

**Understanding how trainee science teachers engage with prior everyday  
knowledge and experiences associated with biological concepts during  
Biology lessons: A case study**

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**By**

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## **Declaration**

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and has not previously in its entirety or in part been submitted at any university for a degree.

Signature: ..... Date:.....

## **Abstract**

Since the Namibian independence in 1990, the education system has undergone some major revamping which involved the adoption of social constructivist perspectives in the teaching and learning of sciences. This learning theory acknowledges learners' background prior knowledge as valuable tools in the effective construction of science concepts during lessons. A corollary is that the socio-cultural circumstances of learners might negatively influence the way learners construct new knowledge in the science classroom if they are not taken into consideration.

This study was thus prompted by the need to understand how trainee science teachers engage with prior everyday knowledge and experiences, so as to enhance the conceptual development of biological concepts. The study was qualitative and it was underpinned by an interpretive paradigm with some elements of action research. Science trainee teachers at Katima Mulilo, Unam Campus were used as research participants. The techniques used to gather data included document analysis, brainstorming, observation, audio-visual, microteaching and semi-structured interviews.

The results of this study showed that the changes that occurred during microteaching practices of the four trainee teachers involved in the study reflected their professional development in this approach. However, it emerged that prior everyday knowledge can be both a barrier and enabler to the construction of meaningful teaching and learning; hence its oversight may lead to instructional failures. The findings also indicated that selected platforms are essential to enable trainee teachers to incorporate prior everyday knowledge and experiences into the teaching of Western science. However, larger scale study should be conducted in order to deepen the understanding of the topic.

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Finally, I owe a debt of gratitude to my third year trainee teachers at UNAM, Katima Mulilo Campus, whom I used as participants in this study. Their willingness, patience, cooperation and valuable contributions made the findings of this study possible.

## **Dedication**

I dedicate this thesis to my late father Kristoph Enghono, my mother Klaudia Taapopi, my late brother Betuel, my husband Joseph and our two sons Herman and Mickael who have been my strength and inspiration. Though my father and my brother are not accorded the opportunity to witness me succeeding this far, their indebted love, care and support during my childhood upbringing and more so during this study will never be forgotten.

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## **List of abbreviations and acronyms**

BETD	Basic Education Teachers' Diploma
IK	Indigenous knowledge
NIEDMR	National Institute of Educational Development Memorandum Report
NNCBE	Namibian National Curriculum for Basic Education
NMBEC	Namibian Ministry of Basic Education and Culture
PCK	Pedagogical Content Knowledge
ZPD	Zone of Proximal Development
OBE	Outcomes Based Education
C2005	Curriculum 2005
LCE	Learner-Centred Education
TCE	Teacher-Centred Education
UNAMKMC	University of Namibia Katima Mulilo Campus
INSE	Integrated Natural Science Education
EHDC	Education Higher Degrees Committee
WS	Western Science
CD	Curriculum Documents
BS	Brainstorming Session
WP	Workshop Programme
IS	Interview Schedule
S1-S18	Student 1 to student 18
T1 –T4	Trainee teacher 1 to 4

# Chapter One

## Situating the study

### 1.1 Introduction

This chapter introduces and discusses the context of my study, and what inspired me to conduct research on how trainee science teachers engage with prior everyday knowledge and experiences associated with the teaching and learning of biological concepts during Biology lessons, a module component of Integrated Natural Science Education for 5-7.

In the first section of this chapter, I outline the context of my study. This is followed by my research goal, research questions and the theoretical framework which underpins the study. Thereafter, I describe the data generation techniques used. I close with definitions of the main concepts used in the study, the thesis outline and the final paragraph of this chapter discusses the potential value of the study.

### 1.2 The context of the study

The past two decades have been marked by a major revamp of science education in the Namibian education system. The new curriculum emphasizes teaching and learning that helps learners construct scientific knowledge. Noticeable changes from the previous curriculum are those that boost the development of conceptual understanding among all learners (Carter, 2007). In the Namibian context, these reforms aimed to change curricula in order to align them with the social and socio-cultural constructivist principles that shaped the new Namibia education system. This is stated in the Government development brief policy, *Toward education for all* (Namibian Ministry of Basic Education and Culture [NMBEC], 1993).

