed by the World Bank, exist, although the reliability of content within these databases is crucial (Ocholla, 2007). Over the years South Africa increasingly followed such steps in establishing a reliable repository for IKS.

The University of KwaZulu Natal conducted a feasibility study on African Indigenous Knowledge Systems (AIKS), which highlighted the university's potential contribution to the field. In 2014, UKZN implemented a policy recognising AIKS as a legitimate knowledge domain, emphasising its integration into research, teaching, and community engagement to address issues like poverty, food security, and health. The importance attributed to AIKS by universities is evident in the formulation of such policies. However, historical tensions between research and indigenous communities present challenges (Govender et al., 2016). Lebakeng and Dalindjebo (2006, p. 75) rightly noted, “the imperative for the inscription of indigenous African epistemology into the curriculum and underpinning education with African philosophy is, in the first instance, a question of rights, and thus a matter of natural and historical justice”.

It is challenge however to incorporate indigenous knowledge in the curriculum. For instance, scholars have observed that in certain educational contexts where cross-cultural science teaching has been established, IK is often neglected due to the overwhelming focus on the traditional curriculum (Battiste et al., 2005; Khupe, 2014; McKinley, 2005). The disparities between the language used in modern science and that of IK pose additional challenges. Moreover, the lack of representation of indigenous voices among curriculum decision-makers further complicates the integration of IK into the curriculum (Reis & Ng-A-Fook, 2010). Decolonial theory is a framework that seeks to challenge and dismantle the enduring legacies of colonialism, placing the experiences and perspectives of colonised peoples at the centre of decolonisation efforts. According to Ndlovu-Gatsheni (2018) the voices and agency of colonised individuals should be central in any endeavour related to decolonisation.

Chilisa (2012) outlines five interconnected stages of the decolonising process that can be adopted in education, namely, rediscovery and recovery, mourning, dreaming, commitment and actions.

The stages relate to my work in the following way:

Rediscovery: Preservice teachers reflected on their indigenous cultures, where they came from and acknowledged that they had lost a lot of their heritage to adopt Western cultures

Recovery: Preservice teachers looked at the indigenous knowledge systems that had been abandoned and planned on how these could be brought back into their lives and in the lives of their learners. For example, they planned lessons that incorporated indigenous knowledge

Mourning: Preservice teachers discussed the role that had been played by them, their families and communities in abandoning indigenous knowledge systems

Dreaming: Preservice teachers came up with goals that reflected their willingness to incorporate indigenous knowledge that pertained to foods and beverages within science lessons.

Commitment: Preservice teachers designed lesson plans where they chose scientific concepts that aligned with science concepts to illustrate their willingness to incorporate indigenous knowledge within science lessons

Let us look at each of them:

Rediscovery and recovery. In this phase, colonised individuals create a platform to examine their history, language, and culture (Sahu et al., 2023). The goal is to recover valuable resources embedded in their traditions, which can foster self-reliance and emancipation (Khudu-Petersen & Chilisa, 2019; Mudaly, 2018). It involves reclaiming and valuing indigenous knowledge systems that have been marginalised or suppressed. This is characterised by the active exploration and reclaiming of history, language, and culture by colonised individuals. It involves valuing and revitalising the indigenous knowledge systems that have been marginalised or suppressed, with the aim of fostering self-reliance and emancipation. This process plays a pivotal role in breaking free from the legacy of colonialism and asserting the importance of indigenous knowledge within the broader context of knowledge production and societal development.

Mourning. Here, the focus is on reimagining and acknowledging the trauma associated with the dispossession of land, epistemicide (the erasure of indigenous knowledge systems), cultural genocide, linguicide, and the systemic dehumanisation experienced by colonised peoples (Le Grange, 2016; Lebakeng & Dalindjebo, 2006). Mourning is not limited to past experiences but also involves reflecting on the persistent coloniality in education today, where alternative knowledge systems are silenced, and epistemic violence continues (Mudaly, 2018). Engaging with and acknowledging this trauma can lead to healing and transformation. It involves mourning past and present injustices while critically examining and challenging coloniality in education. By engaging with this trauma and recognising its impacts, individuals can work towards healing, transformation, and the decolonisation of education.

Dreaming. In this phase, colonised individuals re-envision a more diverse and culturally inclusive curriculum. Drawing from their recovered worldviews, histories, and beliefs rooted in indigenous knowledge systems, they imagine different possibilities and challenge the dominance of Euro-Western perspectives (Le Grange, 2016; Mudaly, 2018). Embracing emancipatory imaginations, they seek intercultural pathways to overcome Euro-Western hegemony (Omer, 2020). In other words, during this phase, colonised individuals engage in the re-envisioning of a more diverse and culturally inclusive curriculum. They draw from their recovered worldviews rooted in indigenous knowledge systems and challenge the dominance of Euro-Western perspectives. Through emancipatory imaginations and intercultural pathways, they seek to overcome Euro-Western hegemony and create an educational framework that respects and incorporates diverse knowledge systems and perspectives.

Commitment: This phase involves raising awareness about the silencing of colonised voices. Academics and researchers become political activists who are dedicated to re-centering the voices and experiences of the colonised within education (Le Grange, 2016). This stage involves advocating for decolonial perspectives and challenging the existing power dynamics in knowledge production. In this stage the commitment stage involves raising awareness about the silencing of colonised voices and becoming advocates for decolonial perspectives in education. It requires challenging existing power dynamics and working towards "re-centering" the voices and experiences of marginalised communities (Chilisa, 2012). Through activism and advocacy, researchers aim to disrupt dominant narratives, promote cultural diversity, and create spaces for the recognition and validation of indigenous knowledge within education and knowledge production processes.

Action. Here, the focus shifts to the practical implementation of strategies for transformation that respect and value indigenous knowledge (Mudaly, 2018). This stage entails a reconstruction process where dreams and commitments are translated into concrete strategies for meaningful change (Le Grange, 2016). In other words, the action stage emphasises a commitment to transforming the status quo and promoting the recognition and appreciation of indigenous knowledge. This manifests in a genuine dedication to turning aspirations into reality and creating a more inclusive, equitable, and culturally diverse society through concrete actions. At this stage, the transformative potential of IK is harnessed, leading to positive change and a greater appreciation of its unique contributions to various social issues. By following these stages, informed by decolonial theory, individuals and institutions can work towards decolonising education, empowering colonised communities, and creating a more equitable and inclusive knowledge system that acknowledges and values diverse perspectives and knowledge systems. This dynamic process has far reaching implications for how teachers relate to the questions of incorporating IKS in science classroom. While studies have shown every effort in auctioning this process in various fields, it is not immediately clear how preservice teachers approach this subject with reference to food and beverages, as there are limited studies in the regard.

To overcome these challenges, researchers have proposed various frameworks and approaches. For example, a truth-based epistemological framework has been suggested to guide teachers in reconsidering and changing their perceptions and valuing of IK for its incorporation into science teaching (Mashoko, 2022). Additionally, participatory action research calls for collaboration among teachers, parents, community elders, traditional healers, and academics to promote a bottom-up approach to acknowledge integration and decolonising education (Seehawer, 2018).

Similarly, Govender et al. (2016) suggest that involving preservice teachers in dialogues and agricultural projects within their communities can benefit them. This approach aims to raise awareness and recognition of various knowledge systems and knowledge holders. Through dialogues, teachers can understand diverse knowledge systems and appreciate different knowledge holders, including those in agriculture. Engaging in agricultural projects helps teachers apply theoretical knowledge practically, appreciate agricultural skills, and interact with community members possessing local knowledge. Govender et al. (2016) argue that these experiences enhance teachers' understanding and promote the appreciation and recognition of diverse knowledge systems and knowledge holders.

Research has shown that many teachers lack the required pedagogical skills to effectively teach indigenous knowledge (Mudaly & Ismail, 2013). This can be attributed to a lack of training (Mudaly & Ismail, 2013). Although some teachers have the knowledge that links to indigenous knowledge they still need to be trained in the manner in which they need to pass on this knowledge to their learners (Ndlovu, 2014). Integrating indigenous knowledge can also assist learners in their lives.

Anecdotal evidence has illustrated that incorporating indigenous knowledge in the teaching of Life Sciences and Natural Sciences can be very challenging because Life Sciences and Natural Sciences teachers lack the skills that are required to teach indigenous knowledge effectively within the classroom. This illustrates the fact that professional development and support for teachers is of paramount importance. Accordingly, the primary objective of this research seeks explore and deepen our understanding regarding how preservice science teachers perceive, intend, and contemplate incorporating indigenous knowledge concerning foods and beverages within the science classroom. This is a necessary response to the challenge of the marginalisation of IKS within the science classroom with the practical goal of shaping the future (Hoppers, 2000).

2.6.2 Tenets pertaining to Post Colonial Indigenous Theory

How power and privilege shape the curriculum

"Although there have been attempts to relate postcolonial theory to teacher education, those attempts have been somewhat limited" (Viruru & Persky, 2019, p. 1). It is undisputable that power and privilege shape the curriculum and we need to work collaboratively to constantly balance the equation, especially within the education sector. Power and privilege play a profound role in shaping the curriculum, particularly within the context of postcolonial indigenous theory and the critical paradigm. These theoretical frameworks illuminate how historical and ongoing power dynamics influence the content and structure of educational programs.(Mansfield et al., 2024). Drawing from the postcolonial indigenous theory, we understand that colonial powers historically imposed their cultural norms, values, and knowledge systems upon indigenous communities. This process often involved the erasure or marginalisation of indigenous perspectives, languages, and knowledge systems within educational curricula. Consequently, the curriculum became a tool for perpetuating colonial power structures and reinforcing the dominance of the colonisers' worldview (Heleta & Chasi,

2024). Moreover, the critical paradigm highlights how societal power imbalances, rooted in factors such as race, class, and gender, shape educational systems. Those in positions of power and privilege within society often dictate the content and priorities of the curriculum to serve their own interests and maintain their dominance. This can result in the exclusion or distortion of knowledge that challenges the status quo or empowers marginalised groups (Dimock, 2021). Upon scrutinising Natural Sciences and Life Sciences textbooks, a stark reality is evident. Indigenous knowledge is noticeably limited, relegated to the periphery or even absent, while Western science and European scientists bask in the spotlight. This deliberate sidelining of indigenous perspectives serves as a glaring testament to the conscious decisions made by policymakers (Fletcher et al., 2021). The imbalance in coverage unmistakably reflects a systemic bias favouring Western epistemologies, effectively erasing the rich tapestry of indigenous wisdom and insights. This marginalisation perpetuates a narrative where indigenous voices are silenced, contributing to the perpetuation of colonial legacies within the realm of science education and other curricula (Vijayan et al., 2022).

How indigenous knowledge can inform a greater discourse in teacher education

Indigenous knowledge holds immense potential to enrich and deepen the discourse in teacher education. By integrating indigenous perspectives into teacher training programs, we can foster a more inclusive and culturally responsive approach to education. Indigenous knowledge offers valuable insights into holistic pedagogies, sustainability, community-based learning, and intergenerational wisdom (de Beer & Kriek, 2021). Incorporating these perspectives into teacher education not only honours diverse ways of knowing but also equips teachers with the tools to better engage with Indigenous learners and communities (Govender & Mudzamiri, 2021). Furthermore, by centering indigenous knowledge in teacher education, we challenge colonial narratives and contribute to the decolonisation of education systems (Mpofu, 2021). This holistic approach to teacher preparation not only benefits Indigenous learners but also enhances the educational experiences of all learners, promoting respect for cultural diversity and fostering a more equitable and socially just society (Battiste, 1998; Borona, 2019; Snively & Corsiglia, 2001)

How teachers can resist the notion that the only worthwhile knowledge in science comes from the global north

"Teachers of any subject matter across all ages contribute to building students' understanding when teachers encourage students' reasoning; instead of telling students the what and how, they may place students' voices at the centre—empowering students and building their practice of reasoning" (Parker & Bickmore, 2021, p. 474). In this manner, teachers' pedagogical decisions can cultivate and uphold specific principles, such as those pertaining to social justice principles (DiAngelo & Sensoy, 2019). When teachers take the approach of making their lessons more learner centred, they allow their learners to critically engage with moral dilemmas, to explore, reflect on and challenge the status quo that is connected to their lives and experiences. Such fruitful engagements are of paramount importance within the classroom setting. Hence, teachers should always make room for such reflections/input (Blatt & Kohlberg, 1975; Wong, 2021).

There are a number of ways that science teachers illustrate objectivity in the process of teaching and learning, not only in science lessons but across fields as well. Teachers need to learn the art of prioritising diverse perspectives in their teaching practices. This means that teachers should always do research and show their learners that knowledge can and does come various sources, including Eurocentric and indigenous sources and both are essential within the education sector. Learners need to walk away from the lessons feeling that various sources of knowledge have made significant contributions (Mansfield et al., 2024). When teachers choose to present research papers to learners, they should also include photographs of different scientists including underrepresented minority groups (Lemelin et al., 2013). This will assist in avoiding or minimising stereotypes (Welsh, 2011). The onus is on teachers to also emphasise the importance of traditional and indigenous practices, such as indigenous medicine, and tools for educating etc (Krupa et al., 2019). This will steer or clear any misconceptions about indigenous practices as pseudoscience (Zaboski & Therriault, 2020). By challenging the dominance of Eurocentric knowledge and discussing the ethics surrounding the extraction of specimens from indigenous sources and pharmaceutical business practices, teachers can encourage critical thinking and promote inclusivity in the classroom (Bean & Melzer, 2021). Inclusive classroom interactions, embedding equality, diversity, and inclusion training into curricula. Taking the initiative to also learn learners' names with correct pronunciation, and providing space for learners to share their experiences further contributes to fostering a respectful and inclusive learning environment (Moore et al., 2020).

2.7 Chapter Summary

This chapter aimed to establish the significance of the study by providing a comprehensive literature review. The review emphasised the importance of Indigenous Knowledge Systems (IKS), particularly in the context of African indigenous knowledge related to food and beverages. It highlighted the marginalised status of IKS within the formal education system, specifically in science education. By addressing the gap between mainstream science education and African indigenous knowledge, the chapter underscored the need for curriculum transformation and the inclusion of IKS. It recognised the valuable role of preservice teachers in this process, who can actively contribute to bridging the gap and promoting a more inclusive learning environment. The chapter ultimately aimed to empower preservice teachers with the necessary knowledge and strategies to effectively integrate African indigenous knowledge, specifically regarding food and beverages, within science lessons. By valuing and incorporating diverse knowledge systems, they can create a culturally responsive and inclusive science education experience for all learners. In conclusion, this literature review underscored the importance of recognising and valuing IKS, particularly in the context of food and beverages, to promote equity and inclusivity in science education. It highlighted the importance of preservice teachers in fostering a transformative educational environment that honours and integrates diverse knowledge systems.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the research design and methodology utilised in exploring preservice teachers' perspective on indigenous knowledge about African foods and beverages and how these can be integrated into Natural Sciences and Life Sciences lessons. The chapter begins with the research design, exploring the research paradigm by underscoring the overarching ideological and theoretical assumptions that shape this study. Specifically, it discusses the application of postcolonial indigenous theory as a framework for understanding the research context. Moving forward, the chapter provides a comprehensive overview of the research methods utilised, encompassing details about the target population, sample selection, data generation instruments, research procedures, and data analysis process. Ethical considerations are also thoroughly addressed, along with reflections on the justification for choices related to the research methodology.

3.2 Research Design

Research design can be understood as a framework that explains the total plan of performing the research work. It encompasses goals, generating data, analytical methods, work hours, pricing, responsibilities, findings, and actions (Daniel, 2022). Developing a research design aids the researcher in making informed decisions throughout every stage of the study. It helps identify both crucial and minor tasks within the research process, rendering the work constructive and engaging by offering detailed insights at each step. By following the structure outlined in the research design, researchers can easily organize their study plan based on the experimental framework, facilitating a streamlined research process (Ansari et al., 2022). A good research design aids in providing an accurate, reliable, consistent and legitimate research (Akhtar, 2016).

In the context of the critical paradigm theory, the research design does not only serve as a mere framework for conducting research, but rather, it becomes a tool for challenging and transforming the existing power dynamics and social structures. Hence, the research design also seeks to contribute to broader societal change (Paradis et al., 2020).

Research methods encompass the diverse array of techniques utilised in conducting research, while research methodology refers to the systematic approach employed to address research issues comprehensively. It entails the scientific examination of how research is systematically carried out, wherein researchers acquaint themselves with the various steps typically undertaken to investigate a research problem. Therefore, the methodical approach utilised in conducting research is termed as methodology (Pandey & Pandey, 2021).

According to Creswell and Creswell (2017) a research design serves as a framework that outlines the methodology of a study. As will be detailed subsequently, this study privileges the participatory approach which emphasises democracy, the recognition of research participants, and social justice (Roque et al., 2022). This approach acknowledges the importance of considering research participants, namely preservice science teachers, as active contributors rather than mere subjects, by valuing their insights and granting them an active role in the research process (Macaulay, 2017). Participatory research recognises participants as co-producers of knowledge who can influence readers and drive change (Cargo & Mercer, 2008). Indeed, by aligning the research methodology with participants' worldviews and employing culturally sensitive approaches, researchers can effectively identify and protect Indigenous Knowledge (Dingle, 2020). In other words, the participatory research approach acknowledges the agency and significance of research participants. Furthermore, drawing on frameworks from scholars who critique the colonial legacy, the study utilises postcolonial indigenous theory to critically analyse knowledge production and work towards transformative practices in the field.

To effectively identify and safeguard Indigenous Knowledge, it is crucial to align the research methodology with the worldviews of the participants and adopt culturally sensitive approach. The effectiveness of the process lies in the degree to which the research methodology respects and resonates with the participants' perspectives (Khudu-Petersen & Chilisa, 2019). This collaborative and respectful approach not only fosters a deeper understanding of Indigenous Knowledge but also contributes to the preservation and revitalisation of indigenous cultures and knowledge systems. Dingle (2020), building upon the works of Ndlovu-Gatsheni and Zondi (2016) and Smith (2012), provides valuable insights and frameworks for exploring the colonial legacy comprehensively. These authors shed light on the experiences of the colonised, interrogated the lasting impact of colonialism on knowledge and place in South Africa, and critically analysed the role of researchers in knowledge production. In the same vein, by

employing postcolonial indigenous theory, it is positioned to provide a rich analysis of the dynamics of knowledge production in science classrooms in South Africa, while recognising and challenging its foundations in colonial and apartheid projects, with the intention of transformation based on the research paradigm upon which this study is pivoted.

3.3 Research Paradigm

The term "paradigm" originates from the Greek word "*paradeigma*," meaning pattern, and was introduced by Thomas Kuhn (1962) to represent a conceptual framework shared by a community of scientists. Hence, a paradigm has been defined as a set of fundamental beliefs or a comprehensive framework that encompasses three dimensions, namely, ontology, epistemology, and methodology that guides the nature of a research project (Denzin & Lincoln, 2018). This implies that a paradigm encompasses understanding the nature of reality (ontology), the process of knowing that reality (epistemology), and the methods employed to achieve credible knowledge in methodology (Mey, 2022). Thus, it is a paradigm that ultimately tells us how meaning will be constructed from the data being gathered in the process of research, based on the individual experiences (Yin, 2015). Accordingly, Kivunja and Kuyini (2017, p. 26) see paradigm as "a researcher's philosophical orientation and," … "has significant implications for every decision made in the research process, including choice of methodology and methods".

Safa et al. (2022) have identified four paradigmatic categories, namely positivism, post-positivism, critical theory, and constructivism. Originally, two paradigms namely constructionism and positivism dominated research. However, Guba and Lincoln (1994) introduced the concept of a critical theory worldview as a compromise between the original binary of constructivism and positivism paradigms. As Yin (2015) explains this middle ground approach in research, this allows for a more eclectic and flexible perspective when studying social phenomena. This means that researchers adopting this approach can consider multiple perspectives and employ various mental models to gain a deeper understanding of the phenomenon under investigation (Guba & Lincoln, 1994). Thus, this middle ground paradigms such as post-positivism and critical theory offer greater adaptability for conducting qualitative studies compared to the extremes of positivism and constructivism. Rather than adhering strictly to one theoretical framework, researchers can draw upon diverse perspectives and approaches to enrich their understanding of the research topic (Enworo, 2023; Gubrium & Holstein, 2014). This is so because the middle approach acknowledges the complexity and multidimensionality of social phenomena, promoting a more nuanced and comprehensive

analysis. This understanding is very critical to focus on this study involving the incorporations of the IKS in science as we shall see subsequently, considering its transformative orientation.

The critical theory is privileged to guide this study in understanding the perspective, plan and reflection of preservice teachers in the incorporation of IKS in science with reference to food and beverages. The critical paradigm is also known to be transformative (Kivunja & Kuyini, 2017, p. 35). The critical paradigm is driven by a commitment to social justice and aims to challenge oppressive systems, promote equity, and empower marginalised communities. It encompasses an interactive and reflective approach that seeks to bring about transformative change in pursuit of social justice. "Its proponents reject positivism and aim to develop socially informed theories that are practical and political" (Alvesson & Skoldberg, 2009, p. 145). Critical theory acknowledges the influence of historical power relationships and recognises the investigator's values in the research process. Critical theory, drawing from the enlightenment tradition, views social science to liberate individuals from restrictive traditions, ideologies, power relations, and identity formations, promoting autonomy and genuine satisfaction (Howell, 2016).

Yin (2015) maintains thus that Critical theory is an interdisciplinary approach that draws on various perspectives such as post-modernism, feminism, and cultural studies to critically analyse the functioning of the capitalist system and its global effects. It seeks to explore the intricate relationship between race, gender, and class to gain a deeper understanding of society. The aim of critical theory is to engage in meaningful conversations about social justice that go beyond mere discussion and lead to concrete action, advocacy, and praxis. Praxis refers to the application of theory in informed practice, emphasising the importance of putting theoretical knowledge into action to effect social change. By integrating theory and practice, critical theory strives to address societal issues and work towards a more just and equitable world (Fox & Jayne, 2020).

Researchers adopting the critical theory paradigm intentionally consider the moral, cultural, and political context of research participants (Morse, 2005). Creswell (2018) emphasises the transformative potential of research, which can impact participants morally, ethically, politically, or economically. Within the critical inquiry or transformative paradigm, educational researchers explore the convergence of various social issues, including culture, politics, and economics. The Critical paradigm is rooted in addressing social justice issues and aims to confront political, social, and economic factors that contribute to social oppression,

conflict, power dynamics, and various forms of inequality (Kivunja & Kuyini, 2017). It seeks to bring about transformative change by challenging existing power structures and advocating for improved social justice. This paradigm is also known as the Transformative paradigm, as it seeks to transform the politics and dynamics that perpetuate social oppression (Kivunja & Kuyini, 2017).

The Critical paradigm operates under a transactional epistemology, which means that researchers actively interact with participants in the research process. This engagement allows for a deeper understanding of the participants' experiences and perspectives. The paradigm embraces a historical realist ontology, particularly focusing on the understanding of oppression and its historical context. It recognises that social oppression is not an isolated phenomenon but rooted in historical and societal structures (Kivunja & Kuyini, 2017).

Methodologically, the critical paradigm emphasises dialogue and critical reflection, since it encourages active engagement and collaboration between researchers and my participants namely preservice science teachers. In this regard the paradigm enables me to take cognisance of the importance of multiple perspectives and diverse voices (Kivunja & Kuyini, 2017). Additionally, the paradigm upholds an axiology that respects cultural norms, valuing the significance of cultural context and diversity in the research process (Kivunja & Kuyini, 2017).

Critical theory focuses on how power and domination work and this can also be attributed to Marxist critiques of the economy and society at large. This theory focuses on an attempt to expose, critique and challenge the exiting power structures (Bilgin, 2023).

The choice of the critical theory in this study allows the researcher to delve into the significance and meaning that individuals attribute to social and human phenomena, using dialectical interactions and hermeneutic interpretation of results (Creswell & Creswell, 2017). Hermeneutics can be understood as a theory of the real experience that the process of thinking comprises of, namely interpretation and understanding. Hence, interpretation can be seen as something that is built on certain rules, standards and principles, whereas understanding is dependent on an indirect influence on methodology (Tomkins & Eatough, 2018).

The aim is to illuminate the emancipatory contributions that critical theory can offer to indigenous knowledge within the science classroom. Given the nature of the research, which explores participants' perceptions and experiences, a positivist paradigm would have been

inadequate in capturing such phenomena. Instead, the selected paradigms align with the research objectives, allowing for a comprehensive understanding of the cultural intersection with science education.

The critical theory suits this study because it aims to address issues of oppression and marginalisation, which is the case when it comes to indigenous knowledge. Indigenous knowledge has been marginalised for a long time and the critical theory enables an exploration of ways to address this. The critical theory aims to change the status quo of things in the world, for example, to change the status quo in education, which privileges a monolithic approach to knowledge construction.

3.4 Methodological Approach

Researchers have three main research approaches at their disposal: quantitative, qualitative, and mixed methods. Limbu (2013) noted that the qualitative approach aligns with the philosophy of empiricism and takes an open, flexible, and unstructured approach to inquiry. It prioritises the description and narration of feelings, perceptions, and experiences over their measurement, and the emphasis is on interpretation of experiences to gain insights into social reality (Mohajan, 2018). Qualitative method uses interviews, observations, focus groups, and textual or visual data analysis (Perry, 2023). Considering these characteristics, the qualitative approach is deemed the most suitable for exploring and understanding individuals' perspectives and experiences regarding a social phenomenon (Kumatongo & Muzata, 2021).

The qualitative method was suitable in this study which delved into exploring how preservice teachers integrate indigenous knowledge about African foods and beverages in science lessons. This methodology allowed for a nuanced understanding of the intricate ways in which preservice teachers engage with and incorporate indigenous knowledge into their pedagogical practices. By employing qualitative methods such as interviews and document analysis, I was able to delve deeply into the perspectives, beliefs, and experiences of the participants (Argyriadis, 2021). This approach enabled me to capture the rich complexities inherent in the integration of indigenous knowledge within the science curriculum, uncovering not only the strategies utilised by preservice teachers but also the underlying motivations, challenges, and cultural considerations that influenced their instructional decisions (Lindlof & Taylor, 2017). Furthermore, qualitative research provided the flexibility to explore emerging themes and delve into the unique cultural contexts surrounding the utilisation of indigenous knowledge, thereby offering valuable insights into enhancing culturally responsive science education practices.

Overall, the qualitative approach proved indispensable in illuminating the dynamic interplay between indigenous knowledge, teaching practices, and cultural identity within the context of science education (Urcia, 2021).

The suitability of this approach for this research can be seen in terms of dynamism and its ability to accommodate a variety of interpretive activities. In contrast to quantitative approaches, which tend to adhere rigidly to specific paradigms, qualitative approaches are more adaptable and open to understanding subjective experiences and making meaning from them. It recognises the significance of contexts in uncovering or providing rich and nuanced insights and interpretations of human experiences and social phenomena. This feature of qualitative methods makes them a powerful tool for investigating complex social phenomena such as IKS in the context of science. Using a qualitative research approach, this study sought to uncover preservice teachers' intricate and nuanced understanding of the incorporation of IK related to African food and beverages in Natural Sciences classrooms. I used the qualitative method to make sense of perspectives, experiences, and interpretations of preservice science teachers, with the view to ultimately contribute to a better understanding of how IK can effectively be integrated into science education with reference to food and beverages.

The qualitative approach allows for in-depth exploration of the subject matter, providing a rich understanding of the complexities and nuances involved (Yin, 2015). This study investigated the preservice teachers' perspectives, experiences, and interpretations of IK in relation to African foods and beverages using methods such as interviews and document analysis. By capturing their perspectives, the research can gain valuable insights into the challenges, opportunities, and potential strategies for integrating IK into science education. In addition, the qualitative methodology aligns with the study's objective of illuminating preservice teachers' understanding. It seeks to go beyond mere quantitative data and numerical measurements, by capturing the depth and context of preservice teachers' perspectives. Through qualitative analysis, patterns, themes, and unique viewpoints were identified, providing a comprehensive picture of how preservice teachers conceptualise and approach the inclusion of IK in their science classrooms.

In the critical paradigm theory, the methodological approach places emphasis on critical inquiry and social transformation. The critical paradigm also acknowledges the inherent subjectivity as well as biases that are accompanied by research. The methodology also challenges dominant ideologies and power structures. Methodological approaches within the critical paradigm encourage researchers to question and challenge the existing assumptions,

societal norms and power dynamics. This involves and is not limited to interrogating how knowledge is produced, assessing who benefits from it and whose voices are marginalised or silenced within dominant discourses (Dimock, 2021). Critical researchers engage in reflexivity, continuously reflecting on their own positions, biases, and assumptions throughout the research process.

This self-awareness helps researchers acknowledge their own role in shaping knowledge and understand how their perspectives may influence the research outcomes (Chowdhury et al., 2023). Methodological approaches within the critical paradigm recognise the importance of understanding the socio-cultural and historical contexts in which research is conducted. Researchers aim to uncover the complex interactions between individuals and society, recognising that social phenomena are shaped by broader structural forces (Mura & Wijesinghe, 2023). Critical researchers often employ participatory and collaborative research methods, actively involving participants in the research process. This approach seeks to empower marginalised communities, amplify their voices, and co-create knowledge that is relevant and meaningful to them (Masiero, 2023). Methodological approaches within the critical paradigm are inherently linked to advocacy and social change. Researchers aim to use their findings to challenge oppressive structures, advocate for social justice, and contribute to transformative change in society (Frisby, 2024).

3.5 Data production methods and instruments

According to Yazgan et al. (2023) data generation refers to the process of gathering and organising existing data in a way that allows for the derivation of new conclusions using various methods. In qualitative research, qualitative information, such as interviews, and document analysis, are employed to uncover perceptions and events in a realistic and holistic manner within the natural environment (Yazgan et al., 2023).

According to Gangaraju et al. (2023), a research instrument refers to a tool utilised by researchers to gather, measure, and analyse data from subjects or participants regarding the research topic. In this study, the primary data collection method was semi-structured interviews. A semi-structured interview involves verbal interaction where the interviewer poses questions to elicit information from the participant/(s). These questions are typically prepared or predetermined. Semi-structured interviews take on a conversational approach, allowing participants to freely express their views on the subject being discussed (Longhurst, 2010). Document analysis was also used as secondary data.

The aspects that were evaluated in the designed lesson plans were: key questions, knowledge strands, the African indigenous food/(s)/beverage(s), grade, subject, specific aims, certain scientific concepts, aim of the lesson and the images used in the lesson plan.

3.5.1 Study Location and Population

This research was conducted specifically among preservice science teachers who are enrolled at the University of KwaZulu-Natal, situated at the Edgewood campus. The Edgewood campus serves as the primary hub for education studies within the university. Located in Durban, in the province of KwaZulu-Natal, the campus provided an ideal setting for this study. The research involved a sample of 20 preservice teachers who were expected to participate in the study, but due to unforeseeable circumstances, 13 of the preservice science teachers could not continue with the study. Hence, only 7 preservice science teachers ended up being interviewed for the semi structured interviews. These individuals had chosen to pursue a career in teaching science and were undergoing their training at the University of KwaZulu-Natal at Edgewood campus. They represent a diverse group of future educators who are at various stages of their academic journey, with a shared focus on developing their skills and knowledge in science education.

3.5.2 Sampling and sampling technique

Sampling is a critical technique employed to accurately determine information about the population of a study. It is employed due to the selective nature of the research aims. Purposive sampling was deemed as the most appropriate for this study to answer specific research aims (Òtúlàjà et al., 2011).

The non-probability sampling techniques, including convenience, purposive, snowball, and quota sampling, play a significant role in qualitative research by allowing researchers to tap into the humanistic element of the participants (Gupta et al., 2023). Sampling is a researcher's technique to systematically select a representative subset of items or individuals from a pre-defined population for observation or experimentation in line with the study's objectives. Gupta (2012) explains that sampling refers to the process of selecting a representative group from the population under study.

For participant selection in this study, purposive sampling, which is a type of non-probability sampling, was utilised. Purposive sampling allows researchers to exercise their discretion in choosing samples that are expected to provide the most relevant information for the study. McMullin (2023) suggests that in purposive sampling the focus is on selecting participants who can offer the necessary information to address the research questions based on their knowledge.

Kumar (2011) supports this idea by emphasising that the researcher's judgment is utilised in selecting participants who can provide relevant information aligned with the research project's rationale.

In this study, purposive sampling was employed, enabling the researcher to select participants based on their expertise or experience related to the specific problem being investigated. This sampling strategy allows the researcher to carefully decide on individuals, data, or cases that hold relevance to the study. The inclusion criteria for participants was that the participants were specialising in Natural Sciences and/or Life Sciences and they were of African descent. Accordingly, 7 preservice science teachers were selected as they had some experience of teaching about indigenous knowledge during their teaching practice. These preservice science teachers also had some insights related to decolonising the curriculum and they intend to teach Natural Sciences, Life Sciences and Physical Sciences when they graduate.

The selection of the participants was based on the fact that the preservice teachers were studying and majoring in Natural Sciences. Others were majoring in Life Sciences and Physical Sciences. Hence, they were able to respond to the research questions as well as the questions posed to them in the semi – structured interview.

In this study, four females and three male participants comprised the sample. In terms of racial demographics, there were five Africans and two Indian participants. They focused on Natural Sciences topics extracted from the four strands namely: “Life and Living” “Matter and Materials” “Energy and Change” “Planet Earth and Beyond” which is present in the CAPS document (DoE, CAPS, 2011, pp.13-14).

3.5.3 Data production process

Producing data for a qualitative inquiry involves the use of different techniques and methods, thus qualitative research is a multi-method approach. Qualitative data derives from many sources such as interviews, observations, documents, diaries, and video material (Lester, 2023).

Table 1 below summarises the approach and instruments of the data generation process employed in this study. Participants for this study were interviewed based on semi-structured interviews schedules. To ensure the quality of the interview process, the use of semi structured interviews facilitated the fair standardisation of the interview schedule, while the spacing of interviews between different participants also assisted in effecting necessary technical

improvement over time. In this regard, I made effort to provide necessary feedback and suggestions to participants to improve the quality of the probing and interaction during the interviews based on their experiences of the same interview or previous interviews with other respondents. These various steps and strategies were aimed to ensure consistency among interviewers while allowing flexibility to adapt questions during the interviews, following the guidance of Cohen and Arieli (2011). I conducted focus group interviews with participants using Zoom meetings to generate data. There were three focus groups, namely focus group 1, focus group 2 and focus group 3. However, due to participants withdrawing from the research, I only managed to interview seven preservice science teachers. Focus group 1 had two preservice science teachers. Focus group two also had two preservice teachers. Focus group three had 3 preservice science teachers that were interviewed. Careful steps were taken to ensure the accuracy of data collection and to uphold confidentiality and data protection. Part of these steps included the creation of transcripts based on recordings after each meeting.

The duration of the interviews conducted for the research study were as follows: the first interview lasted for one hour and twenty-three minutes, the second interview extended for one hour and twenty-six minutes, and the third interview spanned a duration of two hours and twenty-two minutes. During the interview preparation phase, participants were unable to provide a precise timeframe for the completion of the designed lesson plans when questioned. However, it was observed that the collaborative nature of the process involved considerable time for group members to convene, conduct research, and deliberate on the content to be incorporated or omitted from the lesson plans. The period between the data collection and data analysis took place from June 2023 – October 2023 to ensure that all necessary processes were catered for.

The relationship between the interviews and document analysis in qualitative research is often iterative and complementary. Interviews can inform document analysis by providing insights into the practical application and impact of educational materials and policies. Conversely, document analysis can provide a broader context for interpreting interview data, helping researchers identify patterns, contradictions, or areas for further exploration. By combining these methods, researchers can develop a comprehensive understanding of the research topic and generate insights that may not be possible through one method alone.