The new education reforms are drawn from constructivist theories of learning. That is why the Natural Sciences syllabus emphasises active involvement of learners and the use of learners' prior everyday knowledge and experiences in lessons to enhance the comprehension of science concepts. The rhetoric surrounding the introduction of the new education system stresses the pride of building on a socio-cultural learning perspective which incorporates the learner-centred approach rather than the teacher-centred approach employed in the past.

In the Government policy documents, a learner-centred approach is described as:

- The starting point of the learners' existing knowledge, skills, interests and understandings, derived from previous experience in and outside school;
- The natural curiosity and eagerness of all young people to learn to investigate and make sense of a widening world must be nourished and encouraged by challenging and meaningful tasks and this must form the basis of the teaching and learning practices the teacher should bring in the classroom (Malcolm, 2003);
- Learners should be empowered to think and take responsibility not only for their own, but also for one another's learning and total development; and
- Learners should be involved as partners not as receivers of educational growth (NMBEC, 1993; Kasanda, Lubben, Gaoseb, Kandjeo-Marenga, Kapenda & Campbell, 2005).

The description of the learner-centred approach listed above argues for the use of everyday contexts in science teaching and learning. That is, building on socio-cultural achievements and widening access and promoting learners' empowerment. This research study investigates how trainee teachers engaged with prior everyday knowledge and experiences associated with biological concepts during teaching practice. This was done with a view to improve their professional development particularly their pedagogical content knowledge (PCK).

The study was prompted by my personal experience and observation from the 8 years I worked as a senior secondary school Biology teacher. Also, the evidence I collected as a teacher educator over the past five years during school based studies (SBS) prompted this study. I have observed that many trainee teachers struggle to provide 'good' science education to the learners. That is, one that considers learners' existing knowledge (includes indigenous knowledge) as encouraged by the Namibian science curriculum. Instead, trainee teachers still stick to the old traditional style of teaching characterized by the usage of only western knowledge contained in the textbooks.

My observations are supported by the unpublished external moderator report of SBS on Natural Science subjects for grade 5-7 and the National Institute for Educational Development Moderation Report (NIEDMR) (2008). In the report it was stated that many trainee teachers are failing to adapt to the constructivist worldview during teaching practices. It was stressed that trainee teachers are struggling to contextualise science content with learners' prior everyday knowledge and experiences during Natural Science lessons.

The Namibian National Curriculum for Basic Education (NCBE) (2010) also encourages and emphasises the use of verbal interactions between teachers and learners and among learners themselves when teaching science concepts. It presupposes that when teaching for conceptual understanding, teachers should have a holistic view of learners, valuing their prior everyday knowledge and experiences as the starting point of their learning. This could then be followed by constructing new knowledge through ways of working together with teachers and other learners (Learner-centred education in the Namibian context, 2003).

An analysis of the current official curriculum shows that the Biology discourse requires a change in teaching practices (NCBE, 2010). For example, Ndolo (2011) states that when teaching for conceptual understanding in Natural Science including Biology, “teachers need to first understand learners’ existing knowledge, identify issues that may cause confusions and then create opportunities for the learners to integrate the old and new ideas”. Kibirige and Van Rooyen (2006) further stress that if meaningful science education is to be devised for all learners then their background experiences must be taken into consideration (p. 1).

The onus is on us science educators (including Biology) to ensure that we strategically rethink the curriculum on how science concepts are constructed. This requires science teachers to integrate learners’ prior everyday knowledge and experiences into the teaching process. This will help teachers to monitor learners’ understanding of science concepts. Furthermore, it will boost the interest of many learners who still believe that science is a subject that comes from another world and has no links with our traditional ways of doing things or thinking.