In investigating how preservice teachers integrate indigenous knowledge pertaining to African foods and beverages into science lessons, a combination of semi – structured interviews and

document analysis play a pivotal role. The semi-structured interviews assisted in delving deeply into the preservice teachers' experiences which uncovered their beliefs, challenges and strategies in incorporating culturally relevant content. The document analysis scrutinised the lesson plans to check whether there was an integration of indigenous knowledge within science education. By intertwining insights from the interviews and document analysis, it was then possible to pinpoint patterns, challenges and gaps in the integration process. This aided in fostering a more nuanced understanding of culturally responsive science education.

Table of Summary: Research question, method, instrument, participants

Research Question	Method	Instrument	Participants
What are preservice science teachers' perspectives about the wisdom embedded within indigenous knowledge?	Interview	Semi-structured Interview schedule	Natural Sciences/Life Sciences preservice *teachers*
	Document analysis (of lesson plan)	Document analysis guideline	
How do preservice science teachers plan to teach science using indigenous foods and beverages?	Interview	Semi-Structured focus group interview	Natural Sciences/Life Sciences *preservice teachers*
	Document analysis (of lesson plan)	Document analysis guideline	
What is the reflection of preservice science teachers when it comes to incorporating indigenous knowledge pertaining to foods and beverages within a science classroom?	Interview	Semi-Structured focus group interview	Natural Sciences/Life sciences teachers' preservice s teachers

3.5.4 Data analysis:

Data analysis, as described by Marshall and Rossman (2014), refers to the critical process in qualitative research by which the researcher(s) brings order, structure, and meaning to a substantial amount of generated data. Accordingly, data analysis is how the researcher makes

sense of the data, interprets its meaning, and develops theories to uncover general patterns and statements (Schwandt, 2007). This study employed thematic content analysis (TCA) to systematically analyse the data to draw meaningful conclusions on perspectives, plans, and reflections of preservice science teachers regarding the incorporation of IKS in Natural Sciences in the context of food and beverages. According to Conroy et al. (2023) thematic content analysis (TCA) involves identifying common themes in interview transcripts or other texts to portray the thematic content. In a way, TCA is more specific than qualitative content analysis, which involves evaluating how words are used, identifying frequencies, recognising trends, and establishing relationships within the data (Stephens, 2022). This distinction positions thematic content analysis as a subset of qualitative content analysis, setting it apart from the general use of content analysis. This is based on the understanding of thematic content analysis as a method that focuses on identifying and analysing common themes in texts, specifically within the context of story-like verbal material. This unique perspective places it within the broader field of qualitative content analysis while emphasising the thematic aspect of the analysis process. This process encompassed several key steps, including transcription, analysis, and discussion (Braun & Clarke, 2006).

Thematic content analysis involves building themes from text and using them as units of analysis (McClelland et al., 2023). It is a flexible approach that can be applied within different theoretical frameworks and for various purposes. The chosen thematic analysis aligns with the recommendations of Braun and Clarke (2006) and Lapadat (2010), supporting its use based on research questions, theoretical assumptions, and its ability to generate insightful interpretations. It also aligns with the theoretical framework of the study. Thematic analysis can be approached from different perspectives, including essentialist/realist, constructionist, and contextualist. constructed reality (Braun & Clarke, 2006). This study used the essentialist/realist perspective as well as the contextual approach.

In line with the critical paradigm theory, the essentialist/realist perspective adopted in this study highlights the importance of reporting participants' experiences and meanings as expressed in the data. By focusing on the lived realities of preservice teachers and their perceptions regarding the integration of indigenous knowledge within science lessons, this perspective aims to unveil the underlying power dynamics and inequalities embedded within educational systems. Furthermore, the constructionist perspective, which explores how societal discourses shape events, realities, meanings, and experiences, aligns with the critical paradigm's emphasis on understanding the socio-cultural context in which knowledge production occurs. It

highlights how dominant discourses influence the construction of knowledge and perpetuate existing power structures. Additionally, the contextualist approach, which acknowledges the interplay between individual experiences and the broader social environment, resonates with the critical paradigm's recognition of the complex interactions between individuals and society. By considering the diversity of meaning construction and the influence of constructed reality, this approach sheds light on how societal norms and values impact educational practices. Overall, by integrating essentialist/realist and contextualist perspectives within the critical paradigm framework, this study aims to critically examine the role of indigenous knowledge in science education and advocate for transformative change towards a more inclusive and equitable society.

Accordingly, by utilising this analytical approach, this study provides a rich and nuanced exploration of the content and context of the data of IKS in science education, particularly in the context of food and beverages through these various lenses. The data includes interviews and documents provided by preservice teachers of Natural Sciences. In the context of this study therefore, all interviews were transcribed, converting the audio recordings into written text. This transcription step ensured that the data was in a readable format for further analysis. Next, I coded the transcribed interviews by categorising and labelling sections of the data based on their content. Coding allowed me to identify themes, patterns, and relationships within the data. In this regard, Braun and Clarke's (2006) six-step approach to thematic analysis, was utilised to guide the analysis of the transcribed interviews. I analysed the information obtained from the interviews and compared data from different participants to identify significant patterns that emerged. These patterns served as logical evidence to support the research findings. Five lesson plans were used in this study alongside the semi-structured interviews that were conducted.

Inductive reasoning was helpful in analysing the data because themes were created from the data. This allowed for the exploration of values, experiences, and emotions that were distinctive of the integration of indigenous knowledge among preservice teachers. When analysing the information obtained through interviews, inductive reasoning is a particularly useful tool because it helps the researcher discover and comprehend the complex interactions between indigenous knowledge and the scientific community (Zidny et al., 2020). With this method of reasoning, the researcher begins with a small set of data points and gradually expands their understanding and interpretation (Petzold et al., 2020). This enabled me to pinpoint recurrent themes, interesting patterns, and new insights by immersing myself in the rich and varied data

production from interviews. By using inductive reasoning, the researcher can get a comprehensive understanding of the experiences and beliefs that preservice science teachers have regarding the inclusion of indigenous knowledge in the study of foods and beverages.

3.6 Research Rigour

To enhance research rigor and validity, concepts such as trustworthiness, credibility, and dependability are associated with qualitative research. These concepts guide the researcher in maintaining the integrity and accuracy of the research process and findings. The concepts of trustworthiness, credibility, and dependability informed the research process, ensuring that the study's findings accurately reflected the experiences and perspectives of the participants. By adhering to these rigorous research practices, the study aimed to enhance the overall quality and trustworthiness of the research outcomes.

3.6.1 Trustworthiness

To ensure the trustworthiness of this research, the quality and accuracy of the information obtained from the participants were thoroughly checked (Iphofen & Tolich, 2019). The aim was to ensure that the study findings were truthful and credible. Careful consideration was given to selecting the most appropriate data generation method for content analysis. Choosing the right method was an important strategy to achieve trustworthiness (Elo et al., 2014).

To enhance trustworthiness and validity in the study, participants were provided with copies of their transcripts to review and verify the accuracy of their thoughts and reflections. This process helped ensure that there were no misrepresentations in the documentation. I sought confirmation and feedback from the participants to ensure that the recorded information aligned with their perspectives. The approval of the participants was deemed essential (Golafshani, 2015).

3.6.2 Dependability

Dependability refers to how data can remain stable over time, even under different conditions. It is for this reason a researcher must state the reasons or motivation for selecting individuals as participants. I selected Natural Sciences and Life Sciences teachers because they were more suitable to answer the research questions since they teach a curriculum that advocates for indigenous knowledge. In ensuring the dependability of this study, careful consideration was given to the reasons for selecting specific individuals as participants. To assess the dependability of the findings, I posed the question of whether the same results would be obtained if the study were replicated with the similar participants in the similar context. This

consideration helped ensure the stability and consistency of the data over time and different conditions (Smyth & Allen, 2011). To achieve dependability, the participants in this study were presented with a consistent set of questions, allowing for a standardised approach to data generation. All the gathered data was carefully documented to minimise any inconsistencies during the analysis process. Moreover, the research findings were supported by relevant quotations extracted from the participants' statements, further enhancing the credibility and dependability of the study.

3.6.3 Credibility

According to Williams, Raffo, and Clark (2018), credibility is regarded as the trustworthiness of a communicator or the source of information, based on how the receiver perceived the authenticity and competence of the communicator. Mohajan and Mohajan (2023) characterised credibility as being determined by how reliable, trustworthy, and consistent the behaviour of an individual was perceived to be. In other words, it was emphasised that the source of information within one's research had to be trusted by those who would be reading or analysing the study. To ensure trustworthiness and credibility, peer debriefing was utilised, as recommended by Hadi and José Closs (2016).

One approach to enhance validity is triangulation, which involves using multiple data sources to establish consistent and coherent themes. By drawing on different sources of data, researchers can strengthen the credibility of their findings. The triangulation of different data sources such as IKS-related literature, document analysis of lessons and interviews helped to establish consistent themes and interpretation, which overall contributed to the credibility of this study.

Credibility was also achieved by ensuring that the selected participants were well informed about the phenomenon being researched, particularly indigenous knowledge in this case. The participants' experiences, knowledge, and beliefs about the phenomenon being researched were recorded. In addition, credibility was ensured by using appropriate research instruments. The first-hand information gathered had to be free from fabrications and distortions, as highlighted by Mohajan (2018).

Since the study sought to gain an understanding of different participants who had different perspectives and personalities, all the data generated was diligently read through and thoroughly analysed to ensure credibility, as emphasised by Golafshani (2015). Member checking, which involves the researcher presenting their study's patterns or themes to the

participants and seeking their input to verify the accuracy of the interpretations was also employed. Where necessary follow ups to allow participants to provide feedback on the research findings, ensuring their perspectives are accurately represented (Creswell & Miller, 2000). Participants were given copies of their transcripts to check whether they accurately reflected what they had articulated.

3.7 Ethical considerations

Ethics is a code of conduct that provides information to the participants in the research and allows them to see with transparency, what data is intended to be gathered from the research and how this information will be used in the future. According to Le Grange ethics relates to the formulation, legislation, and dissemination of ethical issues related to the protection of knowledge (2016). Ethical considerations are of utmost importance in qualitative research involving human subjects such as the preservice science teachers. Thus, it is crucial that I abided by the consultative processes dictated by the ethical standards about autonomy, informed consent, privacy, handling delicate subjects, and maintenance of confidentiality.

3.7.1 Informed consent and autonomy

Autonomy is understood as participants having the freedom to voluntarily participate and the right to withdraw from the study at any time, according to Bertram and Christiansen (2014). Consent, as explained by the same authors, referred to the requirement for all participants to agree to take part in the study without coercion or inclusion without their knowledge. To ensure proper consent, a consent form was utilised, as described by Ginting (2022). Informed consent is defined as an agreement by an individual to participate in a study after being informed of the facts that would be likely to influence his or her willingness to participate (Uwamusi & Ajisebiyawo, 2023). Part of the informed consent form provided was an assurance to the participants that their participation in the study was voluntarily and they could withdraw from the study if they felt they could not continue with it. This form served as an agreement by individuals to participate in the study after being provided with information about the study's expectations and relevant facts that might influence their decision to participate. In my research, I sought written consent from the participants and took the responsibility to read and explain the contents of the consent forms to ensure their full comprehension, as recommended by de Medeiros, Girling, and Berlinger (2022). Furthermore, I emphasised to the participants that they had the freedom to withdraw from the project at any time without facing any negative consequences.

3.7.2 Anonymity and confidentiality

To safeguard the identity and confidentiality of the participants, I implemented the use of pseudonyms, as recommended by Hanson (2012). Respecting the participants' right to privacy was of utmost importance. Pseudonyms were utilised as an additional measure to protect their identity, further ensuring confidentiality. Additionally, consent was obtained from the participants to audio record the interviews, emphasising their understanding of, and agreement with, the research process. By assigning pseudonyms, the real identities of the participants were protected throughout the research process.

Overall, to ensure the ethical integrity of the study, I obtained ethical clearance from the University of KwaZulu Natal. This clearance confirmed that the research was conducted in accordance with the ethical principles and guidelines set forth by the university. In this study, I prioritised confidentiality by assigning substitute names to each participant during the transcription process. Data was stored using code numbers or false names, and a secure key was maintained separately from the data, ensuring the anonymity of the participants.

The principles **of respect for persons, beneficence, and justice** as outlined in the Belmont Report and Singapore Statement guided me in ensuring the protection of participants' rights, the responsible conduct of research, and the generation of reliable and trustworthy results.

Respect for source persons: Each of the participants was treated as a human being, ensuring that their rights were respected.

Beneficence:

I carefully balanced the research benefits to the participants by ensuring that there was no physical or psychological risk. I ensured that the benefits of my research outweighed any potential harm. Considerations regarding ethics as well as the research design, and data generation process safeguarded the welfare of the participants.

Justice: The benefits and burdens of the research will be distributed fairly between the researcher and participants (Butler, 2023). Justice and fairness were upheld while conducting this research. No discrimination or exploitation took place during this research and equal access to participation was given. Participants were selected based on relevant criteria, including the research objectives and questions. There was also effort to integrate different perspectives within the research because there was an understanding that the research will impact on broader societal issues.

3.8 Chapter summary

This chapter provided a description of the research design and methodology employed to explore preservice science teachers' perspectives, plans, and reflections on incorporating indigenous knowledge about food and beverages into the science classroom. The chapter also addressed data generation approaches, data analysis methods, considerations of trustworthiness, and ethical considerations. Thematic content analysis was justified as the tool used for analysing the data related to the preservice science teachers' perspectives, plans, and reflections on incorporating indigenous knowledge. The thematic approach and inductive analysis were chosen to integrate secondary and primary data, encompassing diverse responses, and provided comprehensive answers to the research questions and objectives of the study.

CHAPTER 4
PRESENTATION AND ANALYSIS OF FINDINGS

4.1 Introduction

This chapter will discuss the qualitative data production through three focus group interviews, which were held with three groups of preservice teachers. The Analysis of five lesson plans is also presented. Data is presented within the two key research objectives, namely:

1. *To explore preservice science teachers' perspectives about the integration of indigenous knowledge related to foods and beverages in science lessons.*
2. *To explore preservice science teachers' methods and plan on integrating indigenous knowledge about foods and beverages in science lessons.*

The experiences and reflections of the preservice science teachers and the way they intend to teach learners in a more culturally inclusive manner are analysed.

4.2. Sources of data

To recap, seven preservice teachers were divided into three focus groups and interviewed. Two preservice teachers were in focus group 1. The second focus group also comprised of two preservice teachers and the third focus group had three preservice teacher participants. These three groups (focus group 1, focus group 2 and focus group 3) developed one lesson plan each, and each lesson plan was analysed. It must be clarified that Focus group 1; 2 and 3 designed lesson plans and they also took part in the interviews. However, groups 4 and 5 only agreed to submit their lesson plans and they withdrew from the interview. Hence, in total, five lesson plans were presented.

The themes illustrate that preservice teachers in this study were convinced that science taught within schools should be linked with indigenous knowledge systems. The use of direct quotations in this chapter will be corroborated with the emerging themes. The literature that is presented support the themes.

The following codes are used to distinguish among data from different sources.

preservice teacher	PST
Focus Group 1	FG 1
Focus Group 2	FG 2
Focus Group 3	FG 3
LP	Lesson plan E.g., Lesson plan submitted by group 1 is LP1
DALP	Document analysis of lesson plan Eg. analysis of lesson plan 1 is DALP1

4.3 Synopsis of each lesson plan

It is useful to provide a brief insight into the five lesson plans which the preservice teachers developed.

4.3.1 TABLE 1: Homeostasis and animal nutrition in relation to the *Pentradiplandra brazzeana* (LESSON PLAN 1 developed by focus group 1)

Topic:	**Homeostasis and animal nutrition**
Knowledge Strand	Life processes
Key Question:	How can indigenous knowledge be integrated in a science lesson?
Name of African indigenous food/plant:	*Pentradiplandra brazzeana*
Grade:	11
Subject:	Life Sciences

Group 1 designed a lesson plan which focussed on the use of the African berry *Pentradiplandra brazzeana* as a sweetener which did not increase blood glucose levels. Pentradiplandra brazzeana is a plant that originated from the Western regions of Africa, and is commonly used in Nigeria, the Central African Republic and Angola (Dounias, 2008). It was used widely by the local people of the Western region of Africa. It has a variety of uses. The local people used

the roots of this plant to aid with complication during pregnancies, it was pulped and used as an ointment to protect infants from contracting naval infections, the roots were even hung outside homes to keep snakes away. However, the fruit which this plant bears is even more useful. These plants gave rise to berries that were known for their sweet taste.

This group wanted to show how consumption of the African berry in favour of table sugar can serve to reduce the incidence of diabetes. Diabetes mellitus is a metabolic disorder of carbohydrates caused by the deficiency of insulin secretion and/or the impaired ability of the body to produce or respond to insulin which brings about the failure to maintain proper levels of glucose in the blood (Ruan et al., 2023). The group discussed how the fruit of this plant had the natural ability to ensure that blood sugar levels in a person's body were controlled and contrasted this to the artificial sweeteners that people consume today to keep diabetes under control. The main purpose of this lesson plan was to show how indigenous knowledge can also be a solution to dealing with what we know in our era as lifestyle diseases.

4.3.2 TABLE 2: Energy transformation to sustain life using steamed bread (LESSON PLAN developed by focus group 2)

Topic:	**Energy transformation to sustain life**
Key Question:	How can indigenous knowledge be integrated in a science lesson?
Name of African indigenous food mentioned in lesson plan:	*Steamed bread*
Grade:	11
Subject	Life Sciences
Specific Aim 3:	"Relates to understanding the application of Life Sciences in everyday life as well as understanding the history of scientific discoveries and the relationship between indigenous knowledge and science."
Specific Aim 2:	"Relates to doing science or practical work and investigations"
Scientific concept/(s):	Fermentation

Group 2 developed a lesson plan on cellular respiration with an emphasis on fermentation. The indigenous food that they focused on was steamed bread. Steamed bread is typically made from

wheat and is prepared by steaming instead of baking. This Life Sciences lesson plan was well aligned with the CAPS document. The group focused on Specific Aim 1 which is about understanding the application of Life Sciences in everyday life, as well as understanding the history of scientific discoveries and the relationship between indigenous knowledge and science. The group also focused on Specific Aim 2 which relates to doing science or practical work and investigation. It was a grade 11 lesson and preservice teachers focused on cellular respiration and 'Energy transformation to sustain life'. The valuable activity in this lesson plan was that the group members designed a practical activity for learners. They planned to give learners a method that will guide them into making the steamed bread. This approach was aimed at improving learners' understanding when they carry out a practical task to enhance the theory that they had been taught. This is in line with research objective two because preservice teachers used a pedagogical strategy where they introduced an innovative practical activity. This was done to teach learners to be hands on in the science classroom. The assessment activity asked two important questions which were, *"What is the purpose of steamed bread?"* and *"Do you think it is healthy to eat this type of bread?"*. Both these questions will motivate learners to go and find out the answers through research or by engaging with elders or indigenous knowledge holders. The lesson was planned to encourage learners to tap into knowledge repository of elders. Knowledge of elders is respected by indigenous people. The specific aims which were in line with the CAPS document were clearly stated in this lesson.

The lesson plan incorporated indigenous knowledge because it described steamed bread in relation to the scientific process of steaming and fermentation. The specific aims were achievable. The lesson plan clearly stated that "Learners should be able to complete a practical activity based on food groups which are carbohydrates and fats and oils and demonstrate skills in evaluating solutions". This lesson plan focused on fermentation and food tests. These aspects were in line with the second research question of incorporating indigenous knowledge with science concepts. The lesson plan ended by giving learners the method they need to follow to make the steamed bread which was essential because the learners would take what they have been taught in theory and apply it practically by making the steamed bread. The pictures of steamed bread were in line with the content. Visual aids are aimed at assisting learners to learn using all their senses to enhance or deepen understanding. There was a clear introduction in the lesson plan, and it was essential because it started in a way that learners would be able to relate to.

The lesson was well developed and included the different nutrients that constitute the food pyramid and how this relates to indigenous food and in their example, it described how carbohydrates, fats and oils which are mentioned as essentials in Western knowledge are also incorporated in indigenous foods. The lesson plan also included references that one could visit to verify the given information and to read up more about steamed bread, carbohydrates, fats and oils. An inclusion of references was intended to encourage learners to embark on independent research. There was a clear link between indigenous and scientific knowledge in this lesson plan. These are some examples from the lesson plan:

"Ujeqe is a steamed Zulu bread that is prepared by using flour, yeast, sugar, lukewarm water, a pinch of salt and boiling water for steaming. This bread is prepared by mixing all the ingredients and placing the dough on the sun or heat to raise. The yeast combines with the sugar found in the dough and produce carbon dioxide and alcohol in the process of fermentation. Once the ingredients have been mixed thoroughly to produce the dough, that dough is exposed to the sun or any warm place for the process of fermentation to take place perfectly." (LP2)

Preservice teachers worked from what learners were familiar with and experienced (preparing *Ujeqe*) to the abstract concepts of fermentation.

4.3.3 TABLE 3: Energy transformation to sustain life using *Umqombothi* (LESSON PLAN 3 developed by focus group 3)

Topic:	**Energy transformation to sustain life**
Knowledge Strand/content:	Life processes
Key Questions:	1. What is cellular respiration? 2. What do you think is involved during cellular respiration? 3. Where does cellular respiration occur? 4. Why do we have more mitochondria in the muscle cells in the body? 5. What are the products of fermentation? 6. How is fermentation important in the economy? 7. Why is cellular respiration important?
Name of African indigenous food/beverage mentioned in lesson plan:	*Umqombothi*
Grade:	11
Subject	Life Sciences
Specific Aim 1:	"Knowing Life Sciences"
Specific Aim 3:	"Appreciating and understanding history, importance and application of life sciences in society."
Scientific concept/(s):	Fermentation

Group 3 created a lesson plan on cellular respiration and their topic was 'Energy Transformations to Sustain life'. They focused on two specific aims in the Life Sciences CAPS document. Specific Aim 1 which focuses on "Knowing Life Sciences" and Specific Aim 3 which focuses on "Appreciating and understanding history, importance and application of Life Sciences in society" (DBE 2011). The group explained the purpose and preparation of traditional beer (*umqombothi*) which is also known as traditional Zulu beer. "In ancient times before the introduction of modern technology and science, for weddings, celebrations, and ancestral rituals the traditional beer (*umqombothi*) was brewed to show gratitude to the ancestors" (DALP3). This group took time to explain why traditional beer was and still is

essential to African indigenous people and how the process of making traditional beer can be linked to science, especially the fermentation process.

Hlangwani et al. (2023) describes this beer as: “Umqombothi is a sorghum – based beer with a creamy constituency, an opaque pinkish colour, and a sour taste. The beer is generally considered safe for human consumption when prepared under standard fermentation conditions” (Hlangwani et al., 2023, p. 2). Another definition to corroborate the first is: “Umqombothi is a South African traditional beer nutritionally packed with minerals, amino acids, B group vitamins and much – needed calories” (Hlangwani et al., 2020, p. 1; Lues et al., 2008). “As a result, the production and consumption of this traditional beverage has been an integral part of South African’s social, economic and cultural prosperity” (Hlangwani et al., 2020, p. 1). This is an indication that this traditional practice has been scientifically proven to be highly nutritious for the human body or immune system. Hence it can be said that even if indigenous people were not aware of the nutrients that go into their bloodstream after consuming this beverage, they understood its contribution to good health.

Group 3’s lesson plan was in line with the CAPS document guidelines. The lesson incorporated indigenous knowledge and the inclusion of an African indigenous beverage which learners would be able to relate to. The specific aims were also achievable in this lesson plan. The pictures depicted were well aligned with the specified content. There was a clear introduction to the lesson about *umqombothi* and the ingredients required for making it. An effective cognitive bridge was constructed between the two knowledge systems. The lesson was well developed as it began with what learners could relate to and then went on to discuss cellular respiration.

The preservice teachers in group 3 then went on to explain cellular respiration by distinguishing between aerobic and anaerobic respiration. Teachers focused on anaerobic respiration, namely, fermentation, in indigenous foods to link indigenous knowledge and science concepts. This deepens conceptual understanding. “While photosynthesis transforms sunlight energy into sugar, aerobic and anaerobic respiration (fermentation) catabolises sugars to fuel cellular activities (Pang et al., 2023, p. 1). A link to a video of the process of cellular respiration was also included to enhance learners’ understanding. References were also included to indicate that the group members had engaged research before designing the lesson plan. The nutrients which would be derived from the mentioned beverage (*umqombothi*) were clearly stipulated.

4.3.4 TABLE 4: Genetic Engineering (LESSON PLAN 4)

Topic:	**Genetic engineering**
Grade:	12
Knowledge strand	Life at the molecular level
Key Question:	1. How is corn genetically modified?
Name of African indigenous food/beverage mentioned in lesson plan:	1. Corn 2. Traditional corn bread
Subject	Life Sciences
Aim of lesson:	"Understanding the relationship between indigenous knowledge and Life sciences"
Scientific concept/(s):	Gene mutation
Image of corn from lesson plan 4	

Group 4 designed a lesson plan on genetic engineering. Genetically modified organisms are living organisms whose material has been genetically manipulated in a laboratory by the use of genetic modification with viral, bacterial, animal and plant genes in order to attain a desirable physiological trait (Bakhsh et al., 2023). This desirable trait exists neither in nature nor is it achieved by crossbreeding methods. Genetically modified foods have become a part of our everyday life and there are numerous benefits that come with it even though the disadvantages cannot be ruled out totally. Hunter (2023) also concurs with Bakhsh (2023) that GMOs have become highly controversial globally especially with the increasing scientific advancements in biotechnology. It is for this reason that genetically modified food remains highly controversial globally (Bakhsh et al., 2023). This agricultural practice was initially initiated to combat global food scarcity and the rise of famine. It has for a long time remained a viable option to for large scale production and ensures that global food security is maintained (Bakhsh et al., 2023).

The lesson was a grade 12 Life Sciences lesson that was planned for a duration of one hour. The group chose to start the lesson with a video which would capture the attention of the learners and assist them to be more receptive to the content of genetic engineering. Videos can engage the learners' senses during learning. The group also provided an annotated diagram of

how corn is engineered. The good and notable thing about this lesson plan was that it used food which was widely consumed by indigenous people. Learners are able to relate to corn. The group also mentioned the advantages and disadvantages of corn. For example, they stated that it is "cheaper for farmers to produce modified crops that are resistant to pests or insects", "GMOs can survive unfavourable conditions (drought)" and "can be used to produce medicines". Some of the disadvantages they mentioned were "There are potential health risks for humans" and that GMOs can "decrease biodiversity". This is also corroborated by Bakhsh (2023) that GMOs are open to scrutiny and the health aspect remains a burning issue that to date has not been ignored by law. It is for this reason that many countries have created legislative action to regulate this very sensitive field.

4.3.5 TABLE 5: Digestive System/Healthy Diet (LESSON PLAN 5)

Topic:	**Digestive System**
Grade:	9
Knowledge strand	Life and living
Subject:	Natural Sciences
Content:	Healthy Diet
Aim of the lesson:	Learners should understand the uses of Natural Sciences and indigenous knowledge in society and in the environment. Learners should be able to complete a practical activity based on food groups which are Carbohydrates, fats and oils.

The preservice teachers in group 5 aimed to pass on the message that eating healthily will aid in having a digestive system that works well. *"Your gut is directly linked to your immune system and having a healthy gut helps your body to fight disease."* [DALP 5]

4.4 Themes related to Research Objective 1

Analysis of lesson plans and focus group interviews revealed several themes which are discussed in relation to research objective one which is:

To explore *preservice teachers' perspectives about the wisdom embedded within indigenous knowledge relating to food and beverages.*

The themes emerged from the data related to the above research objective included wisdom related to stable blood glucose levels, moderate consumption of food and food preservation.

4.4.1 Stability in blood sugar levels

Several groups alluded to the value of indigenous foods in regulating blood glucose levels, for example, focus group 1 stated the following during the interview:

"…The people knew that using these berries was healthier for them… knowing that these berries were sweet, but it didn't affect their blood glucose levels or give them, you know like extremely high blood sugar levels…" [**FG1**]

"…There is definitely wisdom in this knowledge …indigenous people knew of the health benefits due to the fact that they used it for a long time and the noticed that as they used these berries, they were less tired and had reduced symptoms of diabetes. This contributed to them maintaining good health and homeostasis" [**FG1**]

The above illustrates that indigenous people consumed foods that allowed their blood sugar levels to remain stable. Hence, they enjoyed good health and lifestyle diseases such as diabetes were reduced.

Group 2 which worked with steamed bread as an indigenous food and fermentation, added:

"…I think that steamed bread very healthy for people who are suffering from diabetes … because it has a low glycemic index." **[FG2]**

Group 3, whose members worked with indigenous food, asserted:

"It contains no added fats or oils, making it lower in calories and fat content." **[FG3]**

These excerpts illustrate that indigenous people were indeed wise and consumed foods that raised blood sugar levels slowly and steadily and this was essential for overall health. This data reveals preservice teacher's views that African indigenous people were aware that steamed bread, *umqombothi* and African berries, were healthy for them and that these foods contained low to moderate quantities of fats and sugar. Hence, indigenous people had the knowledge that consuming foods that were low in fats and sugar would ensure that they were not susceptible to lifestyle diseases. Lifestyle diseases can be eliminated or reduced by a good and proper diet

that takes into consideration all the required food groups in their right quantity (Manderson & Jewett, 2023). Steamed bread has a relatively low production temperature as opposed to baked bread and contains fewer Maillard reaction products such as acrylamide and furan (Peng et al., 2023). Maillard reaction is a chemical reaction that occurs between amino acids and sugars and usually forms during high temperature cooking such as baking, roasting and frying (Zhao et al., 2023). This can cause the human body to rapidly increase blood sugar levels and insulin secretion and these can increase the risk of cardiovascular disease (Grout et al., 2023).

Group 1 added the following views about African berries:

"Brazzein is the protein that is produced by these berries. For many years, the local people used these berries as a low-caloric sweetener in their foods and snacks." **[FG1]**

In their lesson plan, Group 1 wrote:

"There are many natural sweeteners which many people do not know about. It gives these learners a chance to not only learn about the issue but realise solutions. Also, we wish to show learners that there is so much of valuable knowledge to be gained from our Indigenous knowledge system." **[DALP1]**

Group 5 worked on the topics related to a healthy diet and digestion. They wrote the following in their lesson plan:

"Beans and other pulses may help in the prevention of chronic diseases like heart disease, cancer, and obesity and may lower the risk of developing Type 2 Diabetes." **[DALP 5]**

The preceding responses illustrate that indeed there is wisdom in the way African indigenous people related with the African berry. Preservice teachers explained that African indigenous people from west Africa were aware that the *Pentadiplandra brazzeana* berry was added to food as a natural sweetener. Indigenous people relied on their traditional wisdom to eat that which was tasty and the same time healthy for their immune systems.

In focussing on the *Pentadiplandra brazzeana* in relation to indigenous knowledge, Group 1 explained the link between indigenous and scientific knowledge in their lesson plan. This group described how the African sweet berry was used by African indigenous people, especially in West Africa, to sweeten their food. They drew a link between the indigenous plant and how its health benefits have also been backed up by science (DALP1). The food industry has been

looking at how to extract the sweet protein from the *Pentadiplandra brazzeana* plant and make profit from it by putting it in other foods (Saleh et al., 2023).

What emerged from each of the groups' lesson plans and focus group interviews was that even though indigenous people may not have been aware of the scientific terminologies we use today, they were able to use their experiences and observations to use plants to not only add taste to their food, but to also ensure that their health was not compromised. Hence, the preservice teachers drew a logical link between wisdom embedded in African indigenous foods and beverages and preventing diabetes.

Other research supports these findings. Plants are endowed with various nutritional and medicinal properties. These can be used ethnobotanically to manage and improve several ailments or sicknesses (Egbule et al., 2022). "Diabetes mellitus is a long – term metabolic problem that causes high blood glucose levels because the body cannot make or use insulin properly. It has become a widespread epidemic that affects millions of people all over the world" (Mohajan & Mohajan, 2023, p. 1). The root of *Pentadiplandra brazzeana* has been traditionally used as medicine in The Democratic Republic of Congo, Nigeria, Equatorial Guinea, Central African Republic, Northern Angola and Gabon. In Delta State Nigeria the roots have been used as a spice for food Burkill (Cimanga et al., 2018; Daltziel & Burkill, 1985). The nutrients and phytochemicals in medicinal food plants can be used as nutraceuticals for the human body's development and protection against non – communicable inflammatory disorders, such as diabetes mellitus. The plant *Pentadiplandra brazzeana* also has other health benefits. For example, it is used in Edo and Delta States in Nigeria as a soup spice by postpartum mothers for uterine cleansing and it also aids in eliminating colds and fevers. The plant is also used to heal dislocations, inflammation, and headaches. The aqueous extract of the *Pentadiplandra brazzeana* also possesses androgenic activity (Kamtchouing et al., 2002) and has the ability to cure many other health issues.

4.4.2 Moderate food Consumption

Preservice teachers indicated that moderate consumption of food was a lifestyle amongst African indigenous people and food preservation was a great skill.

Group one alluded to consuming food in correct quantities as a way of managing health. The following excerpt alludes to this:

"I do feel they ate in moderation because our bodies work in systems. So, if our bodies have too much sugar, so for example, the berry, if there was too much consumption of that berry, I'm sure our bodies will signal to us that you know what, our blood sugar levels are too high I do feel like, eventually somebody would have learned that they need to eat it moderation. They could have had people who ate too much of it and something happened, and then eventually over time, they learned the properties of this berry (and that it should be consumed in moderation)*".* [**FG1**]

Group 2 added the following view:

"The steamed bread is regarded as a good choice for our bodies. This is because it does not have too much fats or sugar. The steamed bread can be more suitable for people suffering from malnutrition" (DALP2).

Malnutrition arises because of over-consumption or under-consumption of food which contains different nutrients. Steamed bread has a low glycemix index (Chang et al., 2020). This is an indication of how indigenous knowledge holders have known low glycemic foods are healthier for consumption.

One can also see that a link exists between indigenous and scientific knowledge. It is evident that indigenous or traditional practices can serve as a foundation for scientific exploration and findings, and this will deepen understanding and validate indigenous practices. African indigenous people were able to enjoy their meals while maintaining good health and they were aware that it was crucial to eat in moderation. Their lifestyle indicated that there was a high level of wisdom when it came to nutrition in maintaining overall health.

This data reveals that African indigenous people had the ability to engage, think critically and to use prior knowledge and experiences in a way that integrates virtue and wisdom (Zhang et al., 2023). Even if they did not have a formal understanding of scientific concepts such as 'diabetes', 'glucose' and 'homeostasis' they had intuitive and experiential knowledge since indigenous people were also known to communicate with ancestors and spirits. This aligns with the literature review that African indigenous people have always been in synch with nature and have always done their best to incorporate their morals even in what may seem simplistic, such as the way they ate and preserved food and beverages in a way that was environmentally friendly. In addition, their lifestyle and the manner in which they handled foods and beverages also contributed to their good health.

For instance, indigenous people may not have known the English terminologies "Carbohydrates", "Fats" and "Oils" but they knew these terminologies in their mother tongue. In English we refer to "Carbohydrates" as "glucose" or "sugar" and in IsiZulu for example, the term for "sugar" is "Ushukela". And indigenous people knew that too much consumption of sugar made people sick even if they may not have known the English or scientific term "diabetes". The same can be applied to "fats" and "oils" (Kesa et al., 2023).