Despite, a large number of education reforms directed at changing the teaching of science subjects, a growing body of research in Namibia have shown that there is a mismatch between the intentions of curricula developers and the curriculum implementation in the science classroom (Learner-centred education in the Namibian context, 2003; Kasanda, et al., 2005). Kasanda, et al. (2005) argue that at grassroots level, only a limited range of the everyday contexts of learners are used in the classrooms. They state that teachers commonly use theoretical exposition or teacher questioning during teaching. This is prompted by issues related to school contexts and internal matters of teacher qualification. Yet, in the learners’ community, there are cultural materials which contain a lot of science and can be used as starting point to learning or as teaching and learning resource materials.

Consequently, it is therefore not surprising that teacher training education is not also consistent with the constructivist theories of learning. I therefore believe that the learners' failure to grasp conceptual understanding of biological concepts is partially attributable to the teacher training programmes. During teacher training, trainee teachers are equipped with theoretical knowledge but lack pedagogical strategies that modelled to them how to teach for conceptual understanding.

Therefore, this study stresses the need to guide trainee science teachers on how to engage learners' prior everyday knowledge and experiences with the science in the textbooks. Teaching and learning science concepts require the learners to achieve conceptual understanding in order to be able to relate and apply the new concepts learnt to what they actual practice or experience in their everyday life (NIED MR, 2008, p. 46; Lawson, 2010).

In order to confirm or refute the above statements, I anticipated undertaking this study during Biology lessons with the Basic Education Teacher Diploma (BETD) final year science trainee teachers looking into the following goal and questions.

### **1.3 Research goal and research questions**

#### **1.3.1 The research goal:**

The main goal of this study was to understand how trainee science teachers engage with prior everyday knowledge and experiences associated with teaching and learning of biological concepts during Biology lessons.

#### **1.3.2 Research questions**

##### **Main question**

How do trainee science teachers engage with prior everyday knowledge and experiences associated with the teaching and learning of biological concepts during Biology lessons?

##### **Sub-questions**

1. What understanding of prior everyday knowledge and experiences related to the teaching and learning of biological concepts do trainee teachers bring to a Biology classroom?

2. What teaching strategies do trainee teachers identify and consider effective to engage learners during Biology lessons to elicit conceptual development and understanding of biological concepts?
3. To what extent does identifying and implementing relevant Biology topics incorporated with prior everyday knowledge and experiences enable or constrain meaningful learning of biological concepts during classroom instruction?
4. How do trainee teachers design and implement Biology lessons integrated with learners' prior everyday knowledge and experiences to promote meaning making, conceptual development and understanding of biological concepts?
5. What challenges do trainee teachers encounter during the designing and implementation of Biology lessons that incorporate prior everyday knowledge and experiences?
6. What factors enable or constrain the teaching of biological concepts in the curriculum?

#### **1.4 Theoretical framework**

Research in science education widely advocated for the incorporation social or socio-cultural practices in teaching and learning of science subjects (including Biology) to make appropriate links between formal science content and learners' everyday knowledge and experiences (Stears, Malcolm & Kowlas, 2003; Carter, 2007; De Beer & Whitlock, 2009; Ndolo, 2011). Stears, et al. (2003) stressed that linking science learning to learners' everyday knowledge provides them the appropriate platforms that enable them to be active as well as to participate socially in the community of practice (Lave & Wenger, 1991). These communities of practice enable learners to make use of their everyday lives (which includes past experiences, interests and prior everyday knowledge) during classroom instruction thus enhance meaning making to occur.

Carter (2007) adds that indeed research shows that the separation of formal science and indigenous knowledge during science classroom lead many students to perceive "traditional approach to science education as irrelevant to the realities of their complex natural world" (p. 166). This is largely shown by common students' scientific misconceptions and lack of motivation to take science subjects at tertiary level (ibid). These platforms if made available enabled teachers to gain better insight into learners' depth of understanding of a concept thus

help to deal better with the conceptions and difficulties that learners may experience in understanding certain scientific concepts.