In IsiZulu the terms fat is referred to as "Amafutha". Indigenous people knew that "Amafutha" was bad for the heart even though they may not have known the term "cardio vascular diseases" (Mbhatsani et al., 2023). In my mother tongue sugar is called "sukali" and fats are called "amafuta" and these are words that have negative connotations in relation to foods and beverages because there is an understanding that when these nutrients are not consumed in moderation, they cause sickness. For example, preservice teachers mentioned that indigenous people knew how to eat in moderation, especially when it came to the African berry for instance. If they consumed too much of it, they fell ill. The preservice teachers also explained why steamed bread was healthy because it contained very little sugar and fats and oils which is line with general healthy guidelines. Hence, indigenous people were insightful about foods and beverages as they knew what needed to be eaten and in what quantity. This is an illustration of wisdom.

The study by Hsin and Wu (2023) also corroborates how African indigenous people asked questions, did investigations, even though they were not in a laboratory, and they also drew evidence from what they had observed and passed it down from generation to generation. Hence, science and indigenous knowledge have a meeting ground in the sense that they can have certain similarities which can complement each other.

To support the assertions by Hsin and Wu (2023) the following is quoted from focus group 1 interview: *"I feel indigenous Africans are scientists… they locate medicinal properties, different plants and vegetables. They find ways in which this can impact our body or make us feel better, or even like treat wounds. You know, all of that… so they are technically doing their research to find these medicinal properties. But in a way, they are scientists, researchers. Yes, they are doing research basically, trial and error. So, they are scientists. They experimented with materials around them, be it like plants. They are scientists in their own way. They conducted their own experiments. I wouldn't say experiments as in, you know such as using laboratory equipment and conducting procedures, but they experimented in terms of taking the*

genetic, the plants around them, trying them out, you know like, trying to make them useful. So, they were technically exploring their surroundings."

Preservice teachers transgressed familiar boundaries about who can be considered a scientist.

4.4.3 Food preservation

More responses emerged in lieu of research objective one pertaining to the wisdom embedded in the preservation of foods and beverages within the African indigenous context:

"…Just to add onto the point of wisdom, there is wisdom in the preparation of food using the IK because the knowledge that I have is that … people used to hunt certain prey, maybe the rabbit meat, let's say there is the part where they will cook half of the rabbit meat, and the other one will just be hanged until it is dried for a certain period of time, and then that meat will be consumed without cooking it. I think it is called Biltong. I don't think they were taught that knowledge. It was just wisdom that they had acquired. They knew that when the meat was dry enough, there would be no need to cook the meat and it could just be consumed." **[FG2]**

"The first advantage is that they taste good, even in the absence of sauces. **[FG2]**

The preceding responses demonstrate that indigenous people had a deep understanding when it came to food preservation techniques (Kamwendo & Kamwendo, 2017). This highlights a connection between practical knowledge and cultural wisdom. There is also an indication of resourcefulness in the lives of indigenous people (Matsa & Mukoni, 2013).

Previous studies allude to food preservation. "Fermented foods and beverages are an integral part of cultural heritage, even today. These have been developed throughout the history of human civilisation for sustained nutrition and food preservation. Ancient people adopted different preservation methods to store foods" (Ray et al., 2016, p. 5). The statement corroborates what had been said by the preservice teachers that indeed the art of food preservation has existed for centuries amongst indigenous people, and they have been able to sustain their livelihood through their interaction with nature and the earth's resources. It can also be noted from the above mentioned that "preserving cultural heritage and local wisdom is an essential endeavour that ensures the continuity and flourishing of a community's identity, traditions, and values" (Maspul & Almalki, 2023, p. 649).

4.5 Themes related to Research Objective 2

Several themes emerged from the data related to Research Objective 2 which is:

To explore how preservice teachers plan to incorporate indigenous knowledge about food and beverages in science lessons.

Firstly, teachers engaged in learning about African Indigenous Knowledge (AIK) to teach about it.

4.5.1 Teacher-learning: conducting research.

Preservice science teachers described their initiative in taking responsibility for their learning about AIK. These were some responses that emerged:

"Before we bring indigenous knowledge into the classroom, we need to have sufficient knowledge about indigenous knowledge… and do our research pertaining to this type of indigenous knowledge, then only can we take it into the classroom and use the examples of different foods and beverages and incorporate that into our science lesson… We could also conduct experiments such as you know, for instance, investigate the fermentation process or maybe they could explore the environmental factors affecting the growth of a specific crop, by infusing an indigenous crop so that's how I feel we can integrate indigenous knowledge and science pertaining to foods and beverages." **[FG1]**

Document analysis of lesson plan 1 contained evidence of teacher learning through research, because it included the following reference list:

https://www.google.com/search?q=pentadiplandra+brazzeana&source=lnms&tbm=isch&sa=X&ved=2ahUKEwiwl--mucH3AhUUgFwKHWRoDngQ_AUoAXoECAIQAw&biw=1536&bih=754&dpr=1.25#imgrc=rMvBTqrxeTi_TM

https://www.google.com/search?q=brazzein+protein&tbm=isch&ved=2ahUKEwiYzMaoucH3AhXV3oUKHWydCdQQ2-cCegQIABAA&oq=brazzein+protein&gs_lcp=CgNpbWcQAzIFCAAQgAQyBQgAEIAEMgUIABCABDIECAAQGDIECAAQGDIECAAQGDIECAAQGDIECAAQGDIECAAQGDoICAAQgAQQsQM6CAgAELEDEIMBOgsIABCABBCxAxCDATIECAAQAzoECAAQHjoGCAAQCBAeUL0KWItNYLlQaAJwAHgEgAHfBIgBnEaSAQoy

LTUuMTIuNC4zmAEAoAEBqgELZ3dzLXdpei1pbWewAQDAAQE&sclient=img&ei=MiNwYpjrH9W9lwTsuqagDQ&bih=754&biw=1536#imgrc=Vyf1gnr_DbXU7M

https://www.google.com/search?q=Stats+on+young+teens+and+diabetes&tbm=isch&ved=2ahUKEwjAl5aOusH3AhUL1-AKHXhWDjQQ2-cCegQIABAA&oq=Stats+on+young+teens+and+diabetes&gs_lcp=CgNpbWcQAzoECAAQQzoFCAAQgAQ6BAgAEBg6CAgAELEDEIMBOggIABCABBCxAzoECAAQAzoLCAAQgAQQsQMQgwE6BggAEAoQGFD2B1jVmgFgqaABaAFwAHgEgAHnBYgBx2ySAQ0yLTEyLjE5LjcuMS4xmAEAoAEBqgELZ3dzLXdpei1pbWewAQDAAQE&sclient=img&ei=ByRwYoD4Jouugwf4rLmgAw&bih=754&biw=1536#imgrc=ZX-VuPNyZzRlgM

These links in the reference list illustrates that the preservice teachers conducted research before they designed their lesson plans. They did research about different types of foods and beverages and how they could incorporate them. They also learnt about fermentation as it applies to indigenous crops.

The preservice teachers learnt more about indigenous knowledge through conducting research and by tapping into knowledge of indigenous knowledge holders.

"I can just ask an old mother preparing that traditional beer, about fermentation, … during the process of making that traditional beer, you'll see them covering that bucket of umqombothi with big blankets …, maybe for the process of that fermentation to work successfully." **[FG2]**

Blankets can retain heat which accelerates fermentation reactions. These preservice teachers were able to take cognisance of the fact that tapping into the knowledge repository of elders was of paramount importance.

Once preservice teachers learned about AIK, they prepared lessons using several pedagogical insights. Multiple strategies to plan to teach about IK in science classrooms, were adopted.

4.5.2 Leveraging affordances of visual aids to link IK to science lessons.

Group 1 developed a lesson plan which focussed on the relationship between the *Pentradiplandra brazzeana* plant, homeostasis and animal nutrition. Preservice teachers in Group 1 used the image of *Pentradiplandra brazzeana*, to enhance the teaching about this indigenous berry.

[Image of *Pentradiplandra brazzeana* plant taken from lesson plan 1]

Other preservice teachers also planned to use visual aids alongside texts to enhance and deepen conceptual understanding of indigenous and scientific knowledge.

The following image serves as example from Lesson plan 2 which was developed by focus group 2:

	*"Fermentation is the metabolic process in which an organism converts a carbohydrate, such as starch or sugar, into an alcohol or an acid as it happens when preparing the steam bread (Ujeqe). Ujeqe is a steamed Zulu bread that is prepared by using Flour, yeast, sugar, lukewarm water, a pinch of salt and boiling water for steaming. This bread is prepared by mixing all the ingredients and placing the dough on the sun or heat to raise. The yeast combines with the sugar found in the dough and produce carbon dioxide and alcohol in the process of fermentation. Once the ingredients have been mixed thoroughly to produce the dough, that dough is exposed to the sun or any warm place for the process of fermentation to take place perfectly."*

[Image of ingredients used to prepare steamed bread from Lesson Plan 2]

The preceding example shows how text appeared alongside a picture of ingredients used to prepare a familiar food that is consumed by Africans, and the link with biochemical reactions of fermentation, the latter which is taught in science classrooms. The preservice teachers tapped into learners' prior knowledge about steamed bread to plan to teach the concept of fermentation successfully. They chose to begin the lesson with an indigenous food that learners know and can relate to, to effectively teach about fermentation. In this way cognitive bridges were built. Research has shown that making use of prior knowledge before introducing a concept increases learners' engagement and understanding (Pecore et al., 2017).

Group 3 used several images to underscore the process of fermentation in indigenous beverages, such as *Umqombothi*, which learners were familiar with.

[Image of *umqombothi* from lesson plan 3]

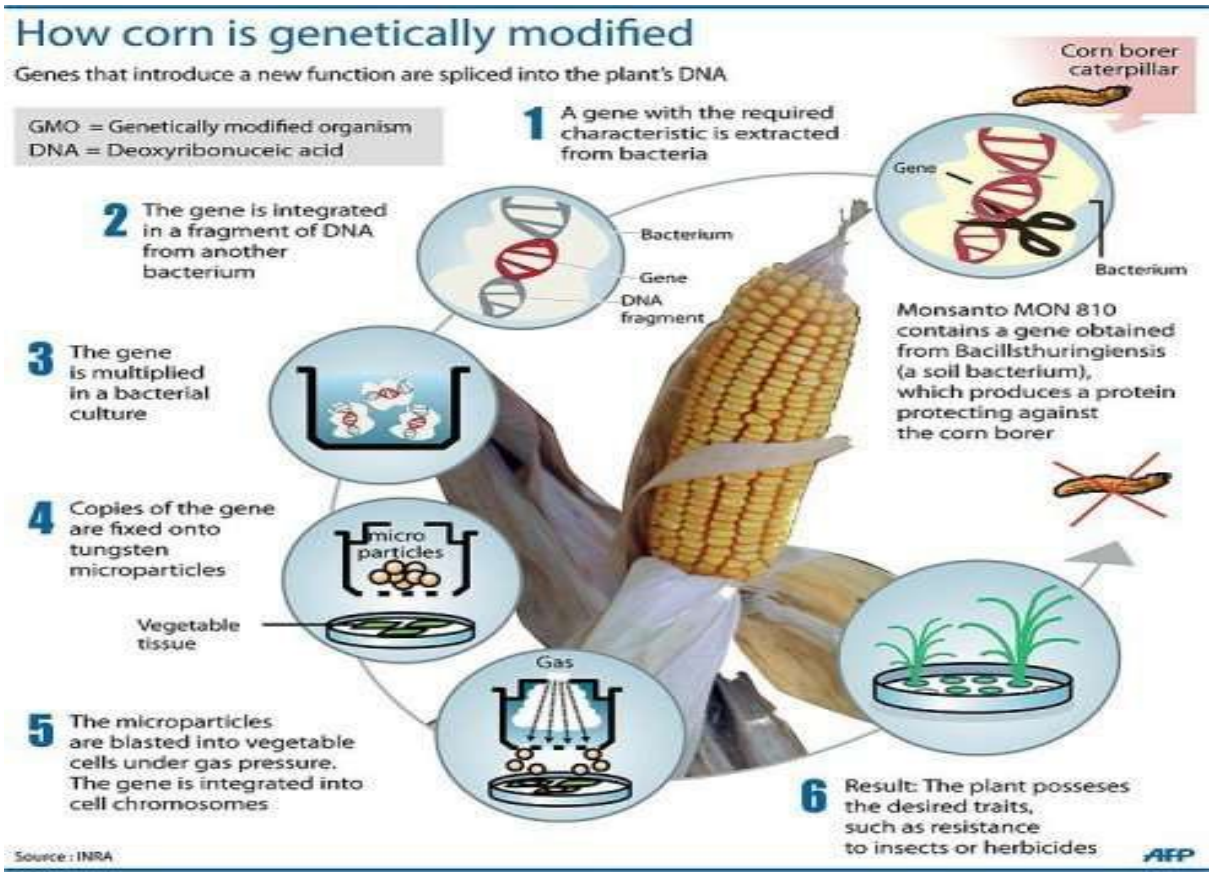
		
Maize Meal	**Maize Malt**	**Wheat Malt**

[Image of ingredients used to prepare *umqombothi* from lesson plan 3]

Group 3 tapped into learners' prior knowledge to build cognitive bridges between school science (fermentation) and production of traditional beer (fermentation). They began by using images to discuss familiar ingredients used in indigenous practices and ended with the science

related to anaerobic respiration. The use of visual aids which learners are familiar with ensured that learners felt more comfortable and relaxed, and they were able to be more receptive to new knowledge that emerged. Hence moving from what is familiar to learners to new knowledge or to the unknown is always preferable in the science classroom (Kukulska-Hulme, 2021).

Group 4 planned a lesson on Genetic modification, and used diagrams that show how corn is genetically modified.



[Image of genetic modification from Lesson plan 4]

These preservice teachers asserted that when learners see an indigenous food that they can relate to (corn) it will be easier for them to grasp the scientific concepts associated with genetic modification.

Group 5 used pictures of familiar grains to teach about the digestive system and a healthy diet.

[Image of grains from lesson plan 5]

Readon and Derner (2023) also emphasise the value of visual aids to enhance understanding. The use of images in science lessons is of paramount importance, especially for learners who do not speak English as their first language and may have a struggle to grasp certain language concepts.

4.5.3 Learner-centred approach

Several preservice teachers opted for learner – centred approach activities in their lessons as this was seen to be more beneficial as opposed to a teacher – centred approach.

Excerpts from the interviews illustrate a learner centred approach.

"I think learner centred … if the lesson is learner centred, learners will communicate what they know with a teacher, and if they know something wrong or have a misconception in what they know, the teacher will try to correct them, yeah." **[FG2]**

"I can say I would prefer a learner centred approach because it will allow learners to ask more questions and I would engage with the learners better." **[FG3]**

Practical work and field trips to indigenous communities were strategies that preservice teachers planned as they worked towards a learner centred pedagogy.

A. Practical work

Some preservice teachers planned to use active learning activities, such as practical work, to engage learners.

Group 2 offered the following reflection in the lesson plan, about the advantages of engaging learners in preparing the dough for steamed bread: *"The main reason is to make learners understand fermentation a little bit more because they will prepare the dough and expose it on the sun to raise it and once it has risen, they will poke it and experience the process of releasing Carbon dioxide and Alcohol (smell)."* Hands on experiences where the learners' senses are fully engaged is encouraged (DALP2).

They added the following comments during the interview:

"Since indigenous knowledge is very important to learners, I can use it to introduce some science concepts. For example, if we are doing cellular respiration in Life Sciences, maybe I can arrange something like an experiment, maybe in that experiment, we'll do steamed bread. During the experiment I'll be telling them that each and every thing that happens in that experiment, relating the indigenous knowledge and Western knowledge. I think it can be easier for them in this way, to understand the topic." **[FG2]**

B. Field trips to indigenous communities and learning in context

Learning in context was also valued by preservice teachers as is evident in the following excerpts:

"As a preservice science teacher, I can take time to research and familiarise myself with the indigenous knowledge and practices related to foods and beverages in my local or regional context. This may involve studying food preparation methods. I can also organise field trips to indigenous communities or farms where learners can engage with indigenous knowledge and learn about traditional foods and beverages." **[FG3]**

"Learning about something that they know they can relate to, because maybe they grew up on a farm and they grew that specific plant or vegetable on their farm, and they know the property/properties which gives them a sense of relation inside the classroom. This will produce better learning and understanding. It allows the learner to embrace a holistic world view rather than a monotone view, which is just the textbook.; where if we include such, they

will feel that they are part of the discussion and not just depend on rote memorisation. They feel like they are included in the discussion and all of that." **[FG1]**

"It is important but in the context of where we are, teaching the learners about their surroundings is important because they need to understand where they come from and where they are actually going. They need to have a diverse understanding of the world. So that's why indigenous knowledge is important, but we also need to learn other things." **[FG1]**

The above is an illustration of how preservice teachers (PSTs) alluded to immersing learners in a familiar context, for example, farms, to construct knowledge. They viewed this as being inclusive of learners' experiences, and therefore as being meaningful to learners' lives.

4.5.4 Learning in context

It is always crucial to teach learners new scientific concepts by starting with what they already know or are familiar with (Heald et al., 2023). This assists learners not to feel overly intimidated or overwhelmed or to lose interest in the subject matter (Campbell & Howitt, 2023). Hence, beginning a lesson with familiar knowledge ensures that one wins the heart of the learner before one manages to train his or her mind (Oladejo et al., 2023).

Some preservice teachers described possibilities of inviting IK holders who were custodians of community knowledge, to discuss indigenous foods and beverages with learners. For example, group 3 preservice teachers said the following:

"I can invite guest speakers who have indigenous knowledge such as community elders, or local experts so that they can share their knowledge and experiences directly with the learners. They can provide insight into traditional food practices, preparation techniques and the scientific principles behind them. This experience can create a rich engaging learning experience to the learners." **[FG3]**

4.5.5 Creative lesson design

Preservice teachers in group 1 designed the lesson plan creatively by introducing a case study about the African indigenous plant. The case study explained how African indigenous people used the *Pentradiplandra brazzeana* plant for numerous purposes including medicinal purposes. The preservice teachers who designed Lesson plan 1 were able to use a case study of the *Pentradiplandra brazzeana* plant to aid learners' participation and understanding of drawing a link between indigenous knowledge and scientific knowledge.

4.5.6 Linking IK to community health.

In the reflection on the lesson plan, Group 1 members wrote:

"One of the biggest reasons why we decided to introduce this knowledge with this grade and topic is to allow grade 11 learners to realise an issue (high incidence of diabetes) *in our communities and to find solutions to these problems.*

It is no secret that the number of people who suffer from diabetes mellitus in our communities is on a rise. The number of young children and teenagers especially who now have diabetes is shocking, and the one cause is an unhealthy lifestyle. The point of introducing this knowledge is to show learners that there are many ways which one can live a healthier lifestyle. There are many natural sweeteners which many people do not know about. It gives these learners a chance to not only learn about the issue but realise solutions. Also, we wish to show learners that there is so much of valuable knowledge to be gained from our Indigenous knowledge system." (DALP1)

The preceding quotes from lesson plan 1 illustrate that preservice teachers selected the indigenous food to integrate in the lesson plan thoughtfully. They intended for this indigenous knowledge to influence learners to tap into the affordances of indigenous foods to manage health challenges.

The preservice teachers who designed lesson plan 2 used a pedagogical strategy of introducing an indigenous food (steamed bread) to teach about fermentation. Their rationale was that the learners got to learn about the health benefits of this indigenous food.

Group 5 developed a lesson plan about a healthy diet. They underscored the importance of protein in the building of worn-out tissue and cells in the body. These preservice teachers also discussed the importance of the different food groups such as carbohydrates and fats and how these are essential in maintaining a healthy diet. In lesson plan 5 they wrote:

"Proteins build and repair tissues and cells in the body…dried beans are high in protein, which promote growth and development."

"Legumes like dried beans can promote cell duplication and muscle density".

"Peanuts are rich in proteins for growth."

"Your gut is directly linked to your immune system and having a healthy gut helps your body to fight diseases".

"The fibre in traditional Samp and Beans may assist in boosting your immune response indirectly via improved gut health" (DALP5)

The value of fibre in indigenous food such as samp (which is derived from maize) and beans, to sustain a healthy microbiome in the gut, was emphasised by Group 5.

Costabile et al. (2016) conducted research which showed that managing the gut microbiome can improve human health. They underscored the value of dietary fibre which comes from maize. Soluble fibre from maize is capable of selective fermentation and is associated with increase in immunity.

4.5.7 Linking food and beverage preparation to biochemical reactions in science

The relationship between preparation of indigenous food and beverages with science concepts about fermentation was emphasised by Group 2.

"Cellular respiration is a set of metabolic reactions and processes that takes place in the cells of organisms to convert chemical energy. Under cellular respiration we have a process called anaerobic respiration which is defined as the production of lactic acid in muscle during exercise, the role of anaerobic respiration in the industry: is beer brewing and bread making. For example, taking the steam bread which is the traditional Zulu bread prepared by steaming the raised dough with boiling water." (DALP2)

Fermentation is key in the production of steamed bread as bubbles are formed continuously in the dough. This provides the aerated structure of steamed bread. The volume of the dough increases simultaneously while the density decreases. Yeast metabolites such as ethanol, succinic acid, hydrogen peroxide (H_20_2), lactic and acetic acid accumulate during fermentation which causes the power of hydrogens in the dough to decrease during the proofing stage (Ruan et al., 2023). These changes have a significant influence on the dough properties (Chang et al., 2020).

4.6 Discussion

Analysis of responses from lesson plans and focus group interviews illustrate that there is indeed a need to incorporate IK pertaining to foods and beverages within science lessons as this will deepen learners' conceptual understanding of IK and science. There was a unanimous

agreement among the preservice teachers to engage in research as this would better prepare teachers for embarking on a journey to understand IK at a deeper level. The preservice teachers also agreed that if learners conduct experiments with their teachers pertaining to indigenous foods and beverages, both the teachers and learners would gain a deeper conceptual understanding. Engaging in practical work by focussing on indigenous food and beverages would assist learners to see the clear link between indigenous foods and beverages and science, such as the process of fermentation in the preparation of *Umqombothi*. The preservice teachers also highlighted the fact that African indigenous people engaged in food practices that incorporated science, but they were probably not aware of the science involved in making *Umqombothi*.

Preservice teachers agreed that when carrying out practical work for learners, using IK, the teacher needs to use and make reference to the foods and beverages that learners know about or have come across so that they understand the correlation between IK and science better and faster. Teachers should plan lessons which show how IK and Western knowledge come together in science lessons. Involving field trips in the teaching of IK and science will deepen teachers' and learners' conceptual understanding and should be encouraged. Inviting IK holders and community members to a science lesson will enhance both the teachers' and learners' conceptual understanding. The preservice teachers agreed that a learner centred approach was preferred as it would enhance learners' understanding since learners also have to be given an opportunity to express their views and to share what they know because teachers do not know everything, and they too can learn from their learners.

CHAPTER 5
DISCUSSION: SUMMARY AND RECOMMENDATIONS

5.1 Introduction

This qualitative study sought to explore preservice teachers' views and experiences about incorporating indigenous knowledge with scientific or Western school knowledge. This chapter aims to reiterate the main findings that emerged inductively from the data. These findings contribute to answering the two crucial questions that guided this study. Firstly, a summary of the key research findings addressing each of the research questions is presented. Secondly, a discussion about the recommendations is given. Finally, the limitations of the study are alluded to.

Insights gained from the literature review in Chapter 2 and the analysis in Chapter 4 will be discussed and concluded here. Indigenous knowledge is multifaceted as it is interconnected with multiple external systems in educational contexts (Khupe, 2014; Sentina et al., 2018). It is imperative to note that in the context of science education, it is necessary to bridge the gap between Western and indigenous perspectives and to address the existing power imbalances between the two. The Postcolonial Indigenous Theory (PIT) can assist preservice teachers as well as teachers who are already in the field to dismantle the stereotypes that exist about indigenous knowledge such as the notion that indigenous knowledge is primitive and obsolete. Preservice teachers in my study illustrated that indigenous knowledge is still very relevant. This was clearly articulated in their interviews as well as their lesson plans.

In adopting a Postcolonial Indigenous theory, it is imperative to embrace an approach that is inclusive and respects the rich tapestry of indigenous knowledge systems. This theory necessitates that a profound re–evaluation of knowledge is studied. Hence, how knowledge is produced, disseminated, or validated needs to be challenged to eradicate the assumption or view that Western knowledge is inherently superior. The theory aims to actively confront historical injustices that were wrought by colonialism; hence this chapter reinforces the fact that embarking on a journey that values and honours diverse cultural perspectives will require a reorientation of the way we think about and implement the curriculum.

There is a commitment to the well-being of humanity within the theory as it is rooted in having a deeper understanding of what it means to be human. This theory seeks to challenge the Eurocentric view that often ostracises indigenous perspectives. The marginalisation of indigenous perspectives results in indigenous people from global South settings acquiring a

less than human status, and the density of "coloniality of being, coloniality of knowledge and coloniality of power" (Maldonado-Torres, cited in Mudaly & Sanjigadu, 2022, p.3), accrues to those from the global North. However, within the indigenous research paradigm, being human is beyond anthropocentric frameworks. In other words, it does not just speak to the fact that human beings are intrinsically important and worthy of recognition, but it goes on to encompass a more holistic approach that looks at recognising the interconnectedness of human beings with their community, environment as well as the spiritual dimension. In my study, a participant mentioned that "*In ancient times before the introduction of modern technology and science, for weddings, celebrations, and ancestral rituals the traditional beer (umqombothi) was brewed to show gratitude to the ancestors*". Their lesson plans revealed that teachers were willing to teach about *umqombothi*, and its role in thanksgiving to the ancestors, and in doing so, referred to the spiritual dimension of life. The interconnectedness of learners with communities was clearly expressed by preservice teachers who planned to take learners to "*indigenous communities or farms where learners can engage with indigenous knowledge and learn about traditional foods and beverages*".

The Postcolonial Indigenous theory seeks to place emphasis on human beings building sustainable relationships not only with other fellow human beings from diverse backgrounds but also with the earth; and this is a deeply entrenched wisdom that has long been prioritised and harmonised by indigenous people to create a balance. Hence, a more holistic view is required when embracing indigenous knowledge to ensure that commitment to the well-being of humanity is reached and not just mere individual prosperity which is the mark of success in the Western world. The well-being of communities was prioritised by each group of participants in my study. Stabilising blood sugar levels by consuming African berries which are sweet tasting but do not elevate blood glucose levels, the consumption of steamed bread which has a low glycemic index, and the variety of nutrients that can be obtained from *umqombothi* are some examples that preservice teachers integrated in their lesson plans. Importantly, they skilfully weaved the preparation of steamed bread and *umqombothi* into the CAPS topic on fermentation.

5.2 Discussion of summary of key research findings

This chapter captures the responses of preservice teachers to answer two crucial questions that framed this study, namely:

1. What are preservice teachers' perspectives about integrating African foods and beverages with indigenous knowledge, in science lessons?
2. What methods do prospective teachers view as most effective for integrating indigenous knowledge pertaining to food and beverages in science lessons?

Sub–questions:

1. What are preservice teachers' perspectives about the wisdom embedded within indigenous knowledge relating to foods and beverages?
2. How do preservice teachers plan to incorporate IK about foods and beverages in science lessons?

This study explored how preservice teachers aim to incorporate indigenous knowledge within science lessons. The study has discussed the challenges that have been incurred by preservice teachers and teachers in the field when it comes to incorporating indigenous knowledge within the science classroom. For example, preservice teachers articulated the challenge of aligning their pedagogical approach with the Curriculum and Assessment Policy Statement (CAPS), which lacks a comprehensive guidance on the incorporation of indigenous knowledge. Their voiced concerns extend to a perceived deficiency in their own understanding of indigenous knowledge, leading to a lack of confidence in effectively delivering this aspect of the curriculum.

The study evolved from previous research which indicates a disconnect between learners and the science curriculum because the curriculum is Westernised and focuses more on Western knowledge while marginalising indigenous knowledge. The study took on a qualitative approach to learn about preservice teachers' perspectives on incorporating indigenous knowledge pertaining to African foods and beverages. The Postcolonial theory which is based on indigenous philosophy, culture, and language aims to promote social change and decolonisation. By utilising this framework, I have demonstrated how decolonising the curriculum will contribute to a meaningful transition away from Eurocentric perspectives and recognise the underdevelopment of indigenous wisdom and its contributions to scientific knowledge.

The findings of this study illustrate that indigenous knowledge is a legitimate research issue that must be treated with paramount importance. Indigenous knowledge including oral tradition is valuable and should be treated as important by both educators and scholars. Research should

incorporate indigenous communities through ongoing dialogue in the co-creation of knowledge which will bring about transformation. In other words, the hegemonic Euro-Western influence in the curriculum must be challenged by embracing of indigenous knowledge, language and culture (Battiste, 2000).

5.3 Themes relating to research question one which is: 'What are preservice teachers' perspectives about the wisdom embedded within indigenous knowledge relating to foods and beverages?'

5.3.1 Science which addresses health needs of communities

Group 1 as discussed in chapter 4 designed a lesson plan which pertained to the *Pentadiplandra brazzeana* which was used by the people of Western Africa. This plant was used for medicinal purposes hence this knowledge, belief and practice was passed from generation to generation as indigenous knowledge. Later on, when scientists embarked on studying this plant, they found that indeed it was worth consuming as part of people's lifestyle to keep life style diseases at bay (Ankrah et al., 2021; Henri et al., 2021). This aligns with research question one which seeks to know preservice teachers' perspectives about the wisdom embedded in African foods and beverages. According to the preservice teachers, African indigenous people were wise and extremely knowledgeable about foods, beverages and plants in general. They were aware through their experiences that certain foods had the ability to keep one healthy and free from lifestyle diseases such as diabetes. Hence, the *Pentadiplandra brazzeana* plant was used by the people of Western Africa to prepare meals and this kept them very healthy.

In the social sciences and humanities, postcolonial scholars have discussed how colonialism remains entrenched, since the mid-20th century. Scholars such as Fanon (1968) and Said (1978) among others, have written extensively on how we can carve out new intellectual paths to deal with colonialism (Swartz et al., 2024). Their approach essentially rejects and challenges the marginalisation of diverse cultural identities and worldviews of the 'other' (Swartz et al., 2024). This is in line with the findings in chapter 4 regarding homeostasis and the maintenance of blood sugar levels. The example of *Pentadiplandra brazzeana* demonstrates that indigenous knowledge has valuable insights to offer and is not inferior to Western knowledge (de Sousa Santos, 2018), and based on this, preservice teachers believed it should be incorporated into the curriculum. This demonstrated preservice teachers' recognition and valuing the wisdom inherent in indigenous knowledge.

5.3.2 Wisdom in preparation of indigenous food

The lesson plan which was designed by Focus Group 2 (refer to chapter 4) incorporated indigenous knowledge in the process of teaching and learning. This was done in relation to the topic from the CAPS curriculum, cellular respiration, with a focus on fermentation, using steamed bread as a case study. This was also an illustration of how indigenous knowledge can be integrated within a science lesson. The integration of indigenous knowledge within the science lesson emphasises the importance of recognising and valuing traditional knowledge.

The assessment activity which was designed for learners included crucial questions, such as the purpose and health aspects pertaining to steamed bread. Teachers planned for learners to go into their communities and engage with their community leaders and elders. This would assist learners to appreciate and respect their elders as indigenous knowledge holders and this is a fundamental aspect of indigenous cultures. The scientific concept of fermentation was well connected with the indigenous practice of preparing the steamed bread which is known as '*Ujeqe'* in IsiZulu (Olusanya et al., 2023). Taking an abstract concept and making it more tangible for learners by drawing a link or connection that which is familiar to them enhances the process of teaching and learning. The visuals and references which were included by the preservice teachers aided in encouraging learners to engage in independent research which will connect their scientific knowledge with their cultural heritage (Santana & Akhurst, 2021). Preservice teachers and teachers in the field should continue to strive for inclusive and culturally relevant education where there is promotion, preservation and appreciation of indigenous knowledge (Armstrong et al., 2023).

5.3.3 Wisdom in the preparation of indigenous drink

The inclusion of *Umqombothi* which is a traditional beer in the lesson plan demonstrated that preservice teachers recognised the value of indigenous knowledge systems (Hlangwani et al., 2023). This is in line with the emphasis that acknowledges traditional practices which were often marginalised during colonisation (Go, 2023), and continue to be marginalised currently. The lesson plan also highlighted the importance of this African beverage in the context of celebrations such as weddings and ancestral rituals. The cultural relevance and significance align with the call for recognising different cultural contexts and their importance in science education. Preservice teachers demonstrated, using the lesson plan, how they would effectively integrate the scientific concepts of cellular respiration and fermentation; an integration which was necessary and essential to teach about indigenous knowledge. When preservice teachers take the time to explain the nutritional value of *umqombothi* and its positive impact on one's

health, they ensure that indigenous communities are empowered. The lesson plan also encouraged learners to seek a cultural and historical understanding of *umqombothi* through community engagement. This aligns with the goal of involving the community and ensuring that there is collaboration in the education process (Lemos, 2023). The inclusion of *umqombothi* and references also align with the call for recognising the validity of indigenous knowledge through research and validation.

5.3.4 Wisdom in critical thinking about food

Preservice teachers chose corn as an African staple food to teach about genetic engineering. There was a correlation between science and indigenous knowledge within the lesson. The lesson plan was culturally relevant, and it included plans to discuss a current and controversial issues related to genetic engineering. The advantages and disadvantages of genetically modified foods were discussed as a way of critically engaging contemporary health and nutritional issues (Ma & Liu, 2023) such as genetic engineering and incorporating diverse perspectives. The incorporation of a video to begin the lesson reflected a strategic pedagogical approach which is consistent with the PIT as it engaged multiple senses and sought to captivate and enhance learners' process of teaching and learning (Chan, 2023).

5.3.5 Food preservation

Indigenous people were resourceful people, and this was evident in the manner in which they interacted harmoniously with nature and the Earth's resources. This is in line with research question one which sought to find out preservice teachers' perspectives about the wisdom embedded within indigenous knowledge related to foods and beverages. The PIT resonates well with this as it acknowledges resilience and indigenous adaptive capabilities in communities. Fermented foods and beverages have been and are still an integral part of cultural heritage which aligns with the PIT which advocates for cultural preservation, traditions and values. The notion that these cultural practices have evolved over centuries further reinforces the historical perspective that food preservation has been an integral part of African indigenous people (Okoye & Oni, 2017). This has contributed to the rich cultural tapestry of indigenous communities. The PIT is encapsulated here as it highlights indigenous wisdom, cultural continuity and sustainability in the context of food preservation (Zidny et al., 2020).

When delving into the essence of food preservation within the African indigenous context, preservice teachers shared perspectives that illuminate a profound connection between cultural wisdom and practical knowledge. Their insights echo the PIT 's call for treating diverse

cultures and ways of understanding as reservoirs of profound knowledge. The example given by preservice teachers of drying rabbit meat to create what we understand as or call 'biltong' reveals the tapestry of indigenous wisdom that has been acquired through lived experiences and has been passed down from generation to generation. This challenges the predominant view that Western knowledge stands as the only reliable source of knowledge or benchmark. Indigenous people did not only demonstrate resourcefulness in their lives, but resilience was also incorporated in their lifestyle, and this assisted them to continue their traditions in a manner that was sustainable which is in line with the PIT. A compelling picture of preserving cultural heritage as well as embracing values that are unique to indigenous knowledge is of paramount importance.

5.3.6 Moderate food consumption

The findings on moderate food consumption within the African context reveal that preservice teachers' perspectives intricately link with the PIT as light is shed on the profound wisdom that is embedded within indigenous knowledge, especially regarding the consumption of foods and beverages. The emphasis on consuming food in the correct quantities as highlighted by preservice teachers aligns with the PIT 's goal of well-being of communities. We are required to eat the right foods in their suitable quantities, and this is corroborated by scientific evidence. Indigenous people, even without the knowledge of scientific research, were aware of this principle through acquired experience and knowledge that was passed down from generation to generation.

The insightful connections that can be drawn between indigenous and scientific knowledge reveal the richness of indigenous practices. The indigenous people's understanding of health even without the 'formal' terminologies such as 'diabetes' or 'cardiovascular diseases' mirrors an experiential and holistic approach to overall well – being. This aligns well with the PIT 's recognition of indigenous people's intuitive and experiential knowledge. Indigenous people were shaped by deep connection to nature and communion with ancestors or spirits. Indigenous people did not just eat food for the sake of surviving, but they were aware that what one consumed over a prolonged period could have either a positive or negative impact on one's overall health.

The assertion by preservice teachers was that African indigenous people explored and made observations, engaged in trial and error practices and generated evidence for what they believed was worthwhile knowledge. This aligns with the PIT 's emphasis on the intersection between

indigenous and scientific knowledge. This is also a foundation for scientific inquiry. In essence, the findings magnify the wisdom that is embedded in the preparation and consumption of indigenous foods and beverages and this aligns with the theory's call for recognising and upholding diverse knowledge systems. This integration of indigenous perspectives enriches our understanding of nutrition and health and counters the view that Western scientific knowledge is the sole arbiter of truth. This fosters a more inclusive and culturally grounded approach to science education.

5.4. Themes relating to research question two which is: 'How do preservice teachers plan to incorporate indigenous knowledge about foods and beverages in science lessons?'

5.4.1 Healthy diet

Preservice teachers demonstrate their dedication to incorporating indigenous knowledge into science lessons through careful planning and a deep understanding of the cultural and holistic aspects of health and nutrition. In the interviews, the preservice teachers further demonstrate their commitment to holistic perspectives, acknowledging the interdependence of nature, life, and health in their educational approach. Their lessons are designed to empower learners with critical thinking skills, aligning with the PIT's goal of fostering a deeper understanding of indigenous knowledge and its relevance to modern issues (Ladson-Billings, 2023). Preservice teachers make content more relatable to students by incorporating familiar foods into their lessons, in line with the recommendation for contextualized education. This method connects scientific concepts to everyday experiences and indigenous perspectives, enriching the learning process.

Furthermore, preservice teachers emphasize the value of a healthy diet in indigenous cultures, which aligns with the PIT's emphasis on incorporating cultural knowledge into educational practices. Their efforts reflect a recognition of the value of traditional wisdom in promoting holistic health, which is consistent with African indigenous traditions that value a comprehensive approach to well-being.

5.4.2 Teacher learning: Conducting research

Preservice teachers expressed the importance of integrating indigenous knowledge in the curriculum, through the interviews as well as their lesson plans. This resonates with the PIT which advocates for an approach that incorporates indigenous knowledge within pedagogical

practices. Preservice teachers' conscientious effort to personally engage in learning about African indigenous knowledge before introducing it to learners within the science lesson reflects an empowering stance. Preservice teachers' plans to tap into the wisdom of indigenous knowledge holders, especially elders, echoes the theory's emphasis on acknowledging and incorporating insights that are deeply connected to traditional practices.

5.4.3 Valuing the visual to link IK to science lessons

The use of relevant visual aids in a science lesson (as was demonstrated by preservice teachers in this study) aligns with the PIT as this fosters cultural relevance and inclusivity (Qochqorova, 2023). Visual aids also provide tangible representations of traditional practices and assist learners who are not aware of certain cultural practices to learn and adapt to new information which will make them culturally sensitive (Faradina & Ikhsan, 2023). Integrated learning is demonstrated as scientific concepts are linked with indigenous knowledge. A pedagogical approach that is culturally inclusive will also empower indigenous learners to feel that they are valued and are part and parcel of the science curricula. This in turn contributes to the PIT which advocated for cultural sensitivity, inclusivity and preservation within an educational context.

5.4.4 Teaching strategies informed by Postcolonial Indigenous Theory

Several tenets of PIT resonated with findings related to RQ2 which related to how preservice teachers plan to integrate IK pertaining to food and beverages.

Preservice teachers expressed their views about the importance of teachers and learners doing practical work within science lessons, especially practical work that encourages both the teacher and learner to be well equipped in indigenous knowledge, about food and beverages. For example, the suggestion in the interviews and lesson plans that if learners were to make steamed bread in the science lesson, given all the ingredients and the method, this would deepen their conceptual understanding as experiential learning is superior to mere theoretical rote learning without application. This not only maximises the use of the senses, but it also establishes a profound link between learners and their cultural heritage, and this is a goal expressed in PIT. The findings in chapter 4 also speak to incorporating field trips to communities to learn science. This articulates with PIT which underscores community knowledge as being worthy of pursuit.

The lesson plan pertaining to energy transformation to sustain life using steamed bread not only drew from the Curriculum and Assessment Policy Statement (CAPS) requirements, but it was also able to inculcate a pedagogical approach which promoted a hands on learning

experience which is essential in a science lesson (DBE, 2011). The preservice teachers' practical activity for learners to make steamed bread was aimed at bridging the gap between theory and practice. This enhanced learners' understanding of science concepts (Wu & Wang, 2023)

When the science curriculum is structured in such a way that it incorporates community engagement, this will assist both teachers and learners to value and appreciate their communities and elders as every aspect or dimension of our environment should be inculcated into our learning. This is in line with the PIT as it clearly demonstrates that teachers, learners and curriculum planners are not the sole repositories of legitimate knowledge but that other actors can play an important role in how knowledge is socially constructed. When a relationship of this nature is built - one that respects and values the community's wisdom and practices - then indigenous knowledge can be moved from the periphery to towards the centre. This will bring about a shift in the mindset that indigenous knowledge and its practices are primitive and obsolete.

When learners can become convinced about positive health implications associated with indigenous foods, this can assist them to share the knowledge with their family members and to incorporate healthy foods into their lifestyle. This will assist to curb lifestyle diseases such as diabetes and cardiovascular diseases which arise from a poor and uninformed diet. This is an example of how learning school science, which incorporates IK, can lead to relational accountability (Le Grange, 2016). Preservice teachers who invest in plans where learners participate in practical work to deepen their conceptual understanding about indigenous foods and beverages can empower learners to adopt healthy lifestyle choices. More importantly learners can come to appreciate indigenous wisdom of their own people, and this resonates with PIT which emphasises that indigenous knowledge is worthy of recognition.

Integrating indigenous food and beverage preparation with the study of biochemical reactions in science resonates with the PIT as it places emphasis on diverse epistemologies as well as positions learners' cultures at the nexus of educational experience. This fusion of indigenous knowledge into scientific discourse serves as a compelling challenge to the prevailing conjecture that Western knowledge should stand as the solitary benchmark. Consequently, this shift towards a more inclusive and enriching learning environment where multiple cultural perceptions are embraced is of paramount importance.

A learner centred approach within science lessons is significant because it allows learners to see and feel that they are active agents in the process of learning and that they too have something significant to contribute (Sakata et al., 2023). The PIT also advocates for an educational setting that is marked by empowering people and motivating them to be active agents and participants of their own knowledge (Potier & Givens, 2023). The theory also calls for an education that can transcend fragmented knowledge hence learners being championed to express unique perspectives validates numerous indigenous knowledge traditions or cultural views.

5.4.5. Model reflecting the link between the incorporation of indigenous knowledge and the Postcolonial Indigenous theory

The above model outlines the different aspects related to incorporating indigenous knowledge into science education, particularly with a focus on the Postcolonial Indigenous theory.

It is important to teach content within a science classroom that portrays a correlation between indigenous knowledge and scientific knowledge. The model aims to highlight specific examples as used in this study to demonstrate how indigenous foods and beverages maintained a nutritional value which is in alignment with the scientific dietary recommendations. This is

connected to the PIT as it recognises the importance of valuing indigenous knowledge as a legitimate form of knowledge that can coexist with and complement scientific understanding.

The model also outlines the pedagogical strategies for teaching indigenous knowledge, including the use of visual aids, hands-on practical work and field trips into communities that will assist teachers and learners to be involved in the community and to be exposed to multifaceted ways of learning. The use of visual aids and practical work for example aligns with the idea of engaging multiple senses and learning styles which promote a more holistic understanding of indigenous and scientific concepts. Group work and community involvement also reflect the way teamwork which is in synch with indigenous ways of constructing knowledge, where cooperation instead of competition, is valued. Recognising the input of community elders also aligns with the PIT which emphasises the importance of incorporating indigenous perspectives and involving the local community in the educational process. Recognising the wisdom that is embedded within indigenous knowledge aligns with the PIT which seeks to challenge and move beyond colonial perspectives which have marginalised indigenous viewpoints.

By incorporating the principles of indigenous knowledge as well as tenets of the PIT, preservice teachers and teachers in the field will develop a more diversified science curriculum, whereby science concepts are corroborated by indigenous knowledge. The PIT serves as the overarching framework which guides the process of emphasising and respecting indigenous knowledge.

5.5 Recommendations for preservice teachers

It is inevitable for preservice teachers to experience challenges when trying to incorporate indigenous especially when the CAPS document that is meant to guide teachers on this aspect has done very little to assist teachers in this regard. Preservice teachers also feel that they lack the necessary resources to impact positively on the learners they will teach in indigenous knowledge. Some also believe that even their high school and university education did not prepare them sufficiently to engage with IK. Policies within the education sector are constantly changing and teachers are expected to learn the art of adapting to these changes (Mudaly & Ismail, 2013). The Curriculum and Assessment Policy Statement (CAPS) expects science teachers to embrace diversity and to infuse indigenous knowledge within science lessons. A scientific and culturally inclusive curriculum can be implemented if teachers are well trained. Many science teachers are ignorant about indigenous knowledge systems and they do not know

where to begin when faced with the expectation to implement a curriculum that is embedded in indigenous knowledge (O'Leary et al., 2020). This is an indication that the need to adjust and bring about tremendous and useful changes within a curriculum can be extremely challenging. But it is not impossible (Mudaly & Ismail, 2013).

The following recommendations have been made based on the findings in this study. The recommendations are aimed at institutions that train educators, university lecturers or educators as well as curriculum designers. These recommendations will also be useful for further studies in incorporating indigenous knowledge within science education.

5.5.1 For Teacher Training Institutions

The modules which are selected for teacher trainees should integrate knowledge from indigenous systems. This will promote indigenous knowledge and better equip teachers who are going to specialise in teaching science subjects upon the completion of their training. There should also be an inclusion of different cultures as well as their practices in all Natural Sciences and Life Sciences modules. This will enable teachers in training to develop cultural sensitivity and this will assist them in the field when they teach learners who are culturally diverse. The method (pedagogy) modules which are offered in Natural Sciences and Life Sciences should integrate practical work which will encourage teachers in training to be hands on when it comes to science practicals. This pedagogic approach is important because it resonates with indigenous ways of working. In other words, indigenous knowledge is centred around investigations, observations and trial and error just as it is the case in school science. In these method modules, teachers in training should also be given the opportunity to teach about indigenous foods instead of foods from elsewhere (global North). This will teach them to deepen their understanding about diversity and they too can pass on this knowledge to their learners in science classrooms. Teacher training institutions can also invest in conferences and workshops that focus on broadening the conceptual understanding of indigenous knowledge systems. *Sangomas*, priests, pastors, sheiks and traditional elders can also be brought into such generating to enlighten young people, particularly preservice teachers in training, about foods in different cultures. This will allow for links to be made between science concepts and indigenous foods and beverages.

5.5.2 Higher education teachers as role models

There is an expectation on lecturers to be culturally responsive. Cognisance of the multicultural learner population is an important consideration in higher education. Knowledge about

learners' (in this case, preservice teachers') backgrounds will allow lecturers to create culturally inclusive teaching approaches. When preservice teachers can see or can be convinced that their lecturers are culturally responsive, they are likely to emulate this when they get into the field. Various teaching styles and strategies must be incorporated to become culturally inclusive. If teachers in training can see their lecturers engage critically and design their activities and assessments creatively, it is likely that they will be inspired to carry out the same calibre of work when they get into the field.

5.5.3 Recommendations for Curriculum Designers

School and university curriculum designers need to design the curriculum in such a way that preservice teachers and teachers who are already in the field are adequately guided to make their teaching culturally inclusive. Clear aims and objectives should be stipulated in simple language to ensure that all those who depend on the curriculum for guidance do not feel ostracised. Curriculum designers also need to design Natural Sciences and Life Sciences policy documents with a clear step by step guideline on how teachers should implement a culturally inclusive curriculum. Indigenous knowledge concepts should not be included in science textbooks in a tokenistic manner. Textbooks should clearly illustrate the link between indigenous knowledge and science concepts. This will assist teachers to better facilitate the construction of this crucial knowledge in science classrooms. This will also create conceptual bridges between indigenous knowledge and school science and render school science more meaningful. Curriculum planners can also design study guides for teachers as well as learners where indigenous knowledge is incorporated with science concepts. These study guides should use scientific content examples and clearly illustrate how all specific aims stipulated within the CAPS document can be achieved. This will assist preservice teachers and teachers who are already in the field to have a clear starting point when working towards culturally inclusive science.

5.6 Recommendations for Further Studies

There is a scarcity of literature on how preservice teachers can incorporate indigenous knowledge within science lessons. This study contributes to the discourse of incorporating African indigenous knowledge about food and beverages within science lessons to deepen scientific conceptual understanding and promote understanding of everyday cultural practices. Studies which specifically explore how preservice teachers can incorporate indigenous knowledge within science lesson are of paramount importance. Further studies on aspects such

as the incorporation of indigenous knowledge with science concepts especially regarding foods and beverages should be undertaken, from learners' and broader communities' perspectives.

5.7 Limitations

The study was conducted at one teacher training institution. Therefore, the findings of this study cannot be generalised to apply to other teacher training institutions. It was also conducted in the Natural Sciences (Senior Phase) area. This study privileged only preservice teachers' views and excluded other stakeholders in the teaching and learning process. Research at other teacher training institutions, and research which focusses on different phases (Foundation, Intermediate and Further Education and Training phases) is recommended.

5.8 Conclusion

This chapter has unveiled a qualitative exploration of preservice teachers' perspectives in infusing indigenous knowledge within the science curriculum using the lens of the Postcolonial Indigenous theory (PIT). The study not only uncovered the profound insights into indigenous wisdom on foods and beverages but there was also an outline of preservice teachers' strategies for integrating this knowledge in science lessons. Themes such as the regulation of blood sugar levels and energy transformation through indigenous foods and beverages reflect an interconnectedness of indigenous and scientific knowledge. This challenges the prevalent Eurocentric dominance in the curriculum, by advocating for a more diversified curriculum which dismantles colonial legacies. Preservice teachers illustrated an alignment with tenets of the PIT which showcased a commitment to decolonising education, cultural relevance, and community engagement. The study illustrates a promotion of sustainability through a resilient education curriculum that incorporates the recognition, celebration, and preservation of indigenous wisdom. While the study is insightful, it also acknowledges limitations and suggest ways in which a culturally inclusive curriculum can be realised. A transformative shift in education which will empower both teachers and learners to appreciate diverse cultures and learn from them needs to be embraced.

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APPENDICES

1. Ethical Clearance Certificate
2. Recent Intention to Submit Form
3. Signed Declaration
4. Turnitin Certificate/Report
5. Letter to preservice teachers (informed consent)
6. Semi Structured Interview Transcript
7. Document analysis table

APPENDIX 1: ETHICAL CLEARANCE CERTIFICATE

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

09 June 2023

Catherine Winfred Nakkazi Muyonjo (215000387)
School Of Education
Edgewood Campus

Dear CWN Muyonjo,

Protocol reference number: HSSREC/00004630/2022
Project title: Exploring inclusion of Indigenous Knowledge about African foods and beverages within Science classrooms
Amended title: Exploring how preservice teachers include indigenous knowledge about African foods and beverages in science lessons.
Degree: Masters

Approval Notification – Amendment Application

This letter serves to notify you that your application and request for an amendment received on 08 June 2023 has now been approved as follows:

- Change in title
- Change in research site

Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form; Title of the Project, Location of the Study must be reviewed and approved through an amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

HSSREC is registered with the South African National Health Research Ethics Council (REC-040414-040).

Best wishes for the successful completion of your research protocol.

Yours faithfully

[redacted]

.....
Professor Dipane Hlalele (Chair)

/dd

Humanities & Social Sciences Research Ethics Committee
UKZN Research Ethics Office Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Tel: +27 31 260 8350 / 4557 / 3587
Website: http://research.ukzn.ac.za/Research-Ethics/
Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

APPENDIX 2: RECENT INTENTION TO SUBMIT FORM

COLLEGE OF HUMANITIES

POSTGRADUATE AND RESEARCH OFFICE

(*THIS FORM IS TO BE COMPLETED THREE MONTHS BEFORE SUBMISSION OF MASTERS DISSERTATION, AND 6 MONTHS BEFORE SUBMISSION OF PHD THESIS, AND HANDED IN AT COLLEGE POSTGRADUATE OFFICE)*

CONFIRMATION OF INTENTION TO SUBMIT THESIS/DISSERTATION

NAME OF STUDENT: CATHERINE W.N MUYONJO **.....**

STUDENT NUMBER: 215000387.....

DEGREE: MASTERS IN SCIENCE EDUCATION.....

SCHOOL: EDUCATION **.....**

NAME OF SUPERVISOR: PROFESSOR RONICKA MUDALY.....

NAME OF CO-SUPERVISOR:

……

TITLE OF THESIS/DISSERTATION: Exploring how preservice teachers include indigenous knowledge about African foods and beverages in science lessons.....

DATE OF INTENTION TO SUBMIT: 01 DECEMBER 2023 .....

POSTAL ADDRESS: N/A.....

TELEPHONE NUMBER: N/A.....

CELLPHONE 0710921038.....

E-MAIL ADDRESS: 215000387@stu.ukzn.ac.za/ catherine25david@gmail.com .....

CANDIDATE'S

SIGNATURE:…… …… 

……..DATE……29/09/2023……..

SUPERVISOR'S

SIGNATURE:…… DATE:…….

CO-SUPERVISOR'S

SIGNATURE:……..DATE:……

…….

APPENDIX 3: TURNITIN CERTIFICATE/REPORT

Masters in science dissertation

by Catherine Muyonjo

Submission date: 22-Dec-2023 04:31AM (UTC+0200)
Submission ID: 2263920902
File name: For_Turnitin.docx (2.75M)
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Masters in science dissertation

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APPENDIX 4: LETTER TO PRESERVICE TEAHERS (INFORMED CONSENT)

University of KwaZulu-Natal

Edgewood Campus

Pinetown

South Africa

Informed Consent Document

Dear Prospective Participant

My name is **Catherine W.N Muyonjo.** I am a master's in education student studying at the University of KwaZulu-Natal, Edgewood Campus, student number **215000387.** The title of my research is "**Exploring how preservice teachers include indigenous knowledge about African foods and beverages in science lessons'."**

The study aims to explore preservice teachers' perspectives on indigenous knowledge and how these can be incorporated within the science lessons. I wish to conduct semi-structured interviews with you to know your experiences during teaching practice and views about teaching indigenous knowledge and Western knowledge within the science classroom.

I also request that you develop lesson plans which demonstrate how you would teach about indigenous African foods and beverages and deepen conceptual understanding in science. The benefit of this study in the long term is that it can increase teacher awareness about culturally inclusive science, and make science more relevant to learners' lives. It can also create a valuing of African Indigenous Knowledge among learners.

I formally seek your written consent to participate in this study where you will be interviewed through semi-structured interviews and be required to design lesson plans.

Please note that:

- Your confidentiality is guaranteed as your inputs will not be attributed to you in person but reported only as a population member opinion.
- Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.
- You have a choice to participate or not participate in this research and you will not be penalised for taking such an action.
- You are at liberty to withdraw from this research should feel too much pressure and you will not be penalised for that.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.
- The interview will be audiotaped for accurate transcribing. No pictures or videos will be taken during this activity.
- After the research has been completed, a report of the findings will be provided to you.
- Data will be stored in secure storage and destroyed after 5 years.

Thank you in advance for considering my request and your contribution to this study.

Please feel free to contact me or my supervisor should you have questions or need clarity on any aspect of my research. I can be contacted at the School of Education, University of KwaZulu-Natal, Edgewood Campus, Pinetown. Email: 215000387@stu.ukzn.ac.za Cell number: [redacted]

My supervisor is **Professor Ronicka Mudaly** who is located at the School of Education, Edgewood Campus of the University of KwaZulu-Natal. Contact details: Mudalyr@ukzn.ac.za Phone number: [redacted]

The Research Office may also be contacted at HSSREC@ukzn.ac.za

If you agree to participate, please sign the declaration form attached to this statement.

Thank you for your contribution to this research.

Kind regards

Catherine W.N Muyonjo

[redacted]

DECLARATION

I…… *(full names of participant*) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participate in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire. I understand the intention of the research. I hereby agree to participate.

I consent/do not consent to have this interview recorded

I consent/do not consent to have my lesson plans admitted as part of a data set

SIGNATURE OF PARTICIPANT:

_____ DATE:_____

APPENDIX 5: RESEARCH INSTRUMENTS

Research instruments

Introduction

Thank you for taking the time to assist me in my research.

Before we start, I want to review some points:

- There are no right or wrong answers to any of these questions.
- I will audio record the session because I don't want to miss any of your comments.
- My role in this session is to be a moderator just to guide the discussion, so please feel free to speak.
- Your name, identity and anything you say will be kept confidential.

Your views will be reported as a population group member opinion, and not attributed to you.

Are the any questions before we start the session?

Semi-structured interview questions:

1 What is your understanding of indigenous knowledge?

2 Do you see a link between indigenous knowledge and science? Justify your answer.

3 Why is it relevant to teach learners about indigenous knowledge within the Natural Science classroom?

4

4.1.1 Details of which foods and beverages are included in the Natural Science textbooks?

4.1.2 How many of these foods/beverages are African foods and beverages?

4.1.3 What does this communicate to you as a Natural Science preservice teacher, in terms of what curriculum planners choose to cover and how much is covered in science textbooks?

5 Would you consider African indigenous knowledge holders as scientists in their own right? Justify your answer.

6 Is there any wisdom embedded within African indigenous knowledge, especially when it comes to the preparation of food and beverages? Justify your answer.

7 How do you as a preservice science teacher intend to incorporate indigenous knowledge pertaining to foods and beverages within a science lesson, with a view to deepening conceptual understanding of science?

8 Does the CAPS document in your view, give sufficient coverage to African indigenous knowledge as well as African foods and beverages? Why do you think this is the case?

9 In your experience, do learners relate more to African indigenous knowledge or Western knowledge? Why do you think this is the case?

APPENDIX 6: DOCUMENT ANALYSIS

Document analysis guideline:

- Are preservice teachers' lesson plans done according to the CAPS guidelines? If so which knowledge stream and topic are selected?
- Which foods are emphasised/included?
- How do preservice teachers progress from food in indigenous context to science concept?
- Did preservice teachers use or refer to textbooks that are CAPS compliant as well as additional sources? If so, what are these?
- Do preservice teachers consider learners' prior knowledge within their lesson plans? Elaboration Do lesson plans illustrate a learner or teacher-centred approach? Elaboration.
- Are any teaching strategies drawn from African ways of teaching? If so what are these?
- What other resources do preservice teachers plan to use to enhance the teaching of science using indigenous knowledge?

APPENDIX 7 PRESERVICE TEACHER LESSON PLANS

LESSON PLAN 1

WHAT MADE THESE BERRIES SO SPECIAL?

The sweet taste which these berries gave were not because they have a high-sugar content, but the sweet taste was actually because of a protein found inside of the berries. Brazzein is the protein that is produced by these berries. For many years, the local people used these berries as a low-caloric sweetener in their foods and snacks.

In 1994, THE University of Wisconsin, in the US, decided to do some research on these berries. They found that this protein had some very interesting properties :

- These berries have been found to have a more stronger taste than sugar, "almost 2000 times sweeter than sucrose"
- The taste lasted much longer than sugar.
- It did not leave behind any after tastes.
- It can be used over a wide pH range.
- It was thermo-stable, meaning that the taste did not disappear after it had been exposed to high temperatures.
- It was low in calories.

They discovered that introducing this protein to the food industry would be huge, and that there was loads of profits to make. That when the researchers at the University decided to patent the genes coding for the protein.

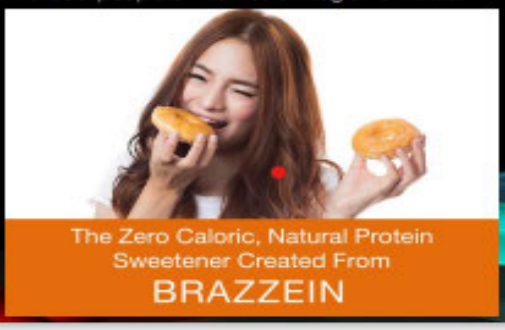
BIOPIRACY OF BRAZZEIN

The researchers then decided that they did not want to produce and extract the protein using the plants, but wanted to genetically modify other plants and micro-organisms so that they may start to produce this protein. They had eventually been able to modify corn into producing this protein.

In 1998 they then sold rights to a small time company in Texas, Nektar Worldwide, to use this protein.

However, in the US, brazzein is still to date, not approved for public consumption.

There was no benefit-sharing with the local people of the western region of Africa.



HOW WILL WE INTEGRATE IKS INTO OUR LESSON???

INTEGRATION

We have decided to pair this knowledge with the topic of animal nutrition and Homeostatic control for Grade 11 learners.

This this topic, learners will learner about how the body maintains optimal blood-glucose levels and what happens when this maintenance fails- Diabetes mellitus. Treatment of both types of diabetes are also discussed.

3 weeks (12 hours)	Animal Nutrition (Mammals)	• The differences in dentition for herbivorous, carnivorous and omnivorous lifestyles in terms of nutritional requirements and energy relationships (link with ecology - food chains). • **Human nutrition** The macro-structure of the alimentary canal and associated organs and the functions of the different parts. • The Processes of ingestion, digestion, absorption, assimilation and egestion and the significance of each: – **Mechanical or physical digestion:** types and functions of different kinds of teeth; processes of chewing. Peristalsis – **Chemical digestion: Enzymes:** functions of carbohydrases, proteases and lipases; where produced; substrate, pH and end-products (Specific enzymes need not be named - link to enzyme activity.) – **Absorption:** small intestine as a region of most absorption of digested food; adaptations to increase surface area. Structure (to tissue level) and significance of villi. Importance of hepatic portal system in the transport of absorbed food to the liver and then through hepatic vein to the rest of the body – **Assimilation:** incorporation of glucose and amino acids into cells, the role of the liver: glucose metabolism, deamination of excess amino acids, and the breakdown of alcohol, drugs and hormones. • **Homeostatic Control** Hormonal control of blood sugar levels.Increase in the number of people affected by diabetes in recent years and brief explanation of diabetes.

HOW WILL THE LESSON PROGRESS?

Introduction:

Learners will be asked questions about their knowledge of diabetes and how the process of negative takes place.

Development :

Learners will be introduced to the process of negative feedback mechanisms, how the pancreas maintains the optimal blood-glucose levels, and how can diabetes develop. Also treatment of diabetes mellitus will be discussed.

Conclusion:

Discussion on how the negative feedback mechanism work in relation to the pancreas maintaining optimal blood-glucose levels.

Assessment:

Activity based on topics learnt during the lesson .

INTRODUCTION:

The introduction is inquiry-based discussions, where learners prior knowledge and experiences is being called on. The aim of this introduction is to aid learners in recalling relevant information about the topic to be discussed.

Learners will be asked the following questions:

- Do you have any family members at home who have diabetes?
- What are they currently doing to treat their medical issue?
- What must we not consume if we had diabetes?

Expected responses are :

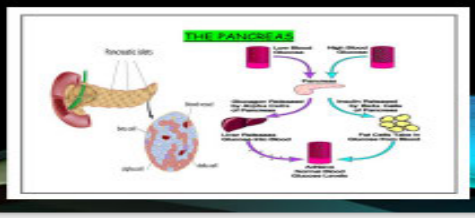
- Yes, we do have members of our family who has this condition; they take medicine in order to treat themselves/ they are injected with insulin everyday/ they follow a strict diet; we must not consume large amounts of sugar if we suffer from diabetes.

Thereafter, the topic of Homeostasis will be introduced:

Homeostasis is the ability of organisms to maintain optimal internal conditions in order for the body to function properly. There are many conditions which must be maintained such as internal temperature, blood-glucose levels, blood-thyroxin levels, etc. When we work with the topic of animal nutrient we will focus on the blood-glucose levels.

DEVELOPMENT:

The development contains several different resources, such as charts, diagrams, case study. The development builds on the topic of homeostasis and how the alpha and beta cells of the Langerhans of the pancreas maintain optimal blood-glucose levels.

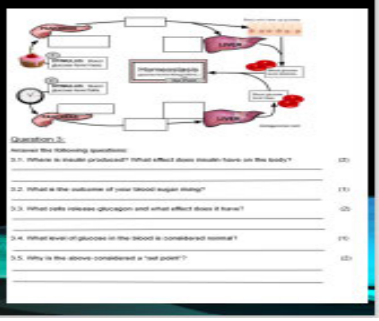


DEVELOPMENT:

The second part of the development talks to the types of diabetes mellitus and how to treat this condition. This is where we can bring in our Indigenous knowledge, to show learners an example of a natural sweetener. We used a case study to introduce this knowledge.

CONCLUSION AND ASSESSMENT:

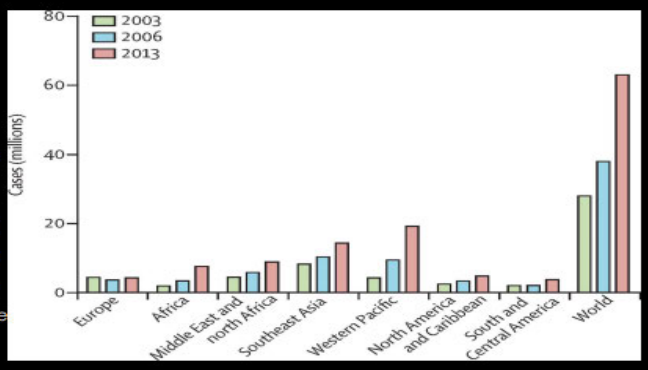
The conclusion and assessment include revising what has been learnt in the lesson. This is done through a whole class discussion and also a classwork activity.



REASONS TO PAIR THIS KNOWLEDGE WITH THIS GRADE AND TOPIC

One of the biggest reasons to which why we decided to introduce this knowledge with this grade and topic is to allow grade 11 learners to realise an issue in our communities and to find solutions to these problems.

It is no secret that the number of people who suffer from diabetes mellitus in our communities is on a rise. The number of young children and teenagers especially who now have diabetes is shocking, and the one cause is an unhealthy lifestyle. The point of introducing this knowledge is to show learners that there are many ways which one can live a healthier lifestyle. There are many natural sweeteners which many people do not know about. It gives these students a chance to not only learn about the issue, but realise solutions. Also we wish to show learners that there is so much of valuable knowledge to be gained from our Indigenous knowledge system.

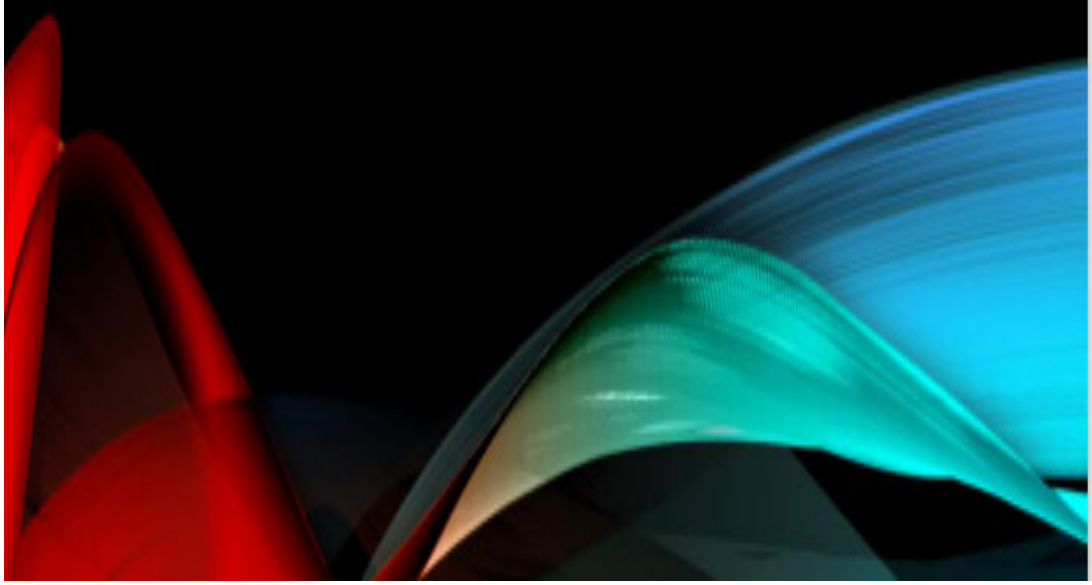


REFERENCES:

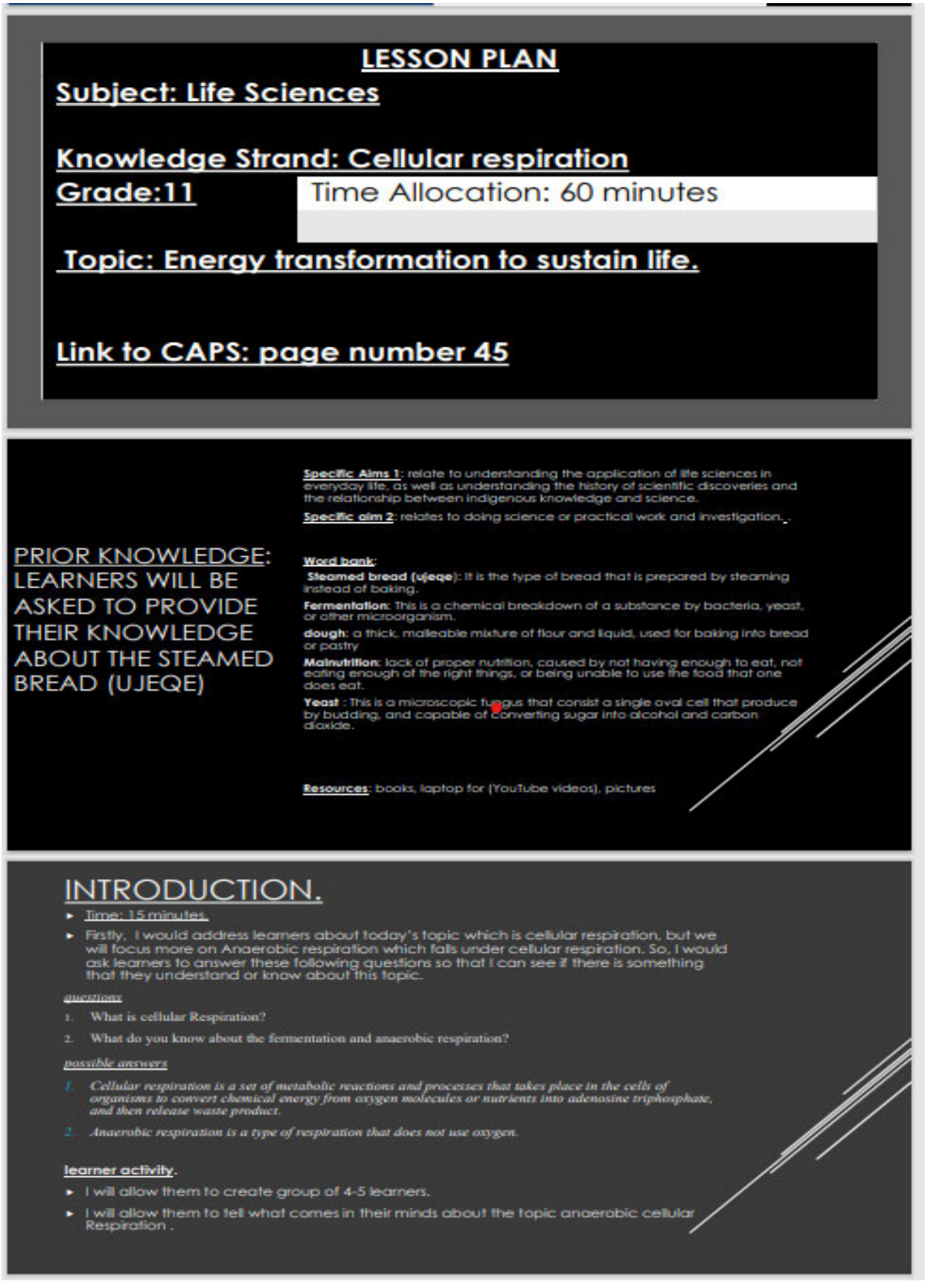
https://www.google.com/search?q=pentadiplandra+brazzeana&source=lnms&tbm=isch&sa=X&ved=2ahUKEwiwl-mucH3AhUUgFwKHWRoDngQ_AUoAXoECAIQAw&biw=1536&bih=754&dpr=1.25#imgrc=rMvBTqrxeTi_TM

https://www.google.com/search?q=brazzein+protein&tbm=isch&ved=2ahUKEwiYzMaoucH3AhXV3oUKHWydCdQQ2-cCegQIABAA&oq=brazzein+protein&gs_lcp=CgNpbWcQAzIFCAAQgAQyBQgAEIAEMgUIABCABDIECAAQGDIECAAQGDIECAAQGDIECAAQGDIECAAQGDIECAAQGDIECAAQGDoICAAQgAQQsQM6CAgAELEDEIMBOgsIABCABBCxAxCDAToECAAQAzoECAAQHjoGCAAQCBAeUL0KWIINYLIQaAJwAHgEgAHfBIgBnEaSAQoyLTUuMTIuNC4zmAEAoAEBqgELZ3dzLXdpei1pbWewAQDAAQE&sclient=img&ei=MiNwYpjrH9W9lwTsuqagDQ&bih=754&biw=1536#imgrc=Vyf1gnr_DbXU7M

https://www.google.com/search?q=Stats+on+young+teens+and+diabetes&tbm=isch&ved=2ahUKEwjAl5aOusH3AhUL1-AKHXhWDjQQ2-cCegQIABAA&oq=Stats+on+young+teens+and+diabetes&gs_lcp=CgNpbWcQAzoECAAQQzoFCAAQgAQ6BAgAEBg6CAgAELEDEIMBOggIABCABBCxAzoECAAQAzoLCAAQgAQQsQMQgwE6BggAEAoQGFD2B1jVmgFgqaABaAFwAHgEgAHnBYgBx2ySAQ0yLTEyLjE5LjcuMS4xmAEAoAEBqgELZ3dzLXdpei1pbWewAQDAAQE&sclient=img&ei=ByRwYoD4Jougwf4fLmgAw&bih=754&biw=1536#imgrc=ZX-VuPNyZzRlgM



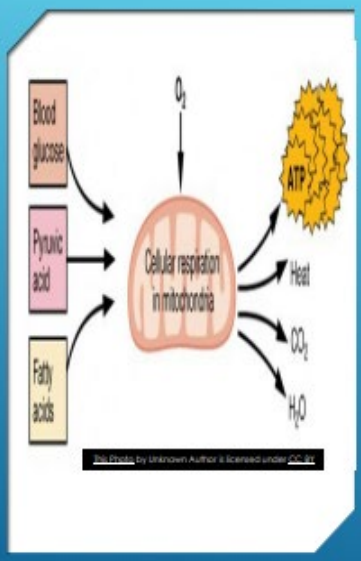
LESSON PLAN 2



FERMENTATION.