Ndolo (2011) further argues that a science classroom should be seen as a social unit where many social and cultural practices are acquired including eliciting learners' prior everyday knowledge and experiences. The emphasis here is that knowledge should not be learnt for its own sake, but rather it should always lead to new understanding and creation of new skills and concepts.

Aikenhead and Jegede (1999) point out that the merging of the two domains of knowledge (IK and western science) during Biology classroom promotes smooth transitions between formal science content taught in the classroom and learners' cultural conflicts. They reinforce the idea of cultural conflicts that arise during such learning process as cultural border crossing. The cultural border crossing is favourable for the teaching and learning of Biology as it brings the congruence between content presented in classrooms and learners' home practices (sociocultural perspectives). Learners will then smoothly cross borders and get blended in the learning of science subjects.

However, Shulman (2007) argues that the accomplished of such skills cannot be easily achieved because they are influenced by teachers' mastery of content knowledge and pedagogical content knowledge (PCK) which is the ability to transform subject matter into a content that is well understood by learners.

Therefore, this study made use of the social constructivist theory of Vygotsky (1978) and socio-cultural theory of Carter (2007) and Pedagogical Content Knowledge (Shulman, 1987) as frameworks and analytical tools to provide the basis for understanding how trainee science teachers make sense of biological concepts by incorporating them with learners' prior everyday knowledge and experiences.

### **1.5 Potential value of the study**

- This study has a potential to bring the role played by prior everyday knowledge and experiences in the teaching and learning of science, particularly the teaching and learning of biological concepts during Biology lessons;
- This study provides some insights on how trainee teachers deal with prior everyday knowledge and experiences during science teaching especially in Biology;

- An intervention carried out during the orientation programme offered some teaching professional skills and support to trainee teachers who participated in the research using the concrete examples modelled during the designed learning activities;
- My study is of potential value to the Ministry of Education in Namibia regarding future policy formulation about the role of prior everyday knowledge and experiences in the teaching and learning of science;
- The findings of this study have the potential to help shape the training of future upper primary school science teachers;
- In addition, once the findings are reworked into appropriate training resource material, it can be used by all practicing Biology and Life science teachers; and
- The study may also be useful for future research in the field of science teaching.

## **1.6 Clarification of terms**

In this section I will clarify some of the terms which are used in this study. These terms are: socio-cultural and constructivist theories, learner-centred education, prior everyday knowledge and pedagogical content knowledge.

### **Socio-cultural theory**

This is a perspective in which we consider that cultural issues need to be considered when teaching and learning science. The understanding in science language is related to a community's language. Learners discuss and use science language as they use it to interpret the phenomena of the environment which they use to their advantage. It is this understanding which leads to the encouragement of the use of science related aspects in the culture of learners to be used in the construction of knowledge.

### **Constructivist theory**

The need to move from teacher-centred to learner-centred approaches created the premise for this perspective. It is a liberating pedagogy in which the teacher is given the responsibility of scaffolding learners after s/he has created activities which encourage learner participation.

### **Learner-centred approach**

It is a response to the constructivist theory of teaching and learning science. A learner-centred approach entails making learners active in the construction of knowledge through the use of

prior everyday knowledge. The learner in science already has prior knowledge; however, in some cases teaching and learning science distances itself from some particular type of prior everyday knowledge which is at the centre of this study.

### **Prior everyday knowledge**

It is the base knowledge from which all learning must start. Prior everyday knowledge makes learners undergo all three types of visualization, namely, mental representation, visualizing by building up mental analogues, seeing the pattern of the concepts constructed by him/her as he/she relates them to his experiences which in turn are useful as pedagogical content knowledge.

### **Biological conceptual development**

This is a transition process from an ordinary way of perceiving, directing attention, conceptualising, reasoning and justifying biological concepts. Thus, the effect of prior knowledge requires a change from the view that learning is absorption of transmitted knowledge, to the view that learning is a conceptual change.