- Learners need to understand the process of fermentation. They also need to have a clear understanding on how fermentation works, because the process of making steam bread is all about fermenting certain ingredients including yeast.
- For example: The video below shows the fermentation of yeast and sugar in the process of raising the dough.

https://www.youtube.com/watch?v=FZGhLil5364



DEVELOPMENT
TIME:35 MINUTES

- **Cellular respiration**
- **Step 1**
- Cellular respiration is a set of metabolic reactions and processes that takes place in the cells of organisms to convert chemical energy. Under cellular respiration we have a process called anaerobic respiration which is defined as the production of lactic acid in muscle during exercise, the role of anaerobic respiration in the industry: is beer brewing and bread making. For example, taking the steam bread which is the traditional Zulu bread prepared by steaming the raised dough with boiling water.

STEP 2
MAKING THE STEAM BREAD FROM FERMANTATION.

Fermentation is the metabolic process in which an organism converts a carbohydrate, such as starch or sugar, into an alcohol or an acid as it happens when preparing the steam bread (Ujeqe). Ujeqe is a steamed Zulu bread that is prepared by using Flour, yeast, sugar, lukewarm water, a pitch of salt and boiling water for steaming. This bread is prepared by mixing all the ingredients and placing the dough on the sun or heat to raise. The yeast combines with the sugar found in the dough and produce carbon dioxide and alcohol in the process of fermentation. Once the ingredients has been mixed thoroughly to produce the dough, That dough is exposed to the sun or any warm place for the process of fermentation to take place perfectly.

STEP 3.
THE CONSUMPTION OF STEAMED BREAD.

The steamed bread is regarded as a good choice for our bodies. This is because it does not have to much fats or sugar. The steamed bread can be more suitable for people suffering from malnutrition.

Conclusion: Time: 10 minutes.

Pedagogy/Teaching methods

Include Teacher activity and Learner Activity

I will close the lesson by asking the learners question and allow them to share their point of views, and if is there anyone who want to add or who need more clarity.

ASSESSMENT :

	Formative	summative
Self	Peer	Teacher

Assessment :

1. What is the purpose of the steam bread?

2. Do you think it is healthy to eat this type of bread? Explain.

3. Provide two advantages of the steam bread.

CONTENT FOR ASSESSMENT:

CONTENT FOR LESSON (include questions /worksheets and other relevant content here):

Expanded opportunities/extension ideas: This will give the learners an opportunity to share their ideas and show that they were focusing during the lesson since it is their time to state their opinions.

PRACTICAL INVESTIGATION.

Learners get more clear understanding on practical work. Since we are talking about fermentation, Learners will be required to make a steam bread dough. Learners will not prepare a complete steam bread but just a dough will be prepared.

The aim of this practical:

The main reason is to make learners understand fermentation a little bit more because they will prepare the dough and expose it on the sun to raise it and once it has risen, they will poke it and experience the process of releasing Carbon dioxide and Alcohol (smell).

material:

- 6 cups(1.42 litres) of cake flour
- 2 teaspoons of salt
- ½ cup(115g) of sugar
- 4 teaspoons of margarine
- 20 g instant yeast (2 packets) for fast rising.
- 750 ml Lukewarm water.

METHOD:

- First, mix the dry ingredients separately. Mix the flour, salt, sugar, and yeast together.
- Add the margarine and squash it with the fingertips to combine perfectly.
- Add Lukewarm water in the mixture and mix.
- Knead the dough for about 10 minutes until it is smooth and not too stiff.
- Cover the dough perfectly.
- Leave it on a warm place 30 minutes for it to rise to a double volume.

Questions:

- What does the instant yeast do in the whole process?
- Why is it necessary to expose the on a warm place or sun?
- What are the two important ingredients required in the process of Fermentation?

LESSON PLAN 3

Grade 11: Life Science

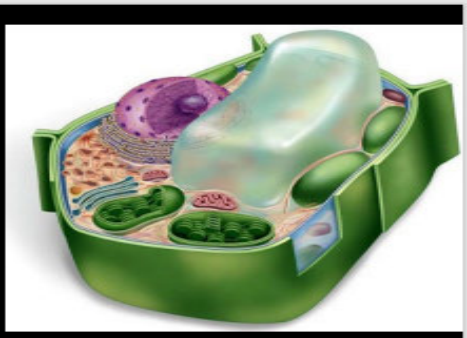
Topic: Energy Transformations to Sustain Life

Content: CELLULAR RESPIRATION

Specific Aim 1:
Knowing Life Sciences

Specific aim 3:
Appreciating and understanding history, importance and application of life sciences in society.

Life Sciences Grade 10-12 CAPS page 36



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AGENDA

- Indigenous Knowledge System: Traditional Beer Making
- Cellular Respiration
- Aerobic Cellular Respiration
- Anaerobic Cellular Respiration

INTRODUCTION (10-12 Mins)

Traditional beer making (umqombothi)

The origin of umqombothi

- Purpose of making umqombothi
- Ingredients and procedure

28/04/2022 3

History of umqombothi

- In ancient times before the introduction of modern technology and science, for weddings, celebrations, and ancestral rituals the traditional beer (umqombothi) was brewed to show gratitude to the ancestors. They used maize and that they cultivated at that time to make malt. They also used maize to make maize meal. These were main three ingredients required to make traditional beer. This is a traditional knowledge hence it was passed on to the next generations repeatedly until today. Even today we still brew the traditional beer for celebrations, rituals even funerals. However, the making of the traditional beer varies according to the different cultures and beliefs, as well as the variety in type of plants that were available in different places.

3 main ingredients of making traditional beer

Maize meal

Maize malt

Wheat Malt

DEVELOPMENT (30-35 min)

CELLULAR RESPIRATION

- WHAT IS CELLULAR RESPIRATION?
- What do you think is involved during cellular respiration?

❖Cellular respiration is a set of metabolic reactions and processes that take place in the cells of organisms to convert chemical energy from oxygen molecules or nutrients into adenosine triphosphate (ATP), and then release waste products.

- CELLULAR RESPIRATION IS DIVIDED INTO TWO PARTS:

1. AEROBIC RESPIRATION

➢TAKES PLACE IN THE PRESENCE OF OXYGEN (O_2)

2. ANAEROBIC RESPIRATION

➢TAKES PLACE IN THE ABSENCE OF OXYGEN (O_2)

- AEROBIC RESPIRATION

- Takes place in the presence of oxygen, in the mitochondria.
- Glucose is broken down to release energy-rich hydrogen atoms.
- The hydrogen atoms (from the glucose molecule) contain energy used to form the energy rich ATP
- ATP is the basic energy carrier in all living organisms.
- The hydrogen molecules later combine with oxygen to form waste products.

Aerobic Respiration Simplified Balanced Chemical Equation

$$C_6H_{12}O_6 + 6O_2 \xrightarrow{\text{Cellular respiration}} 6CO_2 + 6H_2O + ATP$$

Short video clip explaining aerobic respiration

- https://www.youtube.com/watch?v=ZkqEno1r2jk

- What do you think will happen if your cells stop respiring?

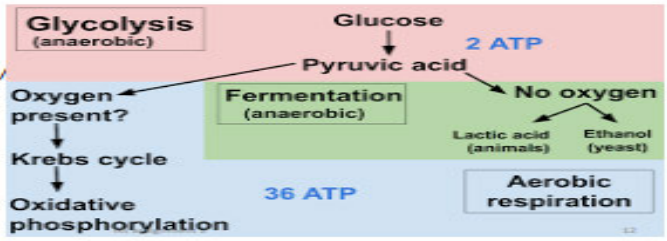
Importance of Aerobic Cellular Respiration

- Provides energy to fuel all cellular processes

Aerobic respiration is divided into 3 stages namely:

1. Glycolysis
2. Kreb's Cycle
3. Oxidative Phosphorylation

https://study.com/academy/lesson/aerobic-cellular-respiration-stages-equation-products.html



ANAEROBIC RESPIRATION

- Anaerobic respiration takes place in the absence of oxygen l in the cytoplasm of all living organisms. Anaerobic respiration occurs in 2 ways: primitive fermentation(in plants) as well as lactic acid fermentation (occurs in animals).

- In humans, anaerobic respiration occurs in your body muscles during strenuous activities when there is energy insufficiency. During strenuous activities, the energy supplied to the cells of the muscles become used up and then the cells start breaking down of glucose through anaerobic respiration thus producing lactic acid. The building up of lactic acid leads to muscle fatigue which is the reason why the muscles get stiff after exercising. After exercising, the body muscles break down lactic acid. This requires excess oxygen called oxygen debt.

- When anaerobic respiration occur in animal cells, it is called lactic acid fermentation.
- When anaerobic cellular respiration takes place in plant cells, it is called alcoholic fermentation

- Alcoholic fermentation chemical equation

$$C_6H_{12}O \qquad 2C_2H_2OH + 2CO_2 + 2ATP$$

- Lactic acid fermentation chemical equation

$$C_6H_{12}O \qquad 2C_3H_6O_3 + 2\ ATP$$

ACTIVITY:
Tabulate the differences between aerobic and anaerobic cellular respiration

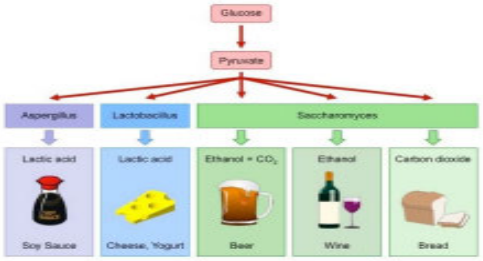
AEROBIC CELLULAR RESPIRATION	ANAEROBIC CELLULAR RESPIRATION
1. Requires oxygen and glucose	Requires glucose only
Produces carbon dioxide + water	Produces alcohol, carbon dioxide or lactic acid
3. 38ATP produced	2 ATP produced

Industrial Uses of Anaerobic respiration

- most food is produced through anaerobic respiration of micro-organisms during biotechnology. During the fermentation of beers, including traditional beers the yeast cells are used.
- Yeast is also used in the production of bread.

OPEN DISCUSSION

Do you think cellular respiration plays a role in the economic growth of our country? Explain



LEARNER ASSESSMENT

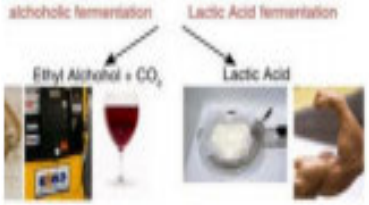
For evaluation, learners will be given the following class activity.

1. There are more mitochondria in the muscle cells compared any other cells in the body. Explain why (3)
2. What are the products of fermentation? (2)
3. How is fermentation important in the economy? (4)
4. Why is cellular respiration important? (3)
5. Briefly explain the three stages of the anaerobic respiration. (9)

Homework

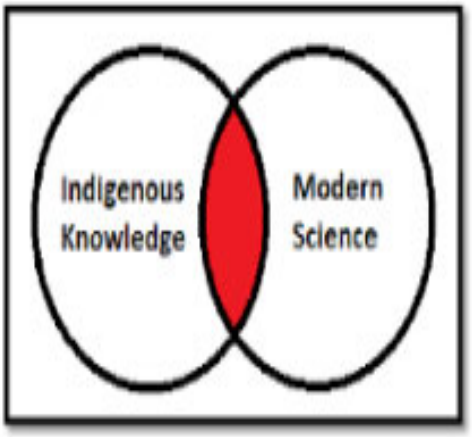
Respiration equation: _____ + _____ → _____ + _____ + _

Aerobic respiration needs _____ to oc
respiration equation: _____ + _____ → _____ + _____. Anaerobic respiration occurs wher is needed.Lactic fermentation equation: _____ → _____ + _____. Alcoholic fermentation equation: _ → _____ + _____ + _____.



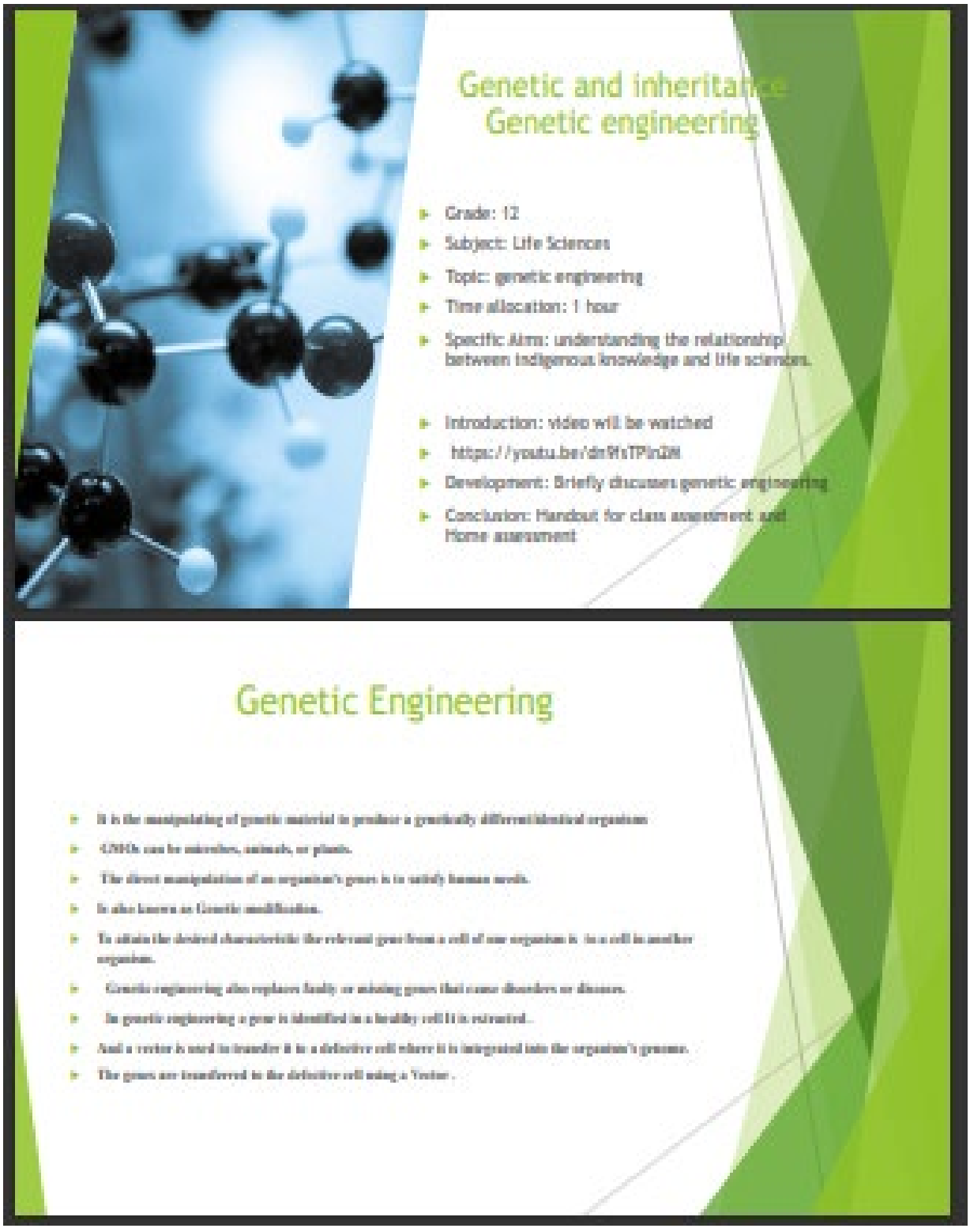
2.Write instructions on how to make bread. Include the ingredients. Your instructions must be logic.

CONCLUSION

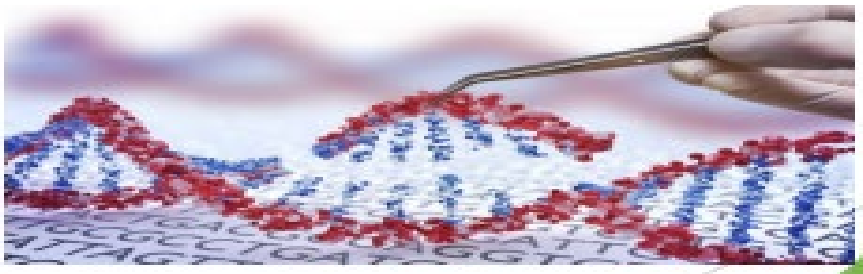


- - What fermentation do you think umqombothi is a result of ?
- Link between the lesson introduction and development.

LESSON PLAN 4



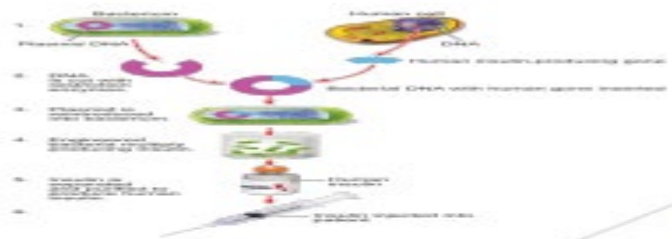
GENETIC ENGINEERING



Genetic engineering

- A vector is a virus or bacteria used to transfer an isolated gene into a defective cell.
- Recombinant DNA is the new DNA that is formed using genetic engineering.
- We look at the uses Of Genetically Modified Organisms (GMOs) in Medicine.
- Certain bacteria and plants can be genetically modified to produce antigens of certain viruses.
- These antigens are then used to trigger an immune response in the body.
- The body will recognise the antigens as foreign and produce antibodies in response.
- The antibodies provide immunity from infection by that particular virus.

GENETIC ENGINEERING



GENETIC ENGINEERING

GENETICALLY MODIFIED ORGANISMS (GMOs)

- ADVANTAGE
- Large better yields and stronger crops.
- Cheaper for farmers to produce modified crops that are resistant to pests or insects.
- GMO's can survive unfavourable conditions (drought).
- Can use them to produce medicines.
- Longer shelf life.
- DISADVANTAGE
- It is an expensive process.
- Have potential health for humans.
- Unsure life term effect.
- Decrease biodiversity.

GENETIC ENGINEERING

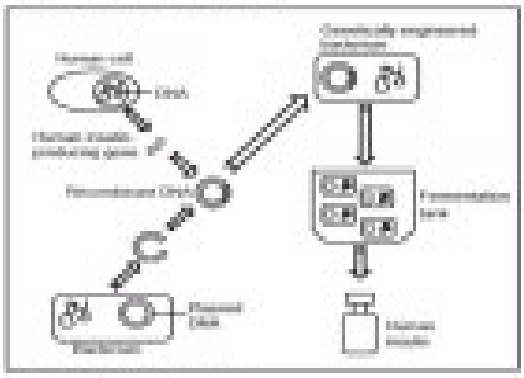
TRADITIONAL CORN BREAD (MIELIEBROOD)

GENETIC ENGINEERING

Importance of genetic engineering and GMOs

- Synthesis of medicinal drugs
- Production of crops such as corn
- Cloning
- Stem Research

CONCLUSION: Class assessment



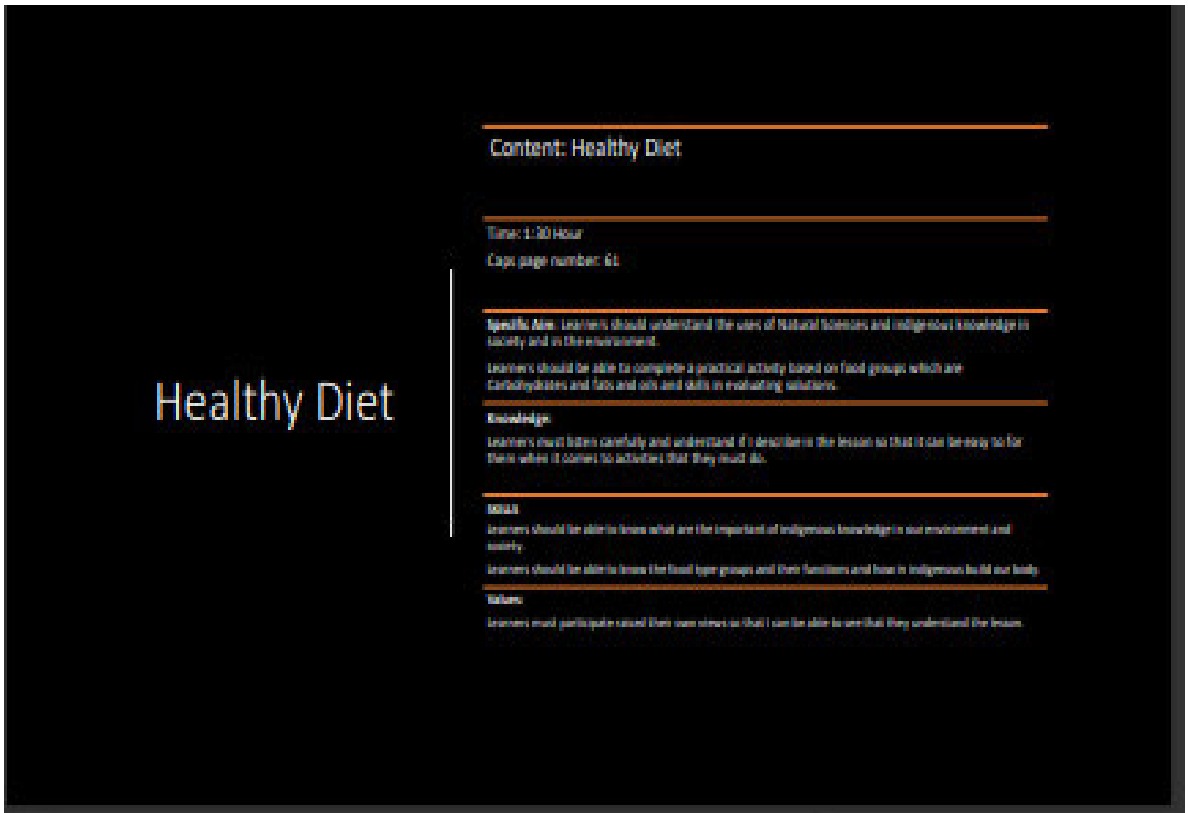
HOME ASSESSMENT

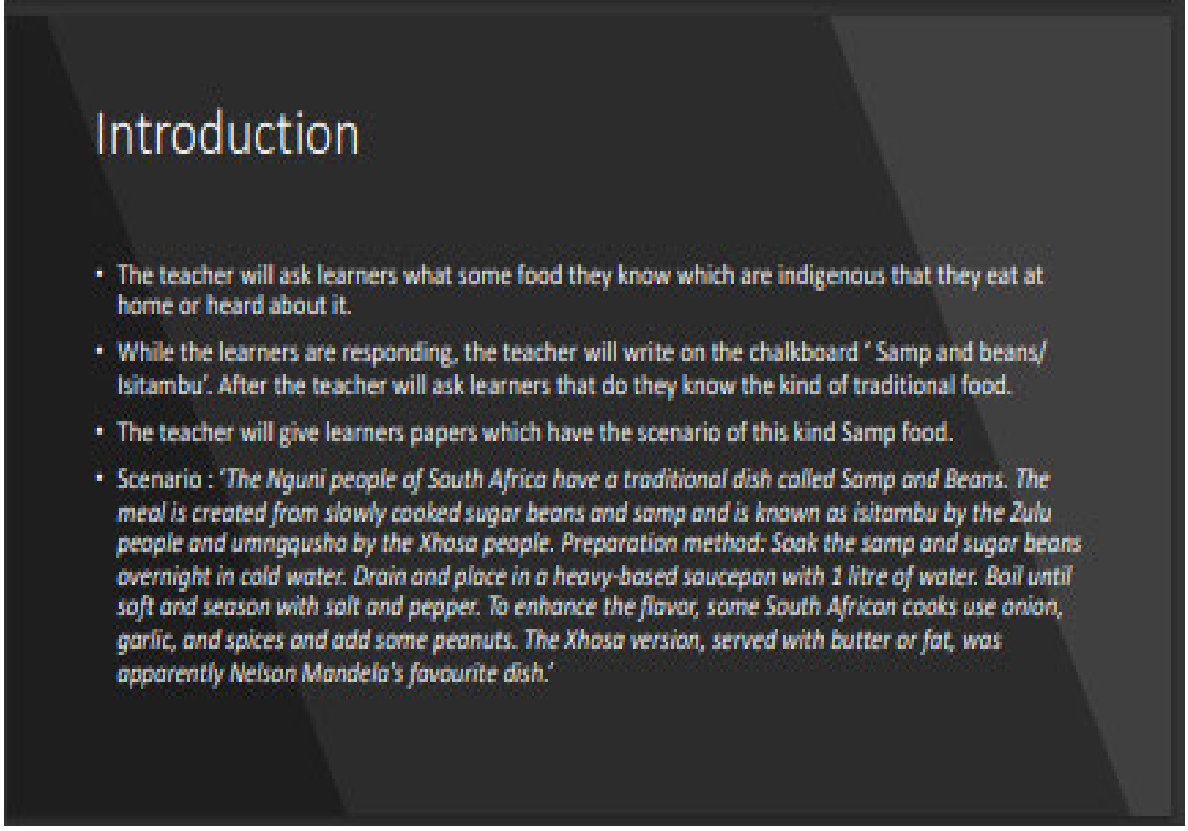
Learners will be given research for the home assessment

The following will be required from the learner's research :

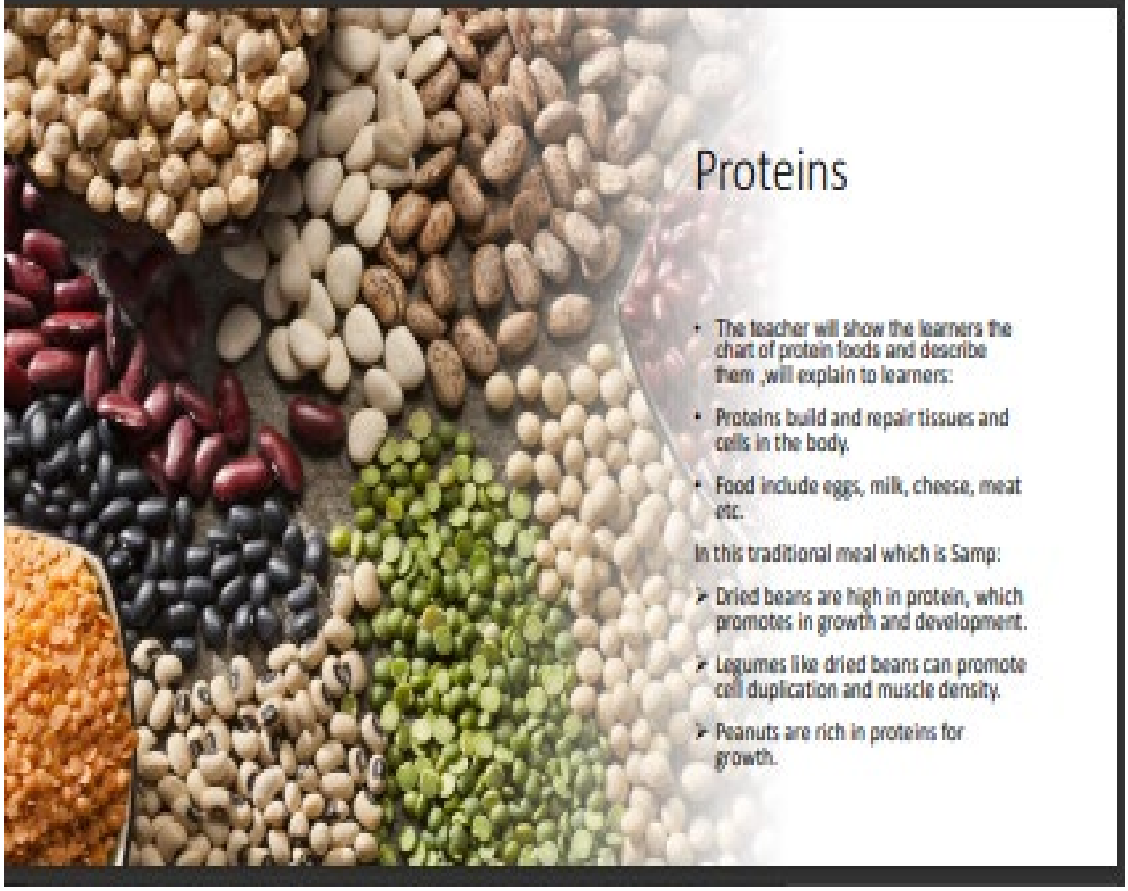
- THE HISTORY OF GENETIC ENGINEERING
- Who started genetic engineering?
- How, when, where, and why genetic engineering was developed?
- Who commenced the process of insulin, why, how, and when briefly discuss?
- Explain the process of insulin and include a picture of it.
- Discuss the impact of insulin on humans and how do humans benefit from insulin?
- Provide pictures and discuss any five crops that are genetically modified, except maize corn.

LESSON PLAN 5





- The Teacher will explain that in Samp and Beans/Isitambu traditional food we find Proteins, Carbohydrates and fats and oils which are useful in our human bodies ...



Carbohydrates

- Carbohydrates provide the body with energy.
- Examples are sugar and starch.

SAMP has:

- we find potatoes, ummbila in samp which are carbohydrate which promotes us with energy.
- Samp and beans are full of fibre, which assist in improving gut health. Your gut is directly linked to your immune system and having a healthy gut helps your body to fight disease. The fibre in traditional samp and beans may assist in boosting your immune response indirectly via improved gut health.

Fats and Oils

- Fats and oil provide the body with energy and insulate the body against the cold when they are stored under skin.
- Examples are avocado pear, cheese, nuts, fried chips and cooking oil.
- In Umgqusho food we get fats and oil which provide us with energy.
- We also find fats in peanut which are good fats which helps to lower the cholesterol levels.
- Also cooking oil.

Health benefits

- Beans and other pulses may help in the prevention of chronic diseases like heart disease, cancer, and obesity.
- Samp and beans are high in fiber, which may help to minimize fat absorption in the diet.
- Because samp and beans are plant-based it promotes digestion function which can help boost your immune response.
- May lower the risk of developing Type 2 Diabetes.

Activity

Some questions will ask to test learners:

What are the three major food groups.

Name one function of protein.

Name 2 food carbohydrates which are found in Isitambu.

What are fats and oil?

What are some benefits of eating indigenous food.

Practical Activity

Test food for starch, fats and oils

Learners are required to form in groups of six.

Materials:

- Dropper
- Iodine solution
- Bread, potato
- Paper or paper filter
- Cooking oil, butter
- White saucer

Continue...

- **Test for Fats:**
- Procedures:

Step 1: Rub some of the cooking oil onto paper.

Step 2: Hold the paper to the light.

Step 3: Record your observation.

Results: The test for fats and oils will have the shiny transparent mark on paper.

Continue..

- **Test for Starch:**
- Procedures:

Step 1: Place the pieces of bread and potato on white saucer.