### **Pedagogical content knowledge**

Experiences gained in the community are sometimes useful to explain scientific phenomena and also to use when handling apparatus. Such experiences when combined with content to be taught in science classrooms are what are referred to as pedagogical content knowledge.

## **1.7 Thesis outline**

This thesis presents the findings for my research study conducted in the Caprivi Region of Namibia. It is entitled “Understanding how trainee science teachers engage with prior everyday knowledge and experiences associated with biological concepts during Biology lessons”. It consists of seven chapters and the details of each chapter are outlined below.

**Chapter One** presents an overview of the context of the study and outlines the reasons that motivated me to conduct the study. I discussed the research goal and research methodology and presented the theoretical framework which will support this participatory action research case study.

**Chapter Two** gives an overview of the literature reviewed relevant to the research questions and research topic. I discuss literature related to how trainee teachers engage with prior

knowledge and experiences when teaching science concepts, in particular, Biology which is the focus of my study.

This was done by presenting both national and international issues regarding how teachers are expected to help learners make sense of biological concepts when integrating them with prior everyday knowledge and experiences. This was done in order to contextualize my study within the Namibian and international perspectives.

In **Chapter Three**, I discuss the methodology employed in this study. I address the theoretical framework that I used to carry out my study and the research design and procedures used in gathering the desired information. It begins with the explanation of the research paradigm; the interpretive paradigm that the study adopted followed by an outline of the goals and questions of the study and then a description of a participatory qualitative case study. Also highlighted is the Pedagogical Content Knowledge (PCK) that I used as an analytical tool to analyse my data. In addition, I describe various data generating techniques that were used, the research site and participants, the ethical issues, validity and trustworthiness as well as limitations of the study.

In **Chapter Four**, I present a narrative account of the data generated from the baseline data generating techniques. In this chapter, the presented data came mostly from document analysis.

**Chapter Five** presents the data generated from the main data generating techniques, namely, the lesson development and microteaching presentation and the individual semi-structured interviews.

In **Chapter Six**, the data presented in chapters four and five are analysed and interpreted together with insights drawn from the literature and theoretical framework that underpins this study. This was done by forming the analytical statements that were developed from the emerging themes regarding conceptions, misconceptions and challenges that both trainee science teachers and students encountered during various data gathering sessions and which may have some influence on how trainee teachers could engage with learners' prior everyday knowledge in the science classrooms.

In **Chapter Seven**, I present the overall summary of the main findings of my study by drawing on the themes discussed in Chapter Six. I also outline my reflections on the research

process and limitations; recommendations and suggestions for future research and conclude the study.

## **1.8 Concluding remarks**

In this chapter, I highlighted the research context, research goal and research questions, the potential value of the study and provided a clarification of terms. The last section provides the thesis outline which show how this study was carried and developed.

In the next chapter, I will provide a detailed discussion of the literature related to this study.

## **Chapter Two**

### **Literature Review**

#### **2.1 Introduction**

The aim of this study was to understand how trainee science teachers make use of prior everyday knowledge and experiences during Biology lessons. For example, how they built on learners' prior everyday knowledge and experiences during classroom instruction to enhance conceptual development of biological concepts. Also, how trainee science teacher planned and implemented relevant Biology topics that are incorporated with prior everyday knowledge and experiences which may help learners to better make sense of biological language and concepts. It was hoped that this would help trainee science teachers shape their own professional teaching practices.

Firstly, I present the national perspective on how teachers should help learners make sense of biological concepts in order to contextualize my research topic in the Namibian curriculum context. The chapter also highlights the international studies related to my research study.

The chapter further explores relevant theoretical frameworks regarding the teaching and learning of Biology.

#### **2.2 Regional curricular issues**

Like many sub-Saharan African countries, South Africa was not spared educational reform after its independence in 1994. The new government felt it was imperative to redress the educational inequalities of the past and prepare citizens for full participation in democracy (Maselwa & Ngcoza, 2003). As a result, the Curriculum 2005 (C2005) was endorsed with Outcome Based Education (OBE), the philosophy that underpinned the C2005.