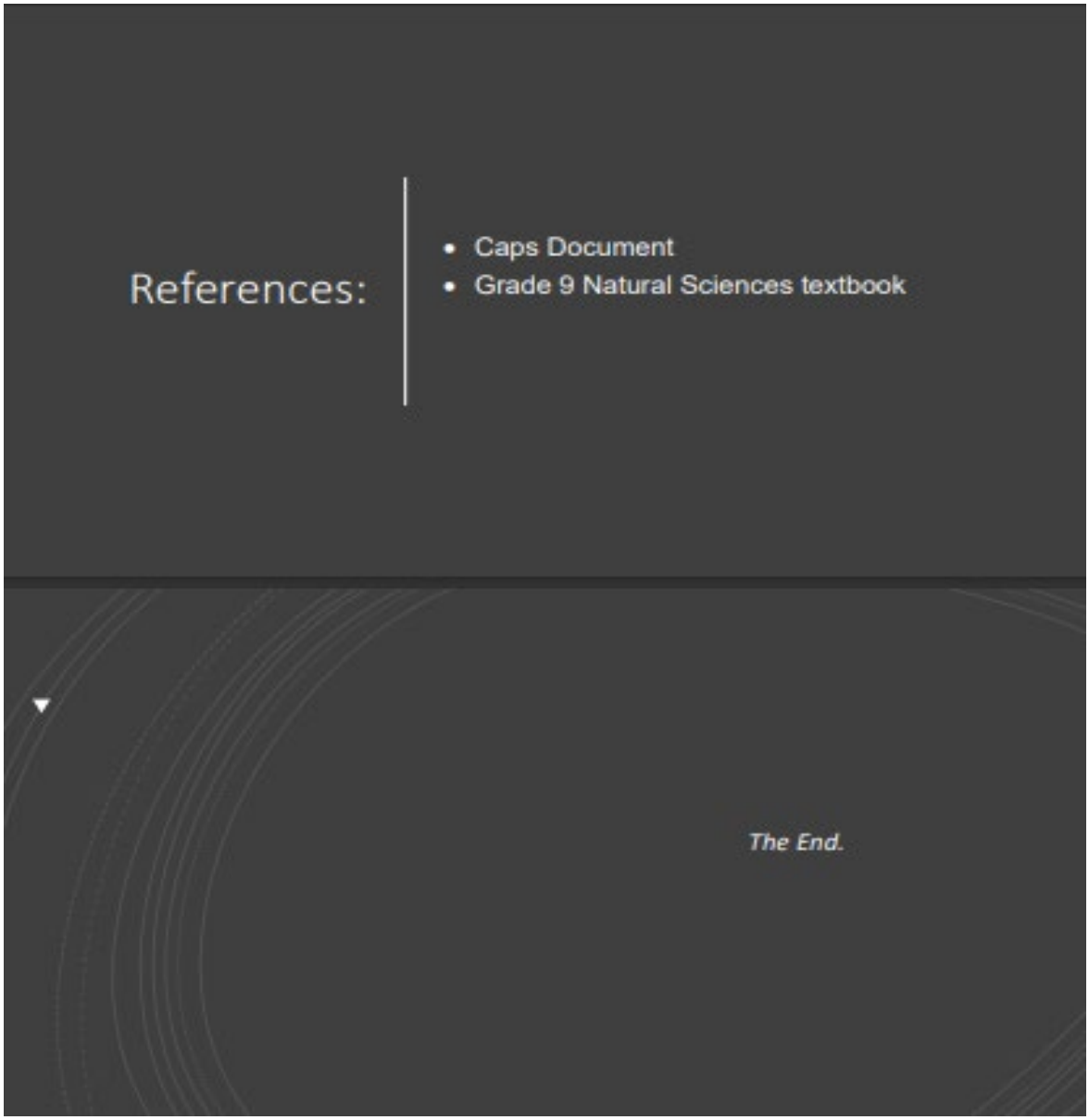
Step 2: Add two drops of iodine solution to the food samples.

Step 3: Record your observations.

Results: The starch test shows that iodine turns blue-black in the presence of starch.

EXTENDED LEARNING/ENRICHMENT:

- Discussion about the other different types of indigenous food which they cook in traditional ceremony.
- Playing the video for learners on how to make this samp and beans.
- https://www.youtube.com/watch?v=HbQv9dYDLpo



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APPENDIX 8: SEMI – SRUCTURED INTERVIEW TRANSCRIPTS

Semi – Structured Interview 1 Transcript

Focus Group 1

Catherine W.N Muyonjo [Interviewer]:

'Thank you so much for taking the time to assist me in this research. Please remember that there are no right and wrong answers and this interview will be recorded. My role in this session is to be a moderator and to guide the discussion, so please feel free to speak your mind. Your names will be kept confidential hence your view won't be attributed to you.

Let's go, with the first question:

'What is your understanding of indigenous knowledge?'

Preservice Teacher 1 [Focus Group 1] : 'Okay, uuhmm, from what ummm when we did this project [Indigenous Knowledge Project] we also worked with indigenous knowledge in our third year as well, ummm, it was also one of Professor Mudaly's modules, so from my understanding it's like basically knowledge of like their beliefs and practices that are like…passed down through generations. You know in the community and like elders and all of that. So it's like more or less knowledge about the natural world and natural resources and maybe like medicine that you can possibly get naturally instead of using you know like Western medicine and all of that… and even sometimes …[audio unclear here due to poor network] spirituality as well … you know the knowledge of your ancestors and all of that. That's my understanding.

Catherine W.N Muyonjo [Interviewer]: …Nice, and do you think that uhumm…indigenous knowledge is only indigenous to a particular group of people? …Or do all people have it?

Preservice Teacher 1 [Focus Group 1]: 'I don't know, I feel like uuhm personally all people have indigenous knowledge, I feel that everybody has their own type of indigenous knowledge, like we live in South Africa and there's like a diverse group of people. Like we've got … for instance, I'm an Indian, But I'm a Hindu Indian and I believe that there's certain things, you know we believe in reincarnation and stuff and you could get someone that is also Indian but they believe in Christianity… From my knowledge I know that in Christianity your'll don't believe in reincarnation, so that's what I understand about it.

Thank you so much Tiara. Illesh do you wish to add anything on what Tiara has said?

Preservice Teacher 2 [Focus Group 1]: Well, my understanding of indigenous knowledge is also I think similar, more or else similar to 'PT1's' understanding. It's about like the natural world and uhhm, knowledge that people gained about how to use their natural resources …

Catherine W.N Muyonjo [Interviewer]: Thank you so much…And PT2, do you think there is a link between indigenous knowledge and science?

Preservice Teacher 2 [Focus Group 1]: Well, yes, there is a link because uhmm, like, if you take for example, like uhhmn, the African sweet berry, right? This berry was used by the indigenous people like a natural sweetener as it had this protein which imitated a sweet taste. So, uhhm, this is indigenous knowledge because they knew that using this berry would sweeten their food. But it has scientific knowledge into it, like, the protein, which is imitating the sweetness, not like Carbohydrates, you know glucose,

Catherine W.N Muyonjo [Interviewer]: Huumm, okay, so how is that related to science?

Preservice Teacher 1 [Focus Group 1]: It is related to science because like uuhm, you see like uhm, even though the people knew they were using these berries it was like a healthier for them but they didn't like, know definitely that it was a protein but it had some scientific knowledge like uhm, knowing that these berries were sweet but it didn't affect their blood glucose levels or give them, you know like extremely high blood sugar levels. So, it does, there is like a slight link between indigenous knowledge and scientific knowledge.

Catherine W.N Muyonjo [Interviewer]: Huumm, okay, let me bring in PT1 here. PT1, based on what PT2 is saying, do you not think that the indigenous people were eating these berries purely because it was a part of their diet?

Preservice Teacher 2 [Focus Group 1]: … I believe that they didn't know the scientific part to the berries, so maybe it was part of their diet or maybe it was something they could only get at that time. So, they had to eat it and they figured that it was sweet, so they may be used it in different methods because of the sweet taste.

Catherine W.N Muyonjo [Interviewer]: So, you think that they took it because of the health benefits or because it was part of their diet?

Preservice Teacher 2 [Focus Group 1]: I don't feel they took it because of the health benefits, I don't feel they were aware of the health benefits, like maybe …it was available to them, and they discovered it had this sweet taste to it and they maybe couldn't get sugar at that time, so they used this like an alternative. I don't feel they knew the health benefits towards it.

Catherine W.N Muyonjo [Interviewer]: What makes you think they didn't know? What makes you think they were not aware of the scientific part of it, or what it can do for your body?

Preservice Teacher 1 [Focus Group 1]: Uhm, I feel like that's where science comes in and they must do more research on this and test it and conclude that …as PT1 said there is a protein … I'm not too sure how you pronounce it. … so, I'm not sure they have the tools to research and locate the protein to identify the medical properties or identify the importance of the berry. They just used it as a sweetener because it was sweet and it was available to them. That's my opinion. I'm not really sure …

Catherine W.N Muyonjo [Interviewer]: Thank you so much PT1. So, PT2, What are your views? Don't worry, there are no right and wrong answers.

Why do you think it is relevant to teach learners about indigenous knowledge within a science classroom?

Preservice Teacher 2 [Focus Group 1]: Okay, uhm, so it's relevant because indigenous knowledge has a lot of value in it. So, if you're looking for… in this case… if you look at diabetes in our current world, it's a common health issue, especially in the community that I live in. I know that every household has at least one person who suffers from diabetes. So, it's important that we teach learners indigenous knowledge in a science classroom so that they can better understand like how to use and you know the…. Value of indigenous knowledge. Say, for example, with these berries, right? People…The students can learn about how they can use these berries in order to make their foods much sweeter but still like maintain their low blood sugar levels. So, it's important to teach them and for them to understand the science behind this indigenous knowledge and how it actually works. So, they know how to implement it in a way that is so much safer and healthier. Like, some indigenous knowledge I know that when it comes to the use and application of it, you can overdose with some of the chemicals and you know genetic material. So, it's important that you know how to apply the indigenous knowledge.

Catherine W.N Muyonjo [Interviewer]: PT2, do you think that indigenous people were able to enjoy their food, yet at the same time, maintaining their health?

Preservice Teacher 2 [Focus Group 1]: Yes, I partially agree. If you're using our example of the brazzein protein, I do agree that they were able to enjoy their food while still maintaining their health, their good health. Yes, I do believe that.

Catherine W.N Muyonjo [Interviewer]: Okay, thank you. PT1?

Preservice Teacher 1 [Focus Group 1]: PT2 just said something that I wish to add on that. He said like when, sometimes they didn't know the properties behind some of the indigenous plants or something. So, there's an example where, you know the cherry seed? The seed of a cherry? If you eat too much of it, I think uhm, more than ten, you could possibly die of cyanide poisoning. So, some people eat the seeds, but if you eat too much of it, there is a possibility of you dying of poisoning.

Catherine W.N Muyonjo [Interviewer]: Ooh, that's interesting! I didn't know that! Wow! Do you think that indigenous people ate in moderation?

Preservice Teacher 1 [Focus Group 1]: I also didn't know that. [Referring to the cyanide poisoning]. I do feel they ate in moderation because, once again our bodies, our bodies work in systems. So, if our bodies have too much sugar, so for example, the berry, if there was too much consumption of that berry, I'm sure our bodies will signal to us that you know what, our blood sugar levels are too high. And by maybe causing our mouth to get dry, or we may eventually like faint if our blood sugar levels go too high. So, I do feel like, eventually somebody would have learned that they need to eat it moderation. They could have had people who ate too much of it and something happened, and then eventually over time, they learned the properties of this berry.

Catherine W.N Muyonjo [Interviewer]: Ooh okay, thank you so much.

Preservice Teacher 2 [Focus Group 1]: Catherine, can I add something? The question that you asked earlier whether the people knew the benefits of eating the berries. I know that PT1 said that it was part of their diet and they didn't necessarily know, but I honestly feel like, with these berries, over time, people basically, discovered when they eat this berry, instead of eating other food that had like, high glucose, maybe they didn't know it had high glucose, uhm, they found out that when using this berry as a sweetener, instead of other stuff that they felt less

tired, urinated less frequently, so they saw that the symptoms of diabetes was reduced. And therefore, they discovered, that these berries had better properties for them to use as a sweetener.

Catherine W.N Muyonjo [Interviewer]: Thank you, that is very good insight. I also think that some of our indigenous people may not have known the science behind it … but when they ate certain foods they would have felt a particular way [their bodies would have reacted differently]. And they would have drawn conclusions, so I agree that makes a lot of sense. Thank you so much for that.

When you look at science textbooks, whether Life Sciences, Physics, Natural Sciences, which foods and beverages are included? And why?

Preservice Teacher 1 [Focus Group 1]: Uhm, I'm not sure on that one. I just need a few moments … I'm not too sure about that, like I haven't really come across anything, because I've only looked at a few textbooks, that is Life Sciences and Natural Sciences and majority of the time I use the study guides because that is what they are using now at school. And the study guides hardly have any indigenous knowledge, when it comes to foods and beverages. But I'm not entirely sure.

Catherine W.N Muyonjo [Interviewer]: …**Should it be like that? [That indigenous knowledge is not included as far as foods and beverages are concerned]**

Preservice Teacher 1 [Focus Group 1]: I feel it shouldn't be like that because indigenous knowledge, the importance of indigenous knowledge is to promote like cultural diversity, and inclusivity in the classroom, so if we can do that … there are so many cultural backgrounds that come into a South African classroom. So, I feel if we include indigenous knowledge, the learners will feel more comfortable learning about that subject, rather than learning about Americans, or the Western medicine. Learning about something that they know they can relate to, because maybe they grew up on a farm and they grew that specific plant or vegetable on their farm and they know the property/properties which gives them a sense of relation inside the classroom. This will produce better learning and understanding. It allows the learner to embrace a holistic world view rather than a monotone view, which is just the textbook.; where if we include such, they will feel that they are part of the discussion and not just rote memorisation. They feel like they are included in the discussion and all of that.

Catherine W.N Muyonjo [Interviewer]: What does this communicate to you as a science preservice teacher, as to what curriculum planners choose to include in the curriculum?

Preservice Teacher 1 [Focus Group 1]: I feel they do this because ….We need to be teaching learners to adapt not only to our understanding but the understanding of the entire world. So, maybe they feel that by teaching us about other countries, and their medicines or their understanding we'll feel more adapted, like say now for example, a child had to go and finish their degree, … or go to a different country and maybe teach there maybe then they'll have like a sense of understanding as to what is required of them overseas.

Catherine W.N Muyonjo [Interviewer]: Do you not think that indigenous knowledge is not so important and that is why they [policy/curriculum makers] choose not to cover it?

Preservice Teacher 1 [Focus Group 1]: I wouldn't say it's not important. It is important but in the context of where we are, teaching the learners about their surroundings is important because they need to understand where they come from and where they are going. They need to have a diverse understanding of the world. So that's why indigenous knowledge is important but we also need to learn other things.

Catherine W.N Muyonjo [Interviewer]: Very true. We need to learn other things. But why are curriculum planners choosing to cover very little of indigenous knowledge and sometimes not covering it at all if it's important?

Preservice Teacher 1 [Focus Group 1]: I'm not sure as to why … I'll get back to you on that one. They should be covering these things because it is important. They just choose not to and then I feel like that us as teachers, we need to include it in our classroom when we teach, even though it's not in the textbook, we need to add context to our lesson and try to include these things so that our learners feel that they are a part of the lesson… say now for example, in our lesson plan, we use a case study on the berry. That wasn't in the textbook. The textbook basically had information about nutrition and how diabetes and all of that… [unclear audio] … that indigenous knowledge was not in the textbook. But as teachers, we need to include that because learners need to have this understanding of the world. That's why I feel like we need to include these things in the curriculum, because we as teachers are going to include it anyway.

Catherine W.N Muyonjo [Interviewer]: What foods and beverages are covered in science textbooks? What does this communicate to you as science preservice teacher?

Preservice Teacher 2 [Focus Group 1]: okay, uhm, yeah, I do agree that they don't really cover much about foods and beverages in science textbooks. I'm not sure why they don't cover. A possible reason I could think of is maybe they uhm, they don't really like find relevant links to link the knowledge that they are teaching about to those food and beverages, maybe. Uhm, maybe they can't, maybe it's hard to link or connect the concepts, scientific concepts that they want learners to know about pertaining to foods and beverages. That's only one possible reason I can think of.

Catherine W.N Muyonjo [Interviewer]: Do you not think that curriculum planners feel that indigenous knowledge is not important and that's why they choose not to cover it?

Preservice Teacher 2 [Focus Group 1]: Uhm, well, I'm not too sure if the people who design or structure the curriculum feel that indigenous knowledge is not important, personally I feel that it is important and it should be covered more and included more into the curriculum, uhm, yeah. I'm not too sure. I'll have to get back to you on that one.

Catherine W.N Muyonjo [Interviewer]: Thank you so much. **Do you consider African indigenous knowledge holders as scientists in their own right?**

Preservice Teacher 1 [Focus Group 1]: I feel they are… they locate medicinal properties, different plants and vegetables. They find ways in which this can impact our body or make us feel better, or even like treat wounds. You know, all of that… so they are technically doing their research to find these medicinal properties. But in a way, they are scientists, researchers. Yes, they are doing research basically, trial and error. So, they are scientists.

Preservice Teacher 2 [Focus Group 1]: Yes, I do. I also agree that they are scientists in their own way… scientists basically explore the natural world and the universe. And these indigenous people, they were like basically exploring their natural world and the universe and resources, such as plants, they are scientists. They experimented with materials around them, be it like plants. They are scientists in their own way. They conducted their own experiments. I wouldn't say experiments as in, you know such as using laboratory equipment and conducting procedures, but they experimented in terms of taking the genetic, the plants around them, trying them out, you know like, trying to make them useful. So, they were technically exploring their surroundings.

Preservice Teacher 1 [Focus Group 1]: … In science, I feel like we do a lot of observation, so in a way, they did these observations and passed this knowledge down through the

generations. I also agree with PT2. …They had a deep connection with their surroundings …environment…and this allowed them to you know develop a rich understanding so they were able to pass on this information to generations and maybe like, for example, agriculture… if they are in a certain area and they need to plant a certain type of crop but climate change and all of that, so they need to adapt to climate change and maybe they come up with ways …to plant crops… using their indigenous knowledge.

Catherine W.N Muyonjo [Interviewer]: Do you think that there is any wisdom embedded in African indigenous knowledge when it comes to the preparation of foods and beverages?

Preservice Teacher 2 [Focus Group 1]: Yes, I do believe that our African indigenous knowledge is rich in food and beverage preparation. When you think about … If you look at the example of the berries … if you look at African beer and fermentation, that's also like African indigenous knowledge. So, they use quite a few examples, so it is rich in terms of our food and beverage preparation. So, there is wisdom in this knowledge and I'm still going to use the same example of the brazzein protein again. So like like I said I, I personally believe that, like the indigenous people they did know of the health benefits due to like, they used it for a long time and the noticed that as they used these berries, compared to like using the carbohydrates and glucose, that sweetened their food, or whatever they found out that they were less tired and had reduced symptoms of diabetes, that what whatnot. So, they use wisdom in this as it like, basically, contributes and provide with them of how to maintain a good health and to keep your body, you know, homeostasis okay …

Catherine W.N Muyonjo [Interviewer]: Do you think they knew what homeostasis was?

Preservice Teacher 2 [Focus Group 1]: … No, I don't think they knew at all what homeostasis was.

Preservice Teacher 2 [Focus Group 1]: I don't think they knew what homeostasis was but their body knew what it was. As PT2 said if they ate too much of the berry they could show symptoms of diabetes… and maybe they said to themselves, 'stop eating these berries… so it was basically trial and error. If somebody got sick and they decided to stop eating so much of this ….

Catherine W.N Muyonjo [Interviewer]: Do you think 'they' [indigenous people] were able to make that diagnosis [of diabetes]?

Preservice Teacher 2 [Focus Group 1]: I think they would partially… they would obviously make observations of similar symptoms …they would make notes of …the person is always feeling tired and they are constantly urinating, or losing their vision…so they make these observations. They won't know that it's definitely diabetes or what is the cause of it or what they need to do. But I'm sure they probably like uhm.. know that it is a common… based on observations, they'll definitely figure out that it's due to something but they won't definitely know that it's diabetes.

Catherine W.N Muyonjo [Interviewer]: I believe diabetes was rare at the time and less common than it is now.

Preservice Teacher 1 [Focus Group 1]: I feel they wouldn't have known…. I don't think they would have been able to determine that they had diabetes. I don't think that they had the sufficient knowledge. I watched on Tiktok that in the olden days they would taste the person's urine …if the urine tasted sweet then there was something wrong with them. But I feel they wouldn't have had that knowledge of diabetes to understand that this person's pee is sweet and they have diabetes.

Catherine W.N Muyonjo [Interviewer]: Thank you so much, very unhygienic but point taken. PT2? Your view? **How do you as a preservice science teacher intend to in cooperate indigenous knowledge pertaining to foods and beverages within a science lesson, with a view of deepening conceptual understanding of science?**

Preservice Teacher 1 [Focus Group 1]: Before we bring indigenous knowledge into the classroom, we need to have sufficient knowledge about indigenous knowledge… and do our research pertaining to this type of indigenous knowledge, then only can we take it into the classroom and use the examples of different foods and beverages and incorporate that into our science lesson… We could also conduct experiments such as you know, for instance, investigate the fermentation process or maybe they could explore the environmental factors affecting the growth of a specific crop, by infusing an indigenous crop so that's how I feel we can integrate indigenous knowledge and science pertaining to foods and beverages.

Catherine W.N Muyonjo [Interviewer]: Does it mean you'll be trying on your part to ensure that learners understand the importance of indigenous knowledge? …

Preservice Teacher 1 [Focus Group 1]: Yes, I think it is the role of the teacher …having said previously, it is not in the curriculum and us as teachers we need to work towards bringing in

this indigenous knowledge into the classroom. So, I feel it is the duty of the teacher to do their research before they introduce it to the learners. Because if they just bring in anything, and just go into the classroom where the learners know more than we do, and they ask us questions and we're not able to answer those questions, you know at that time in the classroom, it doesn't look nice. So, I feel we need to know more before we incorporate it in our science lesson.

Preservice Teacher 2 [Focus Group 1]: I more or less agree with PT1 about doing the research and also to emphasise on to make sure that we can basically uhm… show learners the link between the concepts that are going to come out in the science lesson and the indigenous knowledge. That's something that is very important so, in order to deepen conceptual understanding of scientific or indigenous knowledge they need to know the link. So, the indigenous knowledge based on beverages, we need to make sure that we can show learners that it has …that there is a link to scientific knowledge and therefore it is very valuable for us to understand.

Catherine W.N Muyonjo [Interviewer]: Thank you so much. In your view, does the CAPS document give sufficient coverage to African indigenous knowledge, especially pertaining to foods and beverages?

Preservice Teacher 1 [Focus Group 1]: I feel like according to the CAPS document, it is stated that we use indigenous knowledge but there isn't sufficient amount of information that covers the entire concept of indigenous knowledge. There is a mention of it, yes in the CAPS document but it's not used much in our lessons. It's not incorporated as much.

Catherine W.N Muyonjo [Interviewer]: Why do you think this is the case PT1?

Preservice Teacher 1 [Focus Group 1]: I feel that they want to teach the learners about the world as a whole rather than our indigenous knowledge … you know where we come from. That's why they don't incorporate it as much. But you know us as teachers, we need to bring that into the classroom. We need to accommodate the diversity in the classroom.

Preservice Teacher 2 [Focus Group 1]: I also feel I agree. I totally agree with PT1. The CAPS document does touch on indigenous knowledge, but there is insufficient knowledge, especially pertaining to foods and beverages. So, even me, I remember when taught the CAPS curriculum in school I did not know about indigenous knowledge at all. One thing I remember is that my teachers never took the time or the effort to include indigenous knowledge in our lessons. So, I feel like the CAPS document should emphasise and include indigenous knowledge more into

the CAPS curriculum. Especially common problems, health problems that people face today in our communities, including indigenous knowledge about the food and beverages, might just help the communities… if our students like in my community knew about the berries and they could like maybe find a way to uhm, get some berries… you know grow the plant itself… you know and they could try to use the berries in their homes to make food sweeter for their families. This will reduce their chances of diabetes. It should be included more into the CAPS curriculum more. I feel we have placed too much value on Western knowledge as opposed to our indigenous knowledge… so we take more time to teach Western knowledge and science.

Catherine W.N Muyonjo [Interviewer]: Do you think that learners generally relate more to African indigenous knowledge or Western knowledge?

Preservice Teacher 2 [Focus Group 1]: Well, I personally believe that learners generally relate more to African indigenous knowledge …. In the sense that it involves the resources in our surroundings …the indigenous knowledge that is included in the CAPS document generally relate more to the African beer and fermentation process better because they have seen it …in many African Communities African beer is made at home. So, learners can relate more to African indigenous knowledge …But, like our CAPS document, it doesn't really include the African indigenous knowledge. It is so focused on that Western scientific knowledge. And learners in our community, and in South Africa especially, they don't generally associate so much with that knowledge because they don't see it from day to day or in their communities, so there's no connection to them.

Preservice Teacher 1 [Focus Group 1]: I also agree with PT2… In the South African context, learners will relate more to African indigenous knowledge, in line with their own cultures, heritage and their context that they know of … so when the learners were kids, they may have seen their uncle or granny making the beer at home. And when they see fermentation, in the classroom, they're not looking at the bread, and the yeast in the bread, and how that works or … the making of wine, they are not really relating to that. But if we were to bring the example of umqombothi, if we were to bring that into the classroom, they are going to relate to that, it's going to interest them, and make them pay attention to what you're saying, rather than something they don't know.

Catherine W.N Muyonjo [Interviewer]: Why are these African berries [The berries discussed in the preservice teacher's LESSON PLAN] so important to the people of West Africa and what can they be used for?

Preservice Teacher 2 [Focus Group 1]: I'm not 100% sure … but the diet, that goes on in the West, West Africa… I would say that these berries it's important especially in the context of the African indigenous knowledge context, because … I know that especially in our area, … when we're talking about the food we eat, each and every day, you know it contains so much of sugar… you know the glucose, it's not very healthy, you know many people in our communities suffer from diabetes, it's because of the food that we are eating. So, these berries are especially important, not just to the Western African region, but to Africa as a whole. … I'm not 100% sure but it's important to basically help us to maintain good health.

Preservice Teacher 1 [Focus Group 1]: I feel the berry has a natural sweetener, a lot of our foods that we eat today have artificial sweeteners, and they don't have many nutritional benefits… I feel like they are going to get some of the benefits that it gives off rather than using artificial sweeteners.

Catherine W.N Muyonjo [Interviewer]: Why are we then going for artificial sweeteners when we have a natural sweetener that will be beneficial for our health, and tastes good as well? [The berries discussed in the preservice teacher's LESSON PLAN]

Preservice Teacher 1 [Focus Group 1]: I feel like people see that natural sweeteners don't have an intense taste and they have less calories compared to natural ones which is preferred by those who wish to lose weight. …Also, artificial sweeteners last longer, whereas with berry, it will rot and one won't be able to make use of it. An artificial sweetener can have a long shelf life. You can use it for a very long time. That is why one would rather use the artificial sweeteners rather than use the natural sweetener.

Catherine W.N Muyonjo [Interviewer]: Don't you think we should prioritise our health more? [The berries discussed in the preservice teacher's LESSON PLAN]

Preservice Teacher 1 [Focus Group 1]: I feel we do. We as individuals understand that we need to prioritise our health, but we have companies that look for cost effective ways, so artificial sweeteners are much more cost effective, rather than going and planting … and waiting for them to harvest and extract their product. So, the easy root is just to use artificial sweeteners… and us as consumers, we tend to buy it because it is sweet and accessible… At this stage money does make the world go round, so these big companies are looking for a quick way out… like preying on individuals that need the things that they are offering. They are

making their money, so at the end of the day it doesn't really bother them if they are affecting somebody's health, as long as they are getting what they want.

Catherine W.N Muyonjo [Interviewer]: Your lesson plan mentions that the berry you referred to has protein. How does this contrast what has been said about the African diet and the indigenous diet not having important nutrients?

Preservice Teacher 1 [Focus Group 1]: It does contrast because I know… I'm not 100% sure …the diet in Africa, it is very high in carbohydrates. It does contrast because these berries have protein in them. So, if the indigenous people were consuming these berries their diet did include protein.

Catherine W.N Muyonjo [Interviewer]: Why is biopiracy important in relation to indigenous knowledge and why should this be discussed in a science lesson?

Preservice Teacher 2 [Focus Group 1: … bio-piracy, in the context of indigenous knowledge, some companies like PT1 said only look at making money and making profit for themselves. And so, what they do is, they basically steal this knowledge and they restrict the community from using this knowledge as they have the right to this knowledge and what it entails. It's important to teach about bio –piracy so that people … learners can go back to their communities and look at the indigenous knowledge that their communities have and find a way to protect or ensure that it can be passed on and people in the future generations can still use this knowledge and it's not just going to be used by a company that restricts others and makes money from the product. It is important to safeguard communities' indigenous knowledge and to allow the people in the communities the ability to use this knowledge in order to maintain a better lifestyle.

Preservice Teacher 1 [Focus Group 1: If we were to teach about bio – piracy in the classroom, it's like giving indigenous people a voice. So, we will be giving the indigenous people a voice rather than the company that sold the idea.

Catherine W.N Muyonjo [Interviewer]: You spoke about nutrition in your lesson plan. Life Sciences covers the topic of nutrition. Does the topic of nutrition cover sufficient knowledge pertaining to foods and beverages?

Preservice Teacher 1 [Focus Group 1: When we were doing this research on …doing this lesson plan… when we looked at textbooks… I'm not sure about PT2, but the ones I looked at

didn’t have any indigenous knowledge. So, when we wanted to do animal nutrition, there was homeostasis… so that is why we used the berries. But when it comes to textbooks, there was not sufficient information on indigenous knowledge.

Preservice Teacher 2 [Focus Group 1: I agree with PT1… indigenous knowledge, especially when it comes to the topic of nutrition, there is very little to nonindigenous knowledge … included. So, the topic of nutrition, doesn’t really have much knowledge pertaining to the indigenous knowledge of food and beverages preparation.

Catherine W.N Muyonjo [Interviewer]: Do you think there is anything pertaining to animal nutrition that links up with indigenous knowledge?

Preservice Teacher 2 [Focus Group 1: We looked at diseases that are associated with animal nutrition. We included indigenous knowledge by looking at how people used indigenous knowledge back in the day to combat …

Preservice Teacher 1 [Focus Group 1: I don’t think I have anything to add ….

Catherine W.N Muyonjo [Interviewer]: Thank you very much for your assistance in this research….

Semi – Structured Interview 2 Transcript

Focus Group 2

Catherine W.N Muyonjo [Interviewer]:

‘Thank you so much for taking the time to assist me in this research. Please remember that there are no right and wrong answers and this interview will be recorded. My role in this session is to be a moderator and to guide the discussion, so please feel free to speak your mind. Your names will be kept confidential hence your view won’t be attributed to you. Remember that they are no right or wrong to any of the questions. Please feel free to respond the way you them. But don't feel like you are under pressure. Don't be like oh, my word, I need to give the most perfect answer. There are no right and wrong answers. If you don't know the answer to something. It's fine. Just say we're not sure, or I don't know, for if you want a minute or 2 to think about it. It's fine. Don't feel under pressure. No right from all this this interview definitely

is being recorded. Your name and identity will be kept confidential and your views won't be attributed to you.

Let's go, with the first question:

'What is your understanding of indigenous knowledge?'

Preservice Teacher 1 [Focus Group 2]: I can say that my understanding of indigenous knowledge is ….uhm.. it is about using ancient knowledge that people back then used to make a living. Maybe, to heal using …. herbs…

Preservice Teacher 2 [Focus Group 2] : My understanding of indigenous knowledge …it's a connection about beliefs and our traditions that are intended to be preserved and communicated within the context our culture.

Preservice Teacher 3 [Focus Group 2]: My understanding about indigenous knowledge is that it is the local knowledge that is unique to a particular society. It is actually a type of knowledge that is passed from one generation to another generation.

Catherine W.N Muyonjo [Interviewer]: When you say, "a particular society, you are implying that it can be any group of people? It doesn't have to be a specific group of people.

Preservice Teacher 3 [Focus Group 2]: Yes!

Catherine W.N Muyonjo [Interviewer]: Do you see a link between indigenous knowledge and science?

Preservice Teacher 3 [Focus Group 2]: …uhm, in my opinion I can say that I do see a link between indigenous knowledge and science because … just to justify my answer, I can say that there are things like … I can make an example about the Aloe vera plant… Back then, the Aloe vera plant was used to … was crushed to …people back then would just extract the jelly, …now the Aloe vera plant is used to make the hair growing product…etc.

Catherine W.N Muyonjo [Interviewer]: What is the link between the indigenous knowledge and the science part of it?

Preservice Teacher 3 [Focus Group 2]: …uhm… Aloe vera is an indigenous herb, so the hair growing products that are produced now, are produced by using the scientific methods or knowledge.

Catherine W.N Muyonjo [Interviewer]: Is there anyone else who would like to add to PT3's point about the link between indigenous knowledge and the scientific part of it, when it comes to the hair products and Aloe vera?

Preservice Teacher 1 [Focus Group 2]: …I actually have two opinions about that question. Firstly, I'll say yes. There is a link between indigenous knowledge and science because they both rely on creativity. Yes, but scientific knowledge is universal, whereas the indigenous knowledge is local. I think that is where they differ.

Catherine W.N Muyonjo [Interviewer]: Why is it relevant to teach learners about indigenous knowledge within a science lesson?

Preservice Teacher 1 [Focus Group 2]: uhm… it is because IK is the knowledge found amongst countries, so such knowledge should be valued in the Natural Sciences classroom since communities, cultures and schools cannot be treated as separate entities then it works hand in hand in order to make the education which the learners are receiving more meaningful. IK is the knowledge found among the countries, so such knowledge should be valued in the Natural Sciences classroom, since community, culture and school cannot be treated as separate entities, so they need to work hand in hand in order to make the learning more meaningful for learners. Yeah, it is like that.

Catherine W.N Muyonjo [Interviewer]: Why is it relevant to teach learners about indigenous knowledge within a science lesson?

Preservice Teacher 3 [Focus Group 2]: uhm, it is important because if you start to communicate what students have already known, they will be confident and understand that science is all around us, and they will feel that they know science. It will be much easier for them to understand that particular concept.

Catherine W.N Muyonjo [Interviewer]: Can you describe which foods and beverages are included in our science textbooks or curriculum? [Whether Natural Sciences, Physics, or Life Sciences] And how many of these are actually African foods and beverages?

Preservice Teacher 3 [Focus Group 2]: uhm, I'm not sure about my answers. Under Carbohydrates we have bread, potatoes and so on. Under the proteins, we have meat … I've come across indigenous food like bread, but not steamed bread, just bread. And somewhere under the section of cellular respiration, we find beer. They call it Zulu beer which is umqombothi.

Preservice Teacher 3 [Focus Group 2]: uhm, I think on that point of foods and beverages in the Natural Sciences textbook is that there are foods like amadumbe, I'm not sure if there is an English name for it, but we call it amadumbe.

Catherine W.N Muyonjo [Interviewer]: Do you think science textbooks have covered enough African foods and beverages?

Preservice Teacher 3 [Focus Group 2]: uhm, I cannot be so sure about that one.

Preservice Teacher 3 [Focus Group 2]: I have no idea …

Catherine W.N Muyonjo [Interviewer]: Based on your responses and observations, what can you conclude as science preservice teachers as to what the curriculum planners choose to cover and leave out in the textbooks?

Preservice Teacher 1 [Focus Group 2]: I think indigenous knowledge is not presented that much in the curriculum. The curriculum planners can try to include more information regarding …as a science preservice teacher, I can be guided by the curriculum and present indigenous knowledge.

Preservice Teacher 2 [Focus Group 2]: Well, as for me, the curriculum planners did not focus more on African knowledge, they focused on science. They forgot that using indigenous knowledge in teaching science is very important because learners will feel like they know somethings so it will be easier for learners to communicate what they know, so that they will understand that particular concept that you will be introducing to them .so yes, they do not focus more on African knowledge, it is just …using science.

Catherine W.N Muyonjo [Interviewer]: Why do you think that the curriculum planners are not focusing a lot on indigenous knowledge?

Preservice Teacher 3 [Focus Group 2]: Because I have noted in the books of Natural Sciences and Natural Sciences, a few days ago, I did not find a lot of African food there…

Preservice Teacher 1 [Focus Group 2]: Just to add on what PT3 has said, I think it is because they have not done much research regarding indigenous knowledge. Maybe the textbook writers or curriculum planners didn't visit the old people in the deep rural areas or different areas or countries to gather indigenous knowledge.

Catherine W.N Muyonjo [Interviewer]: Do you not feel that curriculum planners think that indigenous knowledge is not important and hence cover very little of it?

Preservice Teacher 1 [Focus Group 2]: Yes, I do think that because they perceive that indigenous knowledge is a manner in which people lived in ancient days. Now, they want to focus more on the fourth industrial revolution and science to improve the standard of living and not to focus on how people lived, back then.

Catherine W.N Muyonjo [Interviewer]: Do you think that indigenous people did not care about the standard of living?