In their study, Maselwa and Ngcoza (2003) gave an overview of OBE and the C2005 with regard to the use of prior everyday knowledge and experiences of learners in science teaching. They stated that the OBE philosophy like learner-centred education (LCE) is adopted from the social constructivist theory of teaching and learning. The C2005 curriculum is striving for teaching that is more learner-focused, using constructivist methods and based on work which is relevant to the learners' lives. The OBE curriculum also strongly advocates

skills-based education which emphasizes the development of relevant competences such as skills, knowledge, attitudes and values on the learners (Maselwa, 2004).

From the constructivist point of view, the outcomes stated above are believed to be constructed through engaging learners' prior everyday knowledge and experiences in the atmosphere of cooperative learning. If teachers are expected to engage learners in cooperative learning; then they need to be equipped with appropriate pedagogical strategies to enable them to change the manner in which they teach.

The OBE concurs with LCE approaches to teaching and learning. In both curricula, teachers sometimes experience challenges with curriculum implementation (Maselwa, 2004; Kasanda, et al., 2005). Therefore, it is important to take teacher training programme more seriously particularly how they disseminate science information to the learners during instruction setting to ensure that meaningful learning is taking place.

Lesotho, like Namibia, uses the same term LCE. Khoboli and O'Toole (2011) explain the three levels in LCE, namely, creating a caring relationship between learners and teacher, selection of instructional practices that place learners at the centre of teaching and learning and establishment of a learner-centred curriculum goal. These are the same levels which Namibian science teachers are expected to use in their endeavour to integrate learners' prior everyday knowledge during Biology lessons.

### **2.3 Namibian curricular issues**

Learner-centred education (LCE) was endorsed in 1991 as a new foundation policy and an education approach to drive the educational system in Namibia (Learner-Centred Education in the Namibian context, 2003). The new Namibian education system originates from social-constructivist or socio-cultural perspectives (LCE, 2003) which includes the ethos of LCE. Constructivist learning theories implies that all teaching and learning processes should be learner-focused and be based on the work preceded from the learners' prior everyday knowledge and experiences (LCE, 2003). Social constructivism by Vygotsky (1978) provides an appropriate learning theory that views the development of a child as proceeding from the social aspects to the individual aspects.

It was hoped that this approach would motivate the learners, and their teachers to be creative and produce more teaching materials from the local environment. In addition, learner-centred education is defined as a “teaching philosophy that incorporates a particular set of convictions about the ways in which teaching and learning can occur” (Chaka, 1997, p. 14). This includes preparing meaningful activities that enable learners to deepen their understanding of the topic of inquiry. The Namibian Ministry of Education’s (1990) views on learner-centred education (Chaka, 1997, p. 44) are outlined as follows:

- Knowledge and experiences of a learner both at home and school should be recognized and used as a starting point for any instructional setting;
- Learners’ knowledge should be accepted and acknowledged individually;
- Learners should be exposed to the world in order to encourage them to investigate and carry out experiments with less direction from the teacher;
- Learners should be empowered with knowledge and skills in order to promote creative and independent thinking; and
- Learners should be involved in collaborative, cooperative efforts with others that would enable them to share different opinions, ideas, experiences as well as viewpoints.

The above statements emphasise that LCE is a transformative and liberating pedagogy because it gives learners freedom of expression and enhanced ability to reflect on their own learning (Chaka, 1997). This is to ensure that the education system integrates societal practices into the school curriculum. The Broad Curriculum for Basic Education Teacher Diploma (BETD) (2010), a policy that guides teachers’ training in Namibia also stresses that science teachers should have a holistic view of their learners, valuing their prior knowledge and experiences as a starting point for every learning process to ensure that teaching and learning is inclusive of all learners.

The Natural Science and Health Education syllabus for grade 5-7 (Ministry of Basic Education, Sport and Culture [MBESC], 2010) which incorporates many Biology topics also stresses that “learning experiences and subsequent teaching of science concepts including biological concepts should be tailored towards promoting the learners’ knowledge and understanding of their physical and biological world of which they are part” (p. 1).

This is because learners in the science classroom tend to experience the formal structures and tests of science as new ways of thinking different from what they actual experience in their daily life (Stears & Malcolm, 2005). Therefore, for effective teaching to occur, the approach needs to shift from traditional transmission of knowledge to one that enables learners to make linkages and work through possible conflicts that may arise between formal science knowledge and their cultural knowledge (Kasanda, et al., 2005; Stears & Malcolm, 2005).

The curriculum is expected to be delivered using teaching strategies that actively involve learners and draw upon their prior everyday knowledge and experiences. This requires teachers to be able to select learning contents and methods on the basis of the learners' needs and interests within their immediate environment or community (MoE, 2010). Therefore, proper teacher training and monitoring is needed to enable teachers to be able to plan and implement successful science lessons which incorporate everyday knowledge and interests of the learners as well as their cultural knowledge during science lessons.

Like OBE in South Africa, the learner-centred approach in Lesotho and Namibia are also anchored in certain theoretical frameworks. These frameworks are discussed below.

## **2.4 Theoretical Framework**

### **2.4.1 Constructivist learning perspectives**

In this study I used Vygotsky's (1978) social constructivist perspective as well as the socio-cultural perspective by Carter (2007) as appropriate frameworks to address the cognitive conflicts that may arise between cultural differences of the learners' life world and school science during instruction settings. Stears and Malcolm (2005) emphasise that "learning occurs within the context of activities and social interactions likely informed by day to-day contingencies of culture and everyday life" (p. 22).

One of the major challenges in science education today is the call to bridge the gap between learners' everyday life world and the world of school science. Aikenhead and Jegede (1999) describe these cognitive conflicts in terms of *cultural border crossing or collateral learning* (p. 260). They describe these terminologies as the learning experiences that bring to forth the different learners' domains of knowledge or worldviews namely their cultural and prior everyday knowledge and experiences during formal science knowledge.

The focus of this study was to explore how pre-service trainee teachers engaged with such cultural initiatives in order to reduce foreignness to teaching and learning of biological concepts. Also, to engage, inform and empower trainee teachers with appropriate pedagogical strategies that can be used during Biology lessons to make learners have a smooth transition between the indigenous knowledge and formal science (Carter, 2007).

In doing so, it was envisaged that the trainee teachers would see value in integrating learners' prior everyday knowledge and experiences when developing biological concepts. Furthermore, it was hoped that the study would encourage trainee teachers to understand what it means to teach science from a social constructivist perspective, which is also a challenge to many novice teachers.

#### **2.4.2 Socio-cultural perspective**

Researchers in science education today call for the use of a socio-cultural perspective in teaching and learning approaches in science classrooms (Darling-Hammond, Barron, Pearson, Schoenfeld, Stage, et al., 2008; Carter, 2007; Clarke, 2001). Carter (2007) states that the recent science studies have challenged Western science traditions claims to be value free, objective and universal truth of knowledge and stressed the socio-cultural construction of scientific knowledge, and its coexistence with other various local and indigenous versions of science.

It should be noted that the above study's findings do not argue that all prior everyday knowledge or indigenous knowledge (IK) claims should be accepted or should be used as science. However, the study argues that scientific explanations must meet certain criteria. This is because often 'western science' used in Biology is at the expense of the indigenous knowledge (De Beer & Whitlock, 2009; Odora-Hoppers, 2001; Carter, 2007). De Beer and Whitlock (2009) consolidate the above statement that though indigenous knowledge or cultural practices are currently often marginalised during Biology lessons, they have been sustaining millions of local (indigenous) people economically, socially and spiritually for many years.

Carter (2007) further adds that research indicates that nowadays many students and even teachers perceive the traditional approach to science teaching and learning as largely irrelevant to the realities of their complex contemporary world. However, formal science

education only is associated with high students' scientific misconceptions, lack of motivation and feelings of alienation which resulted in the reduction in the number of students opting to take science beyond the compulsory years (Odora-Hoppers, 2001).