Preservice Teacher 1 [Focus Group 2]: Uhm, I'm not sure about that one …

Preservice Teacher 3 [Focus Group 2]: I think they cared about the standard of living. But as you know, things change. …uhm, I think it's the story of evolution, things change, so we had to acclimatise with the Western knowledge and leave the indigenous knowledge.

Catherine W.N Muyonjo [Interviewer]: Do you consider African indigenous holders as scientists in their own right?

Preservice Teacher 3 [Focus Group 2]: I think I can try to answer that question, but I'm not sure about my answer. I don't think they were scientists, because I don't consider them … I said 'no' because I don't consider them as scientists. This is because indigenous knowledge relates to people and their understanding of the world. In order to be called a scientist, you must be trained …yeah, I think you must be trained in order to be called a scientist. In the training you do some experiments and research to prove if something really works. But for IK you just use your knowledge …uhm, yeah, you use your understanding of that particular thing. There is no research that you do.

Catherine W.N Muyonjo [Interviewer]: Interesting. So,PT3, when you look at the women for instance, the women in the African context that are preparing umqombothi for example, and looking at the fact that the fermentation process is involved; distilling, and all the scientific things are going on, and they are doing all of this in the kitchen, or

somewhere in the backyard, or in the village; do you not think that these women are not scientists?

Preservice Teacher 1 [Focus Group 2]: No, to answer that question, I can say that with regard to their knowledge, they are merely preparing their traditional beer. I think they do not have any idea about those processes of fermentation and stuff, …yes.

Catherine W.N Muyonjo [Interviewer]: You think they have no idea of fermentation, even though the process requires fermentation?

Preservice Teacher 1 [Focus Group 2]: … For example, maybe I can just ask an old mother preparing that traditional beer, about fermentation, maybe they'll have no idea. But during the process of making that traditional beer, you'll see them covering that bucket of umqombothi with big blankets to provide that smoke, maybe for the process of that fermentation to work successfully. 22:08

Catherine W.N Muyonjo [Interviewer]: Are you saying that these women are carrying out scientific practices, but they just don't know it? Is that what you're saying?

Preservice Teacher 1 [Focus Group 2]: Yes, that's what I'm trying to say …

Catherine W.N Muyonjo [Interviewer]: So, if you agree that the women are carrying out scientific practices, even though they don't know, they don't know or realise that it's called fermentation, even though they are doing fermentation, does it still mean that they are not scientists in their own right?

Preservice Teacher 1 [Focus Group 2]: Uhm, it's a tricky question mam, but uhm, on the other hand you can say that they are scientists, but not based on their knowledge. They do not know that, but …they are… yes.

Catherine W.N Muyonjo [Interviewer]: So, are you now agreeing that they are scientists?

Preservice Teacher 1 [Focus Group 2]: Uhm, I am now convinced that they are scientists.

Catherine W.N Muyonjo [Interviewer]: So, PT2, are you now convinced that these women are scientists in their own right?

Preservice Teacher 2 [Focus Group 2]: I am not convinced. They are doing science but they are using the knowledge that they know …. the knowledge that they are using, they got it from

their elders. Nobody taught them that, “This is the fermentation. Okay?”. There are no steps. They don’t actually understand the steps, but they know how to do umqombothi.

Catherine W.N Muyonjo [Interviewer]: Do you think that there is any wisdom that is embedded within African indigenous knowledge, especially when it comes to the preparation of food and beverages?

Preservice Teacher 2 [Focus Group 2]: Uhm, yes I think there is wisdom because there are some steps and skills that may be required in order to do something. You cannot do something without being taught to do it. For example, steamed bread… you cannot just do it, you must be taught how to do it.

Catherine W.N Muyonjo [Interviewer]: Okay, so where is the wisdom there?

Preservice Teacher 1 [Focus Group 2]: Uhm, just to add onto the point of wisdom, there is wisdom in the preparation of food using the IK because the knowledge that I have is that …back in the day, people used to hunt certain prey, maybe the rabbit meat, let’s say there is the part where they will cook half of the rabbit meat, and the other one will just be hanged until it is dried for a certain period of time, and then that meat will be consumed without cooking it. I think it is called Biltong. I don’t think they were taught that knowledge. It was just wisdom that they had acquired. They knew that when the meat was dry enough, there would be no need to cook the meat and it could just be consumed.

Catherine W.N Muyonjo [Interviewer]: How do you as a science preservice teacher intend to incorporate indigenous knowledge, pertaining to foods and beverages in a science lesson, with a view of deepening conceptual understanding of science?

Preservice Teacher 1 [Focus Group 2]: I’m not sure about my answer. Since indigenous knowledge is very important to learners, I can use it to introduce some science concepts. For example, if we are doing cellular respiration in Life Sciences, maybe I can arrange something like an experiment, maybe in that experiment, we’ll do steamed bread. During the experiment I’ll be telling them that each and every thing that happens in that experiment, relating the indigenous knowledge and Western knowledge. I think it can be easier for them in this way, to understand the topic. …

Preservice Teacher 2 [Focus Group 2]: In order for learners to understand science better, they must have some background knowledge in indigenous knowledge since IK is the

knowledge that they acquire in their home or in their communities by their elders or community members, so science is the knowledge that they acquire at school, so finding out how much knowledge they know, about IK, can also be used successfully, at school as a preservice teacher, when teaching science in a science classroom.

Catherine W.N Muyonjo [Interviewer]: Does the CAPS document in your view, or understanding give sufficient coverage to African indigenous knowledge as well as African foods and beverages?

Preservice Teacher 2 [Focus Group 2]: Uhm, I cannot be sure about my response in that regard because I think we have touched on a question like this. Yeah, maybe I'm being tricked …. But let me try and answer. So, I don't think it does, because the CAPS document focuses more on Western knowledge. Even if there are experiments that must be done, they are done in science, let's say, in a scientific way. They don't use the indigenous knowledge …yeah, that's what I can say …

Preservice Teacher 1 [Focus Group 2]: Yes, I do agree with PT2's opinion mam. I don't think the CAPS document gives sufficient coverage to African indigenous knowledge. …

Catherine W.N Muyonjo [Interviewer]: Why do you think that is the case?

Preservice Teacher 1 [Focus Group 2]: I think my reasoning will be quiet the same with what I said regarding the previous question, because the curriculum planners do not do much research about the indigenous knowledge in a way that can have enough implementation in a way that they can include it in the CAPS document.

Catherine W.N Muyonjo [Interviewer]: In your experience, either as a learner or a science preservice teacher, do you think that learners relate more to African indigenous knowledge or Western knowledge?

Preservice Teacher 1 [Focus Group 2]: I think they relate more to Western knowledge more than the indigenous knowledge because it is what they are being taught. They are being taught more Western knowledge more than the indigenous knowledge. Most books provide more Western information rather than the indigenous knowledge.

Catherine W.N Muyonjo [Interviewer]: PT2, do you concur with your peer?

Preservice Teacher 2 [Focus Group 2]: I partially agree. They do, but not all the time. It depends on the teacher. You see, when you are introducing a topic, you start by using prior knowledge for students to understand the topic in a good way. And then, as time goes by, you then include science. Yeah, I think it depends on the teacher …

Catherine W.N Muyonjo [Interviewer]: PT2, do you not think that students will relate more to what is indigenous to them, as opposed to what is foreign?

Preservice Teacher 2 [Focus Group 2]: Yes.

Preservice Teacher 1 [Focus Group 2]: I think I can try and come in on that one. I think learners can relate more to what they know as opposed to what is foreign to them. But in the indigenous knowledge aspect, nowadays, in many villages or households, the indigenous knowledge is not valued that much, it is not presented that much, so, even the learners cannot acquire that deep indigenous knowledge from their elders, however this was different in the ancient times.

Preservice Teacher 1 [Focus Group 2]: Mr PT1 is right. Learners relate more to Western knowledge, not indigenous knowledge… They are being fed Western knowledge. Even when they come back at home, there are a few indigenous knowledge's that are used now in the communities, because we are driven by science.

Catherine W.N Muyonjo [Interviewer]: Thank you. PT1 and PT2, you did a very beautiful lesson plan on indigenous knowledge. This interview will not only ask questions about indigenous knowledge in general or the CAPS document. We will also talk about your lesson plans. Do you think that the Life Sciences curriculum is structured to enlighten learners about indigenous knowledge? If not, what can be improved in this curriculum?

Preservice Teacher 1 [Focus Group 2]: No, I don't think that the Life Sciences curriculum is equipped enough with indigenous knowledge in a way that the Life Sciences learners can acquire enough indigenous knowledge. Even the Life Sciences textbooks do not present enough indigenous knowledge as guided by the curriculum.

Catherine W.N Muyonjo [Interviewer]: So what do you think can be done to improve this?

Preservice Teacher 1 [Focus Group 2]: To improve the indigenous knowledge acquisition, maybe there should be textbooks that are provided for them which contain all the indigenous knowledge or information that they can read and understand so that they can acquire more indigenous knowledge in schools more than in their homes. This is because learners are programmed that the only place that they get knowledge is at school so, maybe schools can be provided with textbooks or study guides that have more indigenous knowledge.

Catherine W.N Muyonjo [Interviewer]: PT2, do you agree or disagree?

Preservice Teacher 2 [Focus Group 2]: I disagree mam. PT1 has just said everything. I think the curriculum planners must do more research about the indigenous knowledge and not to focus on Western science only because the indigenous knowledge is also important. So, I think that the things which can be done to improve …hum, okay, I think the CAPS document must include more of IK, especially in some Life Sciences practicals. Practicals must include indigenous knowledge. The practicals that must be done in Life Sciences must be done in an indigenous way. Some, not all of them, in an indigenous way…not in a scientific way.

Catherine W.N Muyonjo [Interviewer]: Like umqombothi?

Preservice Teacher 2 [Focus Group 2]: Yes …

Preservice Teacher 1 [Focus Group 2]: Yes …

Catherine W.N Muyonjo [Interviewer]: And steamed bread?

Preservice Teacher 1 [Focus Group 2]: Yes …

Preservice Teacher 2 [Focus Group 2]: Yeah, …

Catherine W.N Muyonjo [Interviewer]: Should learners bring all that they need, like the ingredients and prepare the indigenous food in the classroom?

Preservice Teacher 2 [Focus Group 2]: Yes …

Catherine W.N Muyonjo [Interviewer]: Okay…and what will doing all these indigenous practicals achieve?

Preservice Teacher 2 [Focus Group 2]: I think, if you do what you know, it can be easy for you to understand particular concept… yeah, like, under Life Sciences, cellular respiration, if

learners do umqombothi or steamed bread, it will be easier for them to understand the topic…All the things that are outlined in a science book, they will see it happening.

Catherine W.N Muyonjo [Interviewer]: Thank you, the next question is: Is there a clear correlation or link between cellular respiration and indigenous knowledge? When you look at cellular respiration, either as a concept or topic, and when you look at indigenous knowledge, do the two come together?

Preservice Teacher 2 [Focus Group 2]: I think they come together.

Catherine W.N Muyonjo [Interviewer]: How?

Preservice Teacher 2 [Focus Group 2]: I think they come together because uhm, I think cellular respiration is about the exchange of gases. Right? I'm not sure if I'm correct. If you do what you call 'steamed bread', there are bubbles which are created inside it… those bubbles, I think they are full of carbon dioxide. Those bubbles, I think they are caused by the yeast… yeah, I think they are related. Cellular respiration is related to indigenous knowledge in making steamed bread, when making uhm, umqombothi.

Catherine W.N Muyonjo [Interviewer]: So, it will be good for the learners to do the indigenous practicals because they'll be able to see the link between the science part and the indigenous part? Correct?

Preservice Teacher 1 [Focus Group 2]: Yes

Preservice Teacher 2 [Focus Group 2]: Yes

Catherine W.N Muyonjo [Interviewer]: Thank you. In your lesson plan you explained 'Specific Aim 1', 'Specific Aim 2', and 'Specific Aim 3'. Please briefly explain how 'Specific Aim 1' in the Life Sciences CAPS document relates to indigenous knowledge?

Preservice Teacher 1 [Focus Group 2]: I think the first specific aim in Life Sciences tells us about the relationship between our everyday experiences and science. So, I think this specific aim is telling us that you must know how to link science and indigenous knowledge, which is mostly used when you are introducing a topic. When introducing a topic, you start by telling learners what it is that they already know; and then you introduce the topic afterwards. After you have introduced what is indigenous to learners, you then introduce the science concept. I'm not sure if I'm making sense ….

Catherine W.N Muyonjo [Interviewer]: PT2, do you agree with PT1?

Preservice Teacher 2 [Focus Group 2]: Yes, yes …

Catherine W.N Muyonjo [Interviewer]: Would you guys consider steamed bread as an example of an indigenous/African food?

Preservice Teacher 1 [Focus Group 2]: Yes

Preservice Teacher 2 [Focus Group 2]: Yes

Catherine W.N Muyonjo [Interviewer]: Why?

Preservice Teacher 1 [Focus Group 2]: I think it is because it is prepared using things like water, salt … what I'm trying to say is that steamed bread, there are no ovens that are used, meaning that … it is the African food …it was discovered and prepared using just uhm, I'm not sure how to put my point, but … just trying to organise how to answer your question. …

Preservice Teacher 2 [Focus Group 2]: Yes, I will consider steamed bread as uhm, indigenous food because uhm, this type of bread is made usually at home. Right? So, there's no school that we attend in order to know how to cook steamed bread. We are being taught by our elders…yeah, I think that is what I can say.

Preservice Teacher 2 [Focus Group 2]: To get back to the question mam, I wanted to say that back in the days, people had no ovens or electric stoves to bake or prepare uhm, bread. So, the steamed bread was the only bread that they could prepare using what they had. And they could also prepare it without any electricity. They just made a fire and used boiling water to provide the steam so that the bread could be prepared successfully. I'm not sure whether I'm making sense mam.

Catherine W.N Muyonjo [Interviewer]: Which approach do you think is best when teaching indigenous knowledge in science classroom? Should it be a learner or teacher centred approach?

Preservice Teacher 2 [Focus Group 2]: I think learner centred mam. Because if the lesson is learner centred, learners will communicate what they know with a teacher, and if they know something wrong or have a misconception in what they know, the teacher will try to correct them, yeah.

Preservice Teacher 1 [Focus Group 2]: I think I can say that teaching science, I can say that I prefer the teacher centred approach because I don't think that there is enough information …or enough scientific information that learners can share among themselves, so I think the teacher must provide sufficient information so that learners can acquire and be able to be knowledgeable.

Catherine W.N Muyonjo [Interviewer]: So, PT1, you think that it is the teacher that knows and the learners don't know? So, the teacher should speak because he/she knows and the learners shouldn't because they don't know?

Preservice Teacher 1 [Focus Group 2]: Learners … I didn't mean that learners don't know at all, but there is insufficient information that they can share amongst themselves, compared to the teacher. Regarding the scientific information, I think it is the teacher that can provide enough scientific information to the learners.

Preservice Teacher 2 [Focus Group 2]: Sorry mam, I have a question for PT1.

Preservice Teacher 1 [Focus Group 2]: Yes, Sir?

Preservice Teacher 2 [Focus Group 2]: Don't you think it is a good idea to build on what students already know?

Preservice Teacher 1 [Focus Group 2]: Yes, it is a uhm, a great method trying to build on uhm, what students already know. But I think you can do that successfully when teaching about indigenous knowledge, not scientific knowledge, so …because it might happen that there are learners in the classroom that have certain information about the indigenous knowledge that they have already acquired in their homes, but scientific knowledge, it is the information that they can only acquire at schools because I don't think that there are parents that have …or back home where they can acquire more scientific knowledge compared to school.

Preservice Teacher 1 [Focus Group 2]: I hear you, I hear you PT2.

Catherine W.N Muyonjo [Interviewer]: Your lesson plan made reference to fermentation since you were speaking about the preparation of steamed bread. Please remind me if there is a clear link between science and indigenous knowledge when speaking about fermentation and steamed bread?

Preservice Teacher 1 [Focus Group 2]: Yes, I think there is a link between science and indigenous knowledge, because the steamed bread is indigenous food. It is prepared using olden methods, so in the process of preparing steamed bread, there is a scientific term that is practiced which is the process of fermentation, so I think there is a link between the two.

Catherine W.N Muyonjo [Interviewer]: PT2 do you agree or disagree with your peer?

Preservice Teacher 1 [Focus Group 2]: I agree with PT1.

Catherine W.N Muyonjo [Interviewer]: You agree that there is a link between science and indigenous knowledge, especially when it comes to steamed bread and fermentation?

Preservice Teacher 1 [Focus Group 2]: Yeah, I think there is a link.

Catherine W.N Muyonjo [Interviewer]: So, since you guys spoke about steamed bread, you mentioned that steamed was healthy. How healthy is steamed bread? And why do you think it is healthy?

Preservice Teacher 2 [Focus Group 2]: I think that steamed bread very healthy for people who are suffering from diabetes. Yeah, because it has a low **glycemic index**.

Preservice Teacher 1 [Focus Group 2]: I think steamed bread is healthy because it is not the type of food that is fried in excessive oil. It doesn't contain a lot of sugar; it usually just has maybe a pinch of sugar …not in a way that it is sweet or contains a lot of fat.

Catherine W.N Muyonjo [Interviewer]: So, do you guys think that our indigenous people were healthier that we are today?

Preservice Teacher 1 [Focus Group 2]: Yes

Preservice Teacher 1 [Focus Group 2]: Yes

Catherine W.N Muyonjo [Interviewer]: So, you think that indigenous food was healthier than most of the Western food that we are consuming today?

Preservice Teacher 1 [Focus Group 2]: Yes

Catherine W.N Muyonjo [Interviewer]: Since you mentioned that steamed bread is healthier and does not contain too much oil, can you say that we are consuming too much oil? As opposed to our indigenous people?

Preservice Teacher 1 [Focus Group 2]: I'm not sure how to answer that question but I think yes. We consume a lot of oil.

Catherine W.N Muyonjo [Interviewer]: Does steamed bread serve any purpose in the indigenous African context?

Preservice Teacher 1 [Focus Group 2]: Yes mam …

Catherine W.N Muyonjo [Interviewer]: What purpose does it serve?

Preservice Teacher 1 [Focus Group 2]: Uhm, I'm not sure if my answer will be uhm, relevant to your question. But … I said yes because there are no scientific steps or materials that are included in making steamed bread

Catherine W.N Muyonjo [Interviewer]: Don't you think you'll be contradicting yourself here, because earlier on, when we were speaking about steamed bread, fermentation, the link between science and indigenous knowledge, you mentioned that yes, there's a link…if you say 'no' now it means you're contradicting what you said earlier.

Preservice Teacher 1 [Focus Group 2]: Yes there is a link because the aim to create something. The product might likely be the same but the processes and the steps are not the same.

Catherine W.N Muyonjo [Interviewer]: What are the advantages of steamed bread?

Preservice Teacher 2 [Focus Group 2]: The first advantage is that they taste good, even in the absence of sauces. And they take less time to ferment.

Catherine W.N Muyonjo [Interviewer]: Oh okay, and what else?

Preservice Teacher 2 [Focus Group 2]: As I have said before, I think it was the 17th or 18th question, but I said it is good for uhm, diabetic people which means it contains less fats and oils.

Catherine W.N Muyonjo [Interviewer]: Would you say there are any disadvantages or you'd say they are none?

Preservice Teacher 1 [Focus Group 2]: I don't see any disadvantage of the steamed bread.

Catherine W.N Muyonjo [Interviewer]: Are you 100% sure of that? Sure, sure, sure?

Preservice Teacher 2 [Focus Group 2]: I think everything has its advantages and disadvantages. But I don't know of a disadvantage pertaining to steamed bread.

Catherine W.N Muyonjo [Interviewer]: Do you think it is better to just teach our learners about African foods and beverages or should preservice teachers encourage their learners to actually make these foods and beverages?

Preservice Teacher 1 [Focus Group 2]: I think it is better to teach them about the indigenous foods and beverages rather than requiring them to make because uhm, in the making process I don't think they'll be enough food or resources and time to prepare those indigenous meals.

Catherine W.N Muyonjo [Interviewer]: What if the school makes provision for it? What if the school is privileged and does Life Sciences, Natural Sciences, Physical Sciences? A school is usually allocated a budget to ensure that sciences are well equipped with all that they need. For example, beacons that are used for practicals are provided, in schools that have the means/funds. Don't you think that a school that has these resources can make provision for things such as: Flour, water …etc… Don't you think that learners learn better when they actually do the practicals, than when they are just told 'you mix hydrogen and oxygen and you get water'. Don't learners learn more when they see things physically in the lab?

Preservice Teacher 1 [Focus Group 2]: I think it will be better in the aspect of those privileged schools. I think my response only focused on those rural schools that do not have resources in a way that they can provide …in the making process for learners. But in those schools that have enough resources and ingredients to prepare those indigenous meals, I think uhm, it will be better to give learners the opportunity to make those indigenous foods, but I think there must be some chefs that can guide them. This will ensure there is no burning or damages etc.

Catherine W.N Muyonjo [Interviewer]: So you agree that if the learners actually make these foods, they would learn more and understand better than merely telling them about these foods?

Preservice Teacher 1 [Focus Group 2]: Yes, yes, they can learn better.

Preservice Teacher 2 [Focus Group 2]: Yes, because if you do something by yourself, you understand it better. I think PT1 has said everything.

Catherine W.N Muyonjo [Interviewer]: Do you think it will serve a very good purpose if they actually learn about indigenous foods, beverages, and they are also making them, do you think it will serve a good purpose for the learner?

Preservice Teacher 2 [Focus Group 2]: Yeah, I think it will serve a good purpose. Yeah, uhm, because…I think we just said the answer, few minutes ago.

Catherine W.N Muyonjo [Interviewer]: Do you think that when it comes to the preparation of African foods and beverages, learning about it and actually making it, do you think it is actually being carried out in schools? Do you think this is being done to enhance the learners' understanding?

Preservice Teacher 2 [Focus Group 2]: No, they don't.

Catherine W.N Muyonjo [Interviewer]: Why do you think that is the case?

Preservice Teacher 2 [Focus Group 2]: I think it is because of the curriculum. Teachers are guided by the curriculum that they have to follow from the beginning of the year, to the end of the year. And the curriculum has a lot to cover, so if they do all these things, they might end up wasting time and not finishing the content.

Catherine W.N Muyonjo [Interviewer]: Do you consider schools that choose to teach children about indigenous knowledge and actually encourage them to make these foods; do you consider them a waste of time?

Preservice Teacher 2 [Focus Group 2]: No, I don't consider it as a waste of time. It can be a good thing, you know, but teachers are guided by a particular document, which is called CAPS, but it can be a very good thing to for learners to do all these things; umqombothi and steamed bread because it can deepen their understanding of fermentation.

Catherine W.N Muyonjo [Interviewer]: Thank you very much gentlemen for your time. We have come to the end of our interview. You did a very beautiful lesson plan and it will be used in this research as well. This interview and your lesson plan will be incorporated into this research.

Preservice Teacher 2 [Focus Group 2]: We are happy that you have noticed our work have regarded it as a perfect work. We really appreciate it.

Semi – Structured Interview 3 Transcript

Focus Group 3

Catherine W.N Muyonjo [Interviewer]: Thank you very much for agreeing to be a part of this interview. Please feel free and do not feel that you need to be under pressure. I have questions that I have designed, however there will be questions that will be spontaneous, where I am required to probe to seek better clarity. Please respond the way you wish to respond. This meeting will be recorded as well.

We are discussing indigenous knowledge and I am interviewing science preservice teachers.

The first question is, what is your understanding of indigenous knowledge?

Preservice Teacher 1 [Focus Group 3]: Okay, I think indigenous knowledge refers to the cumulative body of knowledge, practices and beliefs that have been developed and passed down through generations within indigenous communities. I can also say that it uhm encompasses a deep understanding of the natural environment, ecosystems, traditional technologies, cultural practices, etc.

Catherine W.N Muyonjo [Interviewer]: That's an excellent answer, that is like a memo answer. That is a very good answer, thank you very much. Since you're speaking about the natural environment, do you think that indigenous people were in touch with their environment? And how so?

Preservice Teacher 1 [Focus Group 3]: Okay, I've said it encompasses a deep understanding of the natural environment from indigenous communities.

Catherine W.N Muyonjo [Interviewer]: PT2, you've listened to PT1's response, right?

Preservice Teacher 2 [Focus Group 3]: Yes, about what indigenous knowledge is?

Catherine W.N Muyonjo [Interviewer]: Is there anything you'd like to add or subtract from what has been said?

Preservice Teacher 2 [Focus Group 3]: I don't want to subtract anything.

Catherine W.N Muyonjo [Interviewer]: Is there anything you'd like to add?

Preservice Teacher 2 [Focus Group 3]: I can add… I can add that indigenous knowledge relates only to particular people and their understanding of the world.

Catherine W.N Muyonjo [Interviewer]: Do you think that when it comes to their understanding of the world, that we are in touch with their understanding of the world?

Preservice Teacher 2 [Focus Group 3]: Yes!

Catherine W.N Muyonjo [Interviewer]: Okay, how so?

Preservice Teacher 2 [Focus Group 3]: Yes! Because some things help them, or help us as a country or community in their beliefs.

Catherine W.N Muyonjo [Interviewer]: Do you see a link between indigenous knowledge and science?

Preservice Teacher 2 [Focus Group 3]: Yes! There is a linkage. Because the sciences used indigenous knowledge so that they can do their work helping them to find the word 'life' and beat their relationship between them…

Catherine W.N Muyonjo [Interviewer]: Please repeat your answer. The question was, do you see a link between indigenous knowledge and science?

Preservice Teacher 2 [Focus Group 3]: Meaning they interact?

Catherine W.N Muyonjo [Interviewer]: Yes

Preservice Teacher 2 [Focus Group 3]: Yes, because the other sciences, rely on indigenous people to guide their work.

Catherine W.N Muyonjo [Interviewer]: Are you saying science depends on indigenous knowledge?

Preservice Teacher 2 [Focus Group 3]: Some science ….

Catherine W.N Muyonjo [Interviewer]: Okay, which science is depending on indigenous knowledge?

Preservice Teacher 2 [Focus Group 3]: Which science?

Catherine W.N Muyonjo [Interviewer]: Or which elements of science? What parts of science are depending on indigenous knowledge?

Preservice Teacher 2 [Focus Group 3]: eisssh, pass mam!

Catherine W.N Muyonjo [Interviewer]: Okay. PT1?

Preservice Teacher 1 [Focus Group 3]: I see the link between indigenous knowledge and science.

Catherine W.N Muyonjo [Interviewer]: Do you agree that science depends on indigenous knowledge at some point?

Preservice Teacher 1 [Focus Group 3]: I can say that there is a link between indigenous knowledge and science, although they may differ in their approaches and mythologies. Eisssh, I'm not sure about this but I can …but uhm…my point that can illustrate the connection between the two…I can use climate change adaptation. Indigenous communities have a deep understanding of their local climate and have developed adaptive strategies to cope with environmental changes. This knowledge, I think can contribute to scientific efforts to understand and respond to climate change. Uhm, I can also say that indigenous knowledge or seasonal variations and traditional, ecological can complement scientific data and our understanding of climatic patterns and impact.

Catherine W.N Muyonjo [Interviewer]: I just want to understand something a little deeper… What are those methods that indigenous people have come up with to address the ever changing climate or environment?

Preservice Teacher 1 [Focus Group 3]: Uhm, ive said methologies …

Catherine W.N Muyonjo [Interviewer]: Methologies or methodologies?

Preservice Teacher 1 [Focus Group 3]: Methodologies.

Catherine W.N Muyonjo [Interviewer]: Do you want to explain to us in your own words what you mean by that?

Preservice Teacher 1 [Focus Group 3]: Methologies I think it's uhm, the ways, like approaches …

Catherine W.N Muyonjo [Interviewer]: Okay, thank you. PT2, why is it relevant to teach our learners about indigenous knowledge within the science classroom?

Preservice Teacher 2 [Focus Group 3]: Uhm, it's important because of not leaving the background roles … yeah … So that they can see the importance of the indigenous knowledge and know how people lived a long time ago.

Catherine W.N Muyonjo [Interviewer]: And why is it important for us to know how they lived a long time ago? Of what value is that to us or to the learners?

Preservice Teacher 2 [Focus Group 3]: So that we have an idea of it

Catherine W.N Muyonjo [Interviewer]: And when we have that idea, what are we going to do with that idea?

Preservice Teacher 2 [Focus Group 3]: We can maybe make some difference of it with now generation, like scientists.

Catherine W.N Muyonjo [Interviewer]: Okay, when you mention scientists, are you saying that scientists have something to learn from indigenous knowledge?

Preservice Teacher 2 [Focus Group 3]: I don't get it!

Catherine W.N Muyonjo [Interviewer]: Okay, it's fine. PT1, can you respond to that? Do you think scientists have something to learn from indigenous knowledge?

Preservice Teacher 1 [Focus Group 3]: No, they don't know everything. They rely on indigenous knowledge.

Catherine W.N Muyonjo [Interviewer]: Would you say scientists rely on indigenous knowledge 100%?

Preservice Teacher 1 [Focus Group 3]: Hummn, I'm not sure, but I can say that they can rely on indigenous knowledge.

Catherine W.N Muyonjo [Interviewer]: And do you think our learner should be taught about indigenous knowledge in the science classroom, is it important?

Preservice Teacher 1 [Focus Group 3]: Yes, it is important.

Catherine W.N Muyonjo [Interviewer]: Okay, why?

Preservice Teacher 1 [Focus Group 3]: Indigenous knowledge in the Natural Sciences classroom, enriches the learners' experiences with cultural understanding and it encourages learners to engage critically with complex environments….

Catherine W.N Muyonjo [Interviewer]: PT2, when you look at science textbooks, whether Natural Sciences, Life Sciences, Physical Sciences, which foods and beverages are included in these textbooks?

Preservice Teacher 2 [Focus Group 3]: There are some fish, nuts and carbohydrates, uhm, the meat, and eggs etc…

Catherine W.N Muyonjo [Interviewer]: Okay, and from those you've mentioned PT2, how many of those are actually indigenous? How many of those are actually African indigenous foods?

Preservice Teacher 2 [Focus Group 3]: I think the indigenous …the nuts…yeah.

Catherine W.N Muyonjo [Interviewer]: Nuts are indigenous?

Preservice Teacher 2 [Focus Group 3]: Yes

Catherine W.N Muyonjo [Interviewer]: And the other foods you mentioned are not indigenous? Like the meat?

Preservice Teacher 2 [Focus Group 3]: They are… and the fish …

Catherine W.N Muyonjo [Interviewer]: So, they are all indigenous? All those that you mentioned are all indigenous?

Preservice Teacher 2 [Focus Group 3]: Yes …

Catherine W.N Muyonjo [Interviewer]: PT3, which foods and beverages have you seen in science textbooks, in the South African context?

Preservice Teacher 3 [Focus Group 3]: I've seen sorgum beer which is umqombothi. That's a beverage.

Catherine W.N Muyonjo [Interviewer]: Any other beverages or foods that you have seen in science textbooks?

Preservice Teacher 3 [Focus Group 3]: Uhm, beans …

Catherine W.N Muyonjo [Interviewer]: Okay, and what else?

Preservice Teacher 3 [Focus Group 3]: Uh, yeah, that's it.

Catherine W.N Muyonjo [Interviewer]: PT4, which foods and beverages have you seen in science textbooks?

Preservice Teacher 3 [Focus Group 3]: Uhm, I have seen uhm, the African potato and aloe.

Catherine W.N Muyonjo [Interviewer]: PT1? You've heard all that your peers have said?

Preservice Teacher 3 [Focus Group 3]: Yes…

Catherine W.N Muyonjo [Interviewer]: Now from all that they've said, do you think that there a lot of African foods and beverages that they have spoken about? Would you say it is sufficient or enough?

Preservice Teacher 3 [Focus Group 3]: I don't get you!

Catherine W.N Muyonjo [Interviewer]: From all the foods and beverages that have been mentioned amongst your peers, would you say that the curriculum has covered enough of these foods and beverages?

Preservice Teacher 3 [Focus Group 3]: I can't get you!

Catherine W.N Muyonjo [Interviewer]: Okay, it's fine, PT4? From all the foods and beverages that have been mentioned amongst your peers, would you say that the curriculum has covered enough of these foods and beverages?

Preservice Teacher 4 [Focus Group 3]: I don't think so mam, because uhm, we won't be able to cover all of them since there are many traditional foods. They only choose those that are specific…like, uhm, I don't know how to explain it but…I'll try. They only choose the food that is used to treat a specific disease. Yes, in Life Sciences, as far as I know, they only choose those foods only. The other food was not chosen because I think it is not necessary to know all of the traditional African food.

Catherine W.N Muyonjo [Interviewer]: But do you think that it is not necessary to know all the African foods?

Preservice Teacher 4 [Focus Group 3]: I think it is necessary, just to have more knowledge.

Catherine W.N Muyonjo [Interviewer]: Don't you think that we can create a book that actually covers all the foods? All the African indigenous food?

Preservice Teacher 4 [Focus Group 3]: I think that's gonna be very interesting.

Catherine W.N Muyonjo [Interviewer]: So, do you do think it is something that can be done and envisaged?

Preservice Teacher 4 [Focus Group 3]: Yes

Catherine W.N Muyonjo [Interviewer]: When our curriculum planners choose to only speak about certain foods and beverages, right? In the African context, do you not think they are being biased?

Preservice Teacher 4 [Focus Group 3]: They will be biased because in some Western countries, they don't know about the African traditional food. And some people will want to know about the type of traditional foods that we have and are not aware of.

Catherine W.N Muyonjo [Interviewer]: PT3, can you add to that?

Preservice Teacher 3 [Focus Group 3]: Yeah, I think uhm, when curriculum planners only focus on specific food, and neglect the inclusion of others, it does portray bias, cultural bias specifically; because if our curriculum focuses on the foods of a particular culture while disregarding or underrepresenting others, it may reflect a cultural bias. This can result in an incomplete understanding of other cultures.

Catherine W.N Muyonjo [Interviewer]: So do you think that the curriculum planners designing our curriculum/textbooks are not of African descent?

Preservice Teacher 3 [Focus Group 3]: Uhm, yeah, I think so.

Catherine W.N Muyonjo [Interviewer]: Do you think they are not African and so because of that, they can be considered biased?

Preservice Teacher 3 [Focus Group 3]: Yes, I think so, because if they were Africans, they would have included all the foods we have in Africa.

Catherine W.N Muyonjo [Interviewer]: Okay, do you all agree with what PT3 is saying? That if the curriculum planners were African, they would have included all the food we have in Africa? Would that really be the case?

Preservice Teacher 4 [Focus Group 3]: Yes, mam, I agree with my peer.

Catherine W.N Muyonjo [Interviewer]: Why do you agree with her? How sure are you that if it was an African curriculum planner then all the African foods and beverages would have been included? How sure are you? Why are you so sure?

Preservice Teacher 4 [Focus Group 3]: Uhm, I think uhm, it's because they only chose the food that not only …. they also involved food that is from the rest of Western Africa … so that's why I think it's not an African person who designed or included all the African foods.

Catherine W.N Muyonjo [Interviewer]: Would you consider African indigenous knowledge holders as scientists in their own right?

Preservice Teacher 3 [Focus Group 3]: Yes, yes I do because indigenous knowledge systems have a long history, of observing, understanding and applying knowledge about the natural world and that is what scientists do. So indigenous communities often hold deep knowledge and expertise in areas such as agriculture, herbal medicine and weather patterns…uhm, yeah, so,

Catherine W.N Muyonjo [Interviewer]: When you look at women for instance, that are preparing umqombothi, would you regard them as scientists? Or the women and men who are preparing any of the African foods and beverages?

Preservice Teacher 3 [Focus Group 3]: Yeah, I think so, because uhm, obviously, they investigate about the ingredients that they would want to use for preparing umqombothi. They have deep knowledge of selecting and processing the grains, such as the sorghum that is used to prepare umqombothi and maize as well as understanding the fermentation process. They possess deep understanding of factors such as temperature, they know that uqombothi has to be stored in a place that has certain temperature. So yeah, I think they are scientists.

Catherine W.N Muyonjo [Interviewer]: PT4, do you agree with PT3 on that?

Preservice Teacher 4 [Focus Group 3]: Yes mam, I do agree because umqombothi really needs warm temperature… in its process.

Catherine W.N Muyonjo [Interviewer]: PT4, is there any wisdom that you see within African indigenous knowledge, especially when it comes to the manner in which foods and beverages are prepared?

Preservice Teacher 4 [Focus Group 3]: Yes, I think there is because when it comes to the preparation of food, they only use the ingredients provided, …they do according to the procedure while processing for example, umqombothi.

Catherine W.N Muyonjo [Interviewer]: PT1, do you see any wisdom that is embedded within African indigenous knowledge especially when it comes to the preparation of foods and beverages?

Preservice Teacher 1 [Focus Group 3]: .... African indigenous people are known for their rich flavours, diverse ingredients and different cooking techniques which have been developed over generations.

Preservice Teacher 3 [Focus Group 3]: Yes, I also think that there is significant wisdom embedded in African indigenous systems when it comes to food preparation. For an example, African traditional preservation methods such as smoking, drying, fermentation have been developed and refined over generations. This technique effectively extends the shelf life of the foods while maintaining their nutritional value. Indigenous knowledge holders possess valuable insight when it comes to food preservation that can inform sustainable food systems.

Catherine W.N Muyonjo [Interviewer]: PT4, how do you as a preservice science teacher intend to incorporate indigenous knowledge pertaining to foods and beverages within a science lesson, with a view of depending conceptual understanding of science?

Preservice Teacher 3 [Focus Group 3]: Can I please think about the answer … I don't know the answer yet…

Catherine W.N Muyonjo [Interviewer]: Okay, I've written it down for you, you can look at the question in the chat. You can think about it and your peers can give it a go …

Preservice Teacher 1 [Focus Group 3]: As a preservice science teacher, I can take time to research and familiarise myself with the indigenous knowledge and practices related to foods and beverages in my local or regional context. This may involve studying food preparation methods. I can also organise field trips to indigenous communities or farms where students can engage with indigenous knowledge and learn about traditional foods and beverages.

Preservice Teacher 3 [Focus Group 3]: I can invite guest speakers who have indigenous knowledge such as community elders, or local experts so that they can share their knowledge and experiences directly with the students. They can provide insight into traditional food

practices, preparation techniques and the scientific principles behind them. This experience can create a rich engaging learning experience to the learners.

Catherine W.N Muyonjo [Interviewer]: Does the CAPS document in your view, give sufficient coverage to African indigenous knowledge as well as African foods and beverages?

Preservice Teacher 3 [Focus Group 3]: No.

Catherine W.N Muyonjo [Interviewer]: Please explain …

Preservice Teacher 3 [Focus Group 3]: The CAPS document didn't give …because they don't mention everything … they can mention 'foods and beverages' but they didn't mention the method…how to do it …

Catherine W.N Muyonjo [Interviewer]: Please repeat … the network isn't good.

Preservice Teacher 3 [Focus Group 3]: I've said the CAPS document didn't give sufficient coverage to African indigenous knowledge as well as ….

Catherine W.N Muyonjo [Interviewer]: The CAPS document does not give sufficient coverage. Right?

Preservice Teacher 3 [Focus Group 3]: Yes.

Catherine W.N Muyonjo [Interviewer]: Okay, why do you think so?

Preservice Teacher 1 [Focus Group 3]: I think it is because CAPS is there to guide teachers on what to teach, not the methods and strategies on how they should ….eissh, uhm, they should learn by themselves on how to teach learners about methods of doing or preparing foods and beverages, such as umqombothi and steamed bread.

Catherine W.N Muyonjo [Interviewer]: Okay, uhm, maybe you should revisit the question! Look at the question again. Does the CAPS document in your view give sufficient coverage to African indigenous knowledge as well as African foods and beverages? So, the question is asking that when you look at the CAPS document, do you think that it has sufficiently African indigenous knowledge? Would you say there is so much about African indigenous knowledge that has been covered or spoken about? Would you say that African foods and beverages have been sufficiently covered?

Preservice Teacher 1 [Focus Group 3]: I can't get the question clearly.

Catherine W.N Muyonjo [Interviewer]: Okay it is fine. PT3, do you get the question clearly?

Preservice Teacher 3 [Focus Group 3]: Yes mam, I'm not sure if I get it clearly but I can try. Okay, uhm, eissh, a minute please mam…

Catherine W.N Muyonjo [Interviewer]: Okay, while PT3 is thinking about it, let us allow PT4 to respond. Kindly unmute …

Preservice Teacher 4 [Focus Group 3]: Yes mam, I think the CAPS document didn't give us the sufficient coverage regarding the African indigenous knowledge as well as African foods and beverages because the CAPS document only provided the food that is just uhm, a guide or just uhm, for us to only know that there is something such as 'African potato'. For example, that there is an African potato, but they didn't give us the effects, the side effects of the African potato, the impact of the African potato and the procedures …and…they only gave us the location of some of the African foods, but not the effects. They never gave us any sufficient knowledge or more information about these foods and beverages.

Catherine W.N Muyonjo [Interviewer]: Thank you PT4. Do you think that the CAPS document should have covered more? Do you think it should have given more coverage? And why did they not cover more?

Preservice Teacher 4 [Focus Group 3]: I think they didn't cover more because they wouldn't be space for all the African food. That's why they didn't cover more of the African food. They only chose the African food that helps us with most of the diseases, and for the teachers to also uhm, have some research, to have some research on their own about other African food that is around…. That is global.

Catherine W.N Muyonjo [Interviewer]: …And does the CAPS document state that teachers are supposed to go and find out more information? Does it say that?

Preservice Teacher 4 [Focus Group 3]: No it doesn't.

Catherine W.N Muyonjo [Interviewer]: Okay, so how are teachers supposed to know that they are supposed to go and find out more information if the CAPS document that is meant to guide them, doesn't tell them that?

Preservice Teacher 4 [Focus Group 3]: I think … just for more knowledge to tell the students that there is something like this … such as umqombothi. There is also a …. Meal… for the teacher to make examples, while explaining to the students … that's why I'm saying they have to have another knowledge to visit …

Catherine W.N Muyonjo [Interviewer]: PT3 kindly give your view, briefly.

Preservice Teacher 4 [Focus Group 3]: Uhm, I think it does cover enough indigenous knowledge system information …

Catherine W.N Muyonjo [Interviewer]: Tell us why ….

Preservice Teacher 4 [Focus Group: …because in the CAPS curriculum there are topics such as, 'cultural heritage', 'indigenous knowledge systems', and 'sustainable agricultural practices'. These topics provide opportunities to explore African indigenous knowledge related to food, agriculture and culinary traditions … However, there are specific depths and breath that … coverage may depend on factors such as the grade level. I remember in my lower grade; I can't recall very well whether it was grade 6 or 5. I got exposed to different cultures. We were taught about different cultures, the food they eat, the medicine they use, … I was only exposed to the African potato and the other plants that were used for remedies in my higher grades. I only got exposed to them in my higher grades; grade 10 -12. I think they do cover enough information.

Catherine W.N Muyonjo [Interviewer]: Thank you. Please answer the next question … So, PT3, in your experience, as a learner, a preservice science teacher, do you think learners relate more to African indigenous knowledge or Western knowledge?

Preservice Teacher 4 [Focus Group: … I think they relate more to Western knowledge. … just a minute please ….

Catherine W.N Muyonjo [Interviewer]: Okay, while PT3 is still thinking, PT4, kindly give us your view… PT4, in your experience, as a learner, a preservice science teacher, do you think learners relate more to African indigenous knowledge or Western knowledge?

Preservice Teacher 4 [Focus Group 3]: I think they know more based on African knowledge, uhm, because they only know the African knowledge that they were told by their grannies, their own parents… they only know that knowledge such as … in some schools, in rural areas,

when their teachers are teaching they only teach about what they know from their background, based on the cultural background. They only teach students what they know and make examples from what they know form their gannies and great grandpa's. I think they only know about the African knowledge not the Western because they are not exposed to the research.

Catherine W.N Muyonjo [Interviewer]: But PT4, when they come to school and are doing Natural Sciences or Life Sciences, do you not think they are getting exposed to indigenous knowledge and Western knowledge as well?

Preservice Teacher 4 [Focus Group 3]: They do, just a little bit, but it's more on African.

Catherine W.N Muyonjo [Interviewer]: Are you saying that the curriculum they are being taught is focusing more on indigenous knowledge and less on Western knowledge?

Preservice Teacher 4 [Focus Group 3]: The curriculum focuses more on the Western knowledge but when teachers make examples they make examples based on African knowledge f

Or the kids, for the students to have ideas, some ideas to understand much faster.

Catherine W.N Muyonjo [Interviewer]: PT3 are you back now? Do you now have your response ready?

Preservice Teacher 3 [Focus Group 3]: I think PT4 has covered my points.

Catherine W.N Muyonjo [Interviewer]: So, you agree with PT4?

Preservice Teacher 3 [Focus Group 3]: Yes, I agree with PT4. …But I also think it differs with the setting… like in the rural areas, educators use indigenous knowledge examples to explain some things. Maybe in the suburbs they use Western knowledge.

Catherine W.N Muyonjo [Interviewer]: So, PT3, what was your lesson plan about?

Preservice Teacher 3 [Focus Group3]: … Our lesson plan was about healthy diet that includes indigenous food.

Catherine W.N Muyonjo [Interviewer]: Kindly elaborate a bit more about your lesson plan. Your lesson plan spoke about a healthy diet in context of the digestive system…. Do you think African indigenous people back in the day were aware of how much to consume in terms of Carbohydrates, Proteins, Fats and Oils?

Preservice Teacher 3 [Focus Group 3]: …No, I don't think they were aware. I think the awareness came with education because people back then were not educated. They didn't have much knowledge on the food content. They were just consuming, yeah.

Catherine W.N Muyonjo [Interviewer]: When you say they were not 'educated', how are you defining education?

Preservice Teacher 3 [Focus Group 3]: …You know, going to school, learning, uhm, going to school, using a curriculum for learning.

Catherine W.N Muyonjo [Interviewer]: So, for you, if indigenous people did not go to a classroom like you and I, then they were not educated?

Preservice Teacher 3 [Focus Group 3]: …Yeah, in my own view, yes.

Catherine W.N Muyonjo [Interviewer]: Do you think that the indigenous people who ate all the healthy meals such as samp and beans were not aware that such meals were healthy and good for them?

Preservice Teacher 3 [Focus Group 3]: Yes, I don't think so because I think that was the only food that was there in their time so they were exposed only to that.

Preservice Teacher 4 [Focus Group 3]: Yes mam, I do agree. I remember my mum telling me that unmarried women were not allowed to eat chicken in their time because it has a lot of protein and iron. …. I agree because chicken should not be confined only to a certain group of people. We all can eat chicken because it contains iron, nutrients and minerals.

Catherine W.N Muyonjo [Interviewer]: Do you not think that unmarried women had to refrain from chicken for a reason? Maybe a cultural reason?

Preservice Teacher 4 [Focus Group 3]: I think it was the culture because they said unmarried women were not allowed to fall pregnant. Chicken meat and eggs could not be eaten by unmarried women.

Catherine W.N Muyonjo [Interviewer]: What is the relationship between not being married and not being allowed to eat the foods you have mentioned?

Preservice Teacher 4 [Focus Group 3]: I think it's about the hormones. When you eat eggs, the hormones in a woman's body become high and they desire sexual intercourse. Hence, they

were prohibiting unmarried women from eating such foods to avoid pregnancy outside of wedlock.

Catherine W.N Muyonjo [Interviewer]: Do you think such claims can be backed up by science? Do those foods affect our hormones?

Preservice Teacher 4 [Focus Group 3]: Uhm, no, I don't think so.

Catherine W.N Muyonjo [Interviewer]: PT1, do you agree that eating these foods affects our hormones?

Preservice Teacher 4 [Focus Group 3]: Uhm, no, I don't …

Preservice Teacher 1 [Focus Group 3]: Yes, I agree because my mum told me that young girls who were growing up in her time could easily get pregnant if they ate those foods.

Catherine W.N Muyonjo [Interviewer]: PT3, Were Africans aware that samp and beans was a healthy meal?

Preservice Teacher 3 [Focus Group 3]: No, I don't think they were aware.

Catherine W.N Muyonjo [Interviewer]: PT3, since you're not aware, are you saying they didn't know that samp and beans had carbohydrates and proteins? And good fats and oils?

Preservice Teacher 3 [Focus Group 3]: With regard to samp and beans, I don't think they had knowledge. Maybe they just had their beliefs, their cultural beliefs of some sort. I really don't think they had knowledge about the contents in the food.

Catherine W.N Muyonjo [Interviewer]: PT3, with regard to your lesson plan, Proteins that are found in certain foods repair and build tissue which is very important. Do you think that African indigenous people didn't know this?

Preservice Teacher 3 [Focus Group 3]: I think they only had the knowledge that if you eat …for example if a girl consumed eggs more than she should, there was a tendency for her to develop secondary sexual characteristics very fast.

Catherine W.N Muyonjo [Interviewer]: PT3, so you are saying that these indigenous people were not aware of the fact that proteins existed and built worn out tissue? They

didn't know about carbohydrates, but they knew that if you eat this type of food, this would be the outcome. Correct?

Preservice Teacher 3 [Focus Group 3]: Yes, that's what I'm saying.

Catherine W.N Muyonjo [Interviewer]: Okay, another question pertaining to your lesson plan is … you spoke about milk, eggs, cheese, samp, dry beans, legumes and nuts. Right? Those are the foods you mentioned in your lesson plan. Do you consider all these foods African indigenous foods? And would you consider milk an African beverage?

Preservice Teacher 3 [Focus Group 3]: Uh, yes, yes I do. I'm now having internal conflict. If they didn't have the knowledge about the food, maybe it doesn't qualify then, as indigenous foods. …yooh! I'm so confused right now….

Catherine W.N Muyonjo [Interviewer]: Okay don't worry, we all get confused sometimes. I also get confused. Let me bring in PT4 and PT3. Would you consider the mentioned foods are African indigenous foods?

Preservice Teacher 4 [Focus Group 3]: Uhm no.

Catherine W.N Muyonjo [Interviewer]: Okay, let's go back to PT3. Let us look at your lesson plan. When you look at the food pyramid, it tells us the quantity that we are supposed to eat. For example, fruits and vegetables are supposed to make up a larger portion of our diet. There is a specific portion for carbohydrates, proteins, dairy, fats and oils. Do you think that indigenous people knew about the quantity that they were expected to consume?

Preservice Teacher 3 [Focus Group 3]: I think they didn't know. I just remembered that my grand mum told me that they used to eat pap and vegetables for the whole year. They only ate meat on Christmas day. Hence, looking at that I don't think they knew about the food quantities.

Catherine W.N Muyonjo [Interviewer]: When your grand mum told you that they only ate meat on Christmas, do you not think that they were financially constrained and not that they didn't know that meat was good for them?

Preservice Teacher 3 [Focus Group 3]: It might be that they were financially constrained …thing is… she told me that they had farms. Her father had cattle but they only ate meat during Christmas. They were farming and planting vegetables.

Catherine W.N Muyonjo [Interviewer]: Do you not think they were using the cattle as a means of getting an income? If you eat the cattle it means you don't have any more to keep generating an income. If you keep the cattle it means you don't eat meat and you keep getting milk…or you keep the hens so that you can keep getting eggs not because you think that hens aren't good to eat. Or you disagree?

Preservice Teacher 3 [Focus Group 3]: Mam, I agree.

Catherine W.N Muyonjo [Interviewer]: So you agree that it was a financial constrain? Not so much because they didn't know the quantity.

Preservice Teacher 3 [Focus Group 3]: Mam, I agree. Yeah, eisssh, let me just agree.

Catherine W.N Muyonjo [Interviewer]: Whether it's in Life Sciences or Natural sciences, you have a way of testing for starch and for fats and oils. When you're doing the starch test, you use iodine. … Do you think indigenous people had a way of testing for these things? Did they even know starch? Did they know what starch was? Did they have a way for testing for starch?

Preservice Teacher 3 [Focus Group 3]: I don't think so.

Catherine W.N Muyonjo [Interviewer]: PT4, your lesson plan was about genetics and inheritance as well as genetic engineering. It was a beautiful lesson plan. What is the relationship between indigenous knowledge and Life Sciences?

Preservice Teacher 4 [Focus Group 3]: It's nature because Life Sciences is probably based on nature. And indigenous knowledge is also based on things that are done culturally. Indigenous knowledge is also based on natural things such as plants and animals.

Catherine W.N Muyonjo [Interviewer]: Okay, and would you say there is a link between indigenous knowledge and genetic engineering?

Preservice Teacher 4 [Focus Group 3]: Yes, mam, there is a link. It does link because most of the food that has been planted, it has been genetically engineered.

Catherine W.N Muyonjo [Interviewer]: Do you think indigenous people knew about indigenous engineering?

Preservice Teacher 4 [Focus Group 3]: No, they didn't know. The only thing I know uhm, is that they usually used some of the pesticides, the sprays, so that their plants wouldn't be affected by the insects. I don't know the name of the sprays but my mum usually uses it in the garden. But I doubt they knew about the genetic engineering. They didn't know about it.

Catherine W.N Muyonjo [Interviewer]: Alright, do you think there was a reason as to why they didn't know about it?

Preservice Teacher 4 [Focus Group 3]: Yes, there is a reason. It's because they were uneducated. They were not exposed to some of the things.

Catherine W.N Muyonjo [Interviewer]: When you say they were uneducated about genetic engineering, how do you define education in this context?

Preservice Teacher 4 [Focus Group 3]: I mean they didn't have knowledge about most of the things in nature and besides nature, technology because genetic engineering is done technologically and it's a new thing to us. It wasn't there years ago because when they were planting they used the cow …uhm, yooh, I can't recall the English name. when I remember it, I will tell you. It's a fertiliser. They didn't know about the seed fertiliser; they only used the cow fee as their fertiliser. There are some of the fertilisers which are sold, I've forgotten, oooh my goodness. ….

Catherine W.N Muyonjo [Interviewer]: When you remember, you'll tell us. Don't worry. …You also spoke about viruses and bacteria in your lesson plan. Right? Viruses and bacteria serve some important purposes in our lives. Right? And also, when it comes to foods and beverages. You spoke very well about them. You age sufficient knowledge as to why they are important. Do you think that indigenous people or African indigenous people knew about viruses and bacteria?

Preservice Teacher 4 [Focus Group 3]: I don't think they knew about the viruses and bacteria pertaining to food. But the only virus they knew about was the human immune deficiency virus. That's the only virus they knew. But they didn't know about bacteria on food.

Catherine W.N Muyonjo [Interviewer]: So, you are saying that our great grand fathers and mothers who lived a very long time ago didn't know about viruses but they knew about HIV?

Preservice Teacher 4 [Focus Group 3]: Yes, they only knew about HIV. They didn't know about viruses and bacteria on food.

Catherine W.N Muyonjo [Interviewer]: Since according to you, African indigenous people were not aware of the viruses and bacteria, does this mean that viruses and bacteria did not affect them in any way?

Preservice Teacher 4 [Focus Group 3]: Yes mam, I think that it didn't affect them. They wouldn't use the virus or bacteria as the reason or cause of a person's death or animal. …

Catherine W.N Muyonjo [Interviewer]: … but you agree that they would have definitely been affected by viruses and bacteria, however they wouldn't have known? In the same way a baby may be affected by a virus or bacteria and is unaware of it, but it doesn't mean the baby hasn't been affected by it.

Preservice Teacher 4 [Focus Group 3]: Yes mam.

Catherine W.N Muyonjo [Interviewer]: If you look at Life Sciences or Natural Sciences you will see that viruses and bacteria have existed for a very long time. And they would have been present at the time of our indigenous people even if they didn't know about them.

Preservice Teacher 4 [Focus Group 3]: Yes mam.

Catherine W.N Muyonjo [Interviewer]: … You also spoke about corn, corn being a part and parcel of the diet of the indigenous people. Do you think that indigenous people knew the benefits of corn? That it was good for them? And that it could be genetically engineered?

Preservice Teacher 4 [Focus Group 3]: I can say that they knew that it could be genetically engineered. But they did benefit from it. Because in those days they were using corn to make maize meal. They used a stone to grind. They waited for the maize meal to be dry and they would grind it with stone. That's what my mother told me about the indigenous knowledge. They grinded the corn until it was smooth and fine and they used it as maize meal. They didn't buy maize meal at the stores as we do now.

Catherine W.N Muyonjo [Interviewer]:PT1 and PT3, anything you wish to add or subtract from what has been said?

Preservice Teacher 3 [Focus Group 3]: From my side, nothing mam.

Catherine W.N Muyonjo [Interviewer]: Okay thank you. PT1?

Preservice Teacher 1 [Focus Group 3]: Nothing to add mam.

Catherine W.N Muyonjo [Interviewer]: Okay, thank you… PT1, in your group with other members, your Life Sciences lesson plan pertained to steamed bread. In your view is the Life Sciences curriculum or CAPS document structured to enlighten learners about indigenous knowledge?

Preservice Teacher 1 [Focus Group 3]: Yes.

Catherine W.N Muyonjo [Interviewer]: It is?

Preservice Teacher 1 [Focus Group 3]: Yes mam.

Catherine W.N Muyonjo [Interviewer]: Okay, why do you say so?

Preservice Teacher 1 [Focus Group 3]: Actually, not sure mam

Catherine W.N Muyonjo [Interviewer]: Okay, that's fine… In your lesson plan you also spoke about cellular respiration. Right?

Preservice Teacher 1 [Focus Group 3]: Yes

Catherine W.N Muyonjo [Interviewer]: Would you say there is a clear correlation between cellular respiration and indigenous knowledge?

Preservice Teacher 1 [Focus Group 3]: Yes

Catherine W.N Muyonjo [Interviewer]: hummm, what is the correlation?

Preservice Teacher 1 [Focus Group 3]: I think uhm, …. [No response]

Catherine W.N Muyonjo [Interviewer]: PT3 can you assist?

Preservice Teacher 1 [Focus Group 3]: I think there is a clear correlation because cellular respiration is a universal biological process which is the connection between cellular respiration and indigenous knowledge is indirect and context dependent, relying on specific cultural beliefs, traditional ecological knowledge associated with respiration, energy and also healthy.

Catherine W.N Muyonjo [Interviewer]: Okay, thank you. PT3, can you briefly tell us whether there is a clear correlation between cellular respiration and indigenous knowledge?

Preservice Teacher 3 [Focus Group 3]: Yes yes, I think so.

Catherine W.N Muyonjo [Interviewer]: How so?

Preservice Teacher 3 [Focus Group 3]: Yes yes, in the process of making umqombothi… yes, uhm, the whole process if fermentation. Is that what you're asking mam?

Catherine W.N Muyonjo [Interviewer]: I'm asking if there is a link between indigenous knowledge and cellular respiration. Is there something in indigenous knowledge that can tell us something about cellular respiration? And vice versa? When you look at cellular respiration, is there anything in that process that can be linked to indigenous knowledge or how food is prepared?

Preservice Teacher 3 [Focus Group 3]: Yes I think in the process of making umqombothi, yeah, I think in the process of making umqombothi, I don't know if I'm correct…

Catherine W.N Muyonjo [Interviewer]: PT1, you spoke about specific aim 1 in your lesson plan. How does specific aim 1 in the Life Sciences CAPS document relate to indigenous knowledge?

Preservice Teacher 1 [Focus Group 3]: I can say that firstly, when studying a subject, it is important to know that indigenous knowledge systems and perspectives are included and represented. This may involve incorporating indigenous viewpoints, theories and methodologies in the curriculum or research process. By doing so, the specific aim of knowing the subject content becomes more comprehensive and diverse.

Catherine W.N Muyonjo [Interviewer]: Okay. PT4, Can you unpack what PT3 has said? Can you put it in your words? Do you understand what has been said?

Preservice Teacher 4 [Focus Group 3]: Can PT1 repeat what she said?

Preservice Teacher 1 [Focus Group 3]: Okay, I said that when studying a subject, it is important to ensure that indigenous knowledge systems and perspectives are included and represented. This may involve incorporating indigenous viewpoints, theories and

methodologies into the curriculum or research process. By doing so, the specific aim of knowing the subject content becomes more comprehensive and diverse.

Catherine W.N Muyonjo [Interviewer]: Thank you PT1. Yes, PT4 can you unpack now?

Preservice Teacher 4 [Focus Group 3]: Yes, mam, I think she's trying to say that as a Life Sciences teacher you always have to have knowledge about the indigenous knowledge globally, not only the local knowledge such as the African knowledge but we also have to have Western knowledge and do research about all the Western knowledge food and plants.

Catherine W.N Muyonjo [Interviewer]: Thank you very much. PT1, going back to your lesson plan, would you consider steamed bread as an example of an indigenous African food?

Preservice Teacher 1 [Focus Group 3]: Yes mam

Catherine W.N Muyonjo [Interviewer]: Why?

Preservice Teacher 1 [Focus Group 3]: Yes mam, I can consider steamed bread as an African indigenous food because steamed bread is the type of bread that is cooked by steaming rather than baking I also say that it is commonly found in various African countries and

you would say it in African culinary traditions

Catherine W.N Muyonjo [Interviewer]: PT3 do you concur?

Preservice Teacher 3 [Focus Group 3]: I don't think it is indigenous food. Maybe

as people got more knowledgeable about different things, maybe that's why they

learned to make steamed bread. It was not indigenous.

Catherine W.N Muyonjo [Interviewer]: Really?

Preservice Teacher 3 [Focus Group 3]: I think so

Catherine W.N Muyonjo [Interviewer]: Let's go back to PT1. Which approach is best when teaching indigenous knowledge in a science classroom? Is it a learner-centred or teacher-centred approach?

Preservice Teacher 1 [Focus Group 3]: I can say it's an indigenous learner -centred approach. Because it's generally considered more appropriate and effective than a teacher-centred approach, because indigenous knowledge is deeply rooted in the culture's traditions and experiences of indigenous communities. So, a learner-centred approach allows for the inclusion and valuing of diverse perspectives, including indigenous voices. It's a knowledge that indigenous students may process different knowledge, encourages their active participation in the learning process.

Catherine W.N Muyonjo [Interviewer]: Thank you. PT3, as preservice science teacher, which approach would you want to consider as the best? Is it the learner-centred, or teacher-centred approach in a science lesson?

Preservice Teacher 3 [Focus Group 3]: I can say I would prefer a learner centred approach because it will allow learners to ask more questions and I would engage with the learners better.

Catherine W.N Muyonjo [Interviewer]: PT4, teacher centred or learner centred approach in a science classroom?

Preservice Teacher 4 [Focus Group 3]: Learner centred approach because learners are able to share their own personal views and points of views and also hey can share their past experiences and knowledge.

Catherine W.N Muyonjo [Interviewer]: Thank you. Let us go back to PT1. PT1, your lesson plan makes reference to fermentation and some of the students have spoken about fermentation. Do you think there's a link between science and Indigenous knowledge in this regard when it comes to fermentation? When you look at fermentation as a process, do you see Indigenous knowledge there? Do you see science there?

Preservice Teacher 3 [Focus Group 3]: Ma'am can I at least think about it and then I will respond?

Catherine W.N Muyonjo [Interviewer]: No problem. Let us hear PT4's view in the meantime, while we wait for PT1 and PT3

Preservice Teacher 3 [Focus Group 3]: Ma'am, I'm sorry. What is fermentation?

Catherine W.N Muyonjo [Interviewer]: No problem, who can define fermentation for us here?

Preservice Teacher 3 [Focus Group 3]: I can try. PT3, when you're making umqombothi ….you get it now?

Catherine W.N Muyonjo [Interviewer]: ….. It's a chemical breakdown…. Of yeast and other micro-organisms… and usually giving off heat in the process.

Preservice Teacher 4 [Focus Group 3]: Oh yes mam, I don't think there is a link…since you say it is a chemical break down.

Catherine W.N Muyonjo [Interviewer]: ….. PT1 back to you

Preservice Teacher 4 [Focus Group 3]: Yes mam…

Catherine W.N Muyonjo [Interviewer]: Your peer says she does not think there's a link? Do you agree?

Preservice Teacher 4 [Focus Group 3]: I think because fermentation is about making traditional beer. Uhm, also using the …

Catherine W.N Muyonjo [Interviewer]: PT3, let's get back to you.

Would you consider steamed bread a healthy food?

Preservice Teacher 3 [Focus Group 3]: No. I think it's good when it is not consumed on a daily basis or excessively, only on random days because based on my experience it causes heart burn, ulcers, yes.

Catherine W.N Muyonjo [Interviewer]: So, you think it is good but should be eaten in moderation?

Preservice Teacher 3 [Focus Group 3]: Exactly!

Catherine W.N Muyonjo [Interviewer]: PT4, do you agree that it causes heart burn?

Preservice Teacher 4 [Focus Group 3]: Yes, mam, I do agree because it causes heart burn and affects your blood system.

Catherine W.N Muyonjo [Interviewer]: How? Share your thoughts.

Preservice Teacher 4 [Focus Group 3]: It affects your blood stream …your arteries.

Catherine W.N Muyonjo [Interviewer]: But why do you say so because steamed bread doesn't have so much fats and oils which would mostly be found in other foods. There is very little of that in steamed bread.

Preservice Teacher 4 [Focus Group 3]: I'm not sure but I think it's because of the gas, the steam. Yes, I think it's because of the steam since steamed bread is put into a pot and all the steam is still in the food, actually I'm not sure why.

Catherine W.N Muyonjo [Interviewer]: Thank you PT4. Do you think that there is any significance that steamed bread has in the African context?

Preservice Teacher 4 [Focus Group 3]: Uhm, I don't think so because in those days as they were making steamed bread instead of baking the bread. It's because they didn't have electricity, the stoves, they didn't have any electronic devices, equipment or appliances at home to make bread from an oven.

Catherine W.N Muyonjo [Interviewer]: Okay, so what significance does steamed bread serve in the African context?

Preservice Teacher 4 [Focus Group 3]: I don't think there is.

Catherine W.N Muyonjo [Interviewer]: You don't think there is any significance of steamed bread within the African context?

Preservice Teacher 4 [Focus Group 3]: Yes.

Catherine W.N Muyonjo [Interviewer]: Okay, do you think Umqombothi as a beverage serves any significant purpose in the African indigenous context?

Preservice Teacher 4 [Focus Group 3]: Yes I think it does because this beverage allows indigenous people to communicate with the ancestors when they are doing ceremonies.

Catherine W.N Muyonjo [Interviewer]: PT3, do you concur with PT4's view?

Preservice Teacher 3 [Focus Group 3]: I think both umqombothi and steamed bread have significance in the African context. Yes because they are both used in communal and festive festivals. Steamed bread is usually prepared on special occasions such weddings, family gatherings, and cultural celebrations as well as umqombohi. It brings people together and they

both hold cultural identity. I'd like to believe that their techniques have been passed down through generations. Reflecting the cultural heritage of specific African communities.

Preservice Teacher 1 [Focus Group 3]: I'm back now mam, I had poor internet connection.

Catherine W.N Muyonjo [Interviewer]: Welcome back PT1. What are the advantages of steamed bread?

Preservice Teacher 1 [Focus Group 3]: I can say that steamed bread since it is generally considered a healthy alternative to baking bread. It contains no added fats or oils, making it lower in calories and fat content. And it also requires a shorter cooking time.

Catherine W.N Muyonjo [Interviewer]: Thank you. I see we all have different views pertaining to steamed bread. PT1, is it better to just teach learners about African foods and beverages or should preservice teachers encourage learners to make these foods by preparing them?

Preservice Teacher 1 [Focus Group 3]: I think teaching learners about African foods and beverages can be a valuable culturally learning experience that can promote diversity and understanding. However, going beyond theory and encouraging learners to make or prepare these foods can offer additional benefits.

Catherine W.N Muyonjo [Interviewer]: Okay, what is that benefit it will bring?

Preservice Teacher 1 [Focus Group 3]: Engaging in the preparation, these foods allow learners to gain a deeper understanding of the cultural significance associated with this.

Catherine W.N Muyonjo [Interviewer]: Okay, and how much of this do you think is actually being carried out in schools?

Preservice Teacher 1 [Focus Group 3]: Yes

Catherine W.N Muyonjo [Interviewer]: It's happening?

Preservice Teacher 1 [Focus Group 3]: Yes

Catherine W.N Muyonjo [Interviewer]: Do you think it's happening a lot? Or not so much?

Preservice Teacher 1 [Focus Group 3]: Not so much

Catherine W.N Muyonjo [Interviewer]: Do you think it's happening in a lot of schools or a few schools?

Preservice Teacher 1 [Focus Group 3]: hum, I'm not sure but I think a few schools.

Catherine W.N Muyonjo [Interviewer]: Okay thank you. PT3, is it better to just teach learners about African foods and beverages or should learners be encouraged to make these foods. So, when you're going for teaching practice, and you're going to teach about indigenous knowledge, would you just stop at teaching learners about it or …?

Preservice Teacher 3 [Focus Group 3]: Uhm, okay I think I will teach them about the indigenous knowledge and traditional foods and beverages. It will just be up to them if they decide to prepare the food for themselves. So I can only teach them so that they can get historical significance. This is because some traditional foods and beverages have historical importance and their inclusion can help students appreciate the scientific advancements and discoveries made over time. It can shed light on how scientific knowledge has been applied to improve food preservation processing or nutritional understanding. So it will be entirely up to them whether they want to prepare the food for themselves or not.

Catherine W.N Muyonjo [Interviewer]: Okay, so you are saying that you agree that it's important to teach learners the importance of indigenous knowledge but you are not going to go out of your way to encourage them to make the foods or to make the lesson that interesting, where they actually prepare the food and have a better cultural understanding? Is that what you're saying?

Preservice Teacher 3 [Focus Group 3]: I would encourage them to make the food, but as I said it will be entirely up to them. Some will decide not to, some won't be interested but maybe to make my lesson more interesting, I would food samples maybe of samp, steamed bread, etc, just so that they can get a better understanding and learn from something practical that they can see in front of them.

Catherine W.N Muyonjo [Interviewer]: PT3, do you think a lot of schools are encouraging learners to know about indigenous knowledge as well as make some of these foods?

Preservice Teacher 3 [Focus Group 3]: I don't think so. I think it depends on the setting of the school. I also don't see a reason of encouraging them to make those foods.

Catherine W.N Muyonjo [Interviewer]: You don't see the need?

Preservice Teacher 3 [Focus Group 3]: Yes.

Catherine W.N Muyonjo [Interviewer]: Why is that?

Preservice Teacher 3 [Focus Group 3]: Because we have different cultures. Some are Indian, some are …

Catherine W.N Muyonjo [Interviewer]: But doesn't the Natural Sciences and Life Sciences CAPS document encourage as teachers to be culturally inclusive?

Preservice Teacher 3 [Focus Group 3]: Well, it does. Most learners and most people shy away from those cultural practices

Catherine W.N Muyonjo [Interviewer]: Is it because you don't want to make anyone uncomfortable?

Preservice Teacher 3 [Focus Group 3]: Yes I can say so.

Catherine W.N Muyonjo [Interviewer]: But do you think that is the best way to approach a science lesson? Should we make our learners comfortable or encourage them to get out of their comfort zone?

Preservice Teacher 3 [Focus Group 3]: I think we should encourage them to get out of their comfort zone.

Catherine W.N Muyonjo [Interviewer]: Thank you very much for being part of this semi – structured interview. Thank you for your honest responses and your lesson plans that were well designed and orchestrated. All the best for teaching practice. Thank you so much for availing yourselves. God bless you!