O'Donoghue, et al. (2007) advocate that one needs to adapt the teaching and learning activities for a particular situation tapping into learners' cultural diversity in the classroom. Science content knowledge should then be presented as part of a wider community which has cultural practices and social norms rather than as an isolated box of knowledge because it contributes fundamentally to individual knowledge construction including development of concepts (O'Donoghue, et al., 2007). Carter (2007) is in agreement with the socio-cultural theories that individual learners create their own unique meanings based upon the interactions with what they already know, believe or the phenomena that they came into contact with prior to the new learning. This means for effective teaching, science teachers particularly beginning teachers; need to be introduced to ways that tackle these challenges of modern-day of teaching and learning (that is, the crucial role played by prior everyday knowledge and past experiences during instruction settings).

These ideas are consistent with the four national goals of education, namely, access, equity, quality and democracy (MESC, 1993) and the education policies stipulated in the New Namibian Curriculum (2003, p. 9) that the classroom and formal textbook content form only one part of the total learning context of the learner. Teaching and learning should comprise the multicultural world (Carter, 2007). It should be a collaborative experience where humans are situated in a natural and cultural context with which they interact, which affects them and from which they draw upon to construct new understandings.

Clarke (2001) reinforces this by saying learning is a:

*Dynamic process that involves a learner's interaction with other members of the community. Construction of knowledge is inadequate unless it takes into account the socio-cultural setting of those activities (p. 55).*

This means that the content that is presented in class should accommodate a common field of experiences from which individual learners select what they need to learn. In this way, the teacher needs to take into account the social dynamics of classrooms and cultural expectations of the learners for a meaningful understanding of science concepts to occur. Research shows that many novice teachers are hesitant to incorporate IK in the classroom out of fear of teaching pseudoscience (Rennie, 2011). The example of the workshop I gave is a

teaching strategy that is anchored in western science but it embraced both cultural knowledge and formal science thus making the learning process livelier and academically sound.

The socio-cultural view of teaching and learning scientific concepts is also consolidated by Lemke (2001) that science is a highly social endeavour that is embedded in the culture of the time and place in which it is practiced. This means that understanding science involves identifying both the culture and practice of science as emphasised by Vygotsky (1978) in which learning process is spearheaded by more knowledgeable peers facilitating the construction of knowledge.

Jaworski (1993, p. 5) describes socio-cultural learning as an integration into a community of practice in which social actions are identified and classroom activities are developed. Jaworski (1993, p. 4) expresses that teaching and learning is ‘taken-as-a shared’ process that develops in a classroom situation. Through collaborative discussions the participants (both students and teachers) negotiate new positions which allow shared meanings to develop. This requires making an effort to listen to and understand other perspectives.

Fosnot (2005) further adds that any learning occurs because of the interactions between the existing social and cultural experiences. Educators should create these platforms for learners to construct knowledge by means of connecting new knowledge to what they already know. Effective teaching of scientific concepts depends on the “adequacy of teachers’ understanding of both content knowledge and on the ways in which this knowledge is conveyed to learners” (Traianou, 2006, p. 827).

Briefly, this entails that learners should be allowed to reflect on their social and material environment through communication with others, and experiences of past occurrences. It is through these reflections that the learners internalize the outer world and activities into an inner understanding which leads to the formation of new information or a modification of previous experiences. Teaching that ignores learners’ past experiences can limit their critical thinking and thus they rarely make connections between the world outside the school and what is learnt in school.

The ideas of socio-cultural interactions in teaching science were also commented by Hodson and Hodson (1998) and Jaworski (1993). Jaworski (1993) characterizes teaching as a “continuum on which negotiation of meaning making is the end point of the learning process” (p. 28). In the same vein, Hodson and Hodson (1998) highlight that for effective teaching and

learning of science concepts to occur, the construction of knowledge should go beyond interactions between teacher and students in the classroom to a wider interaction between students themselves in their social and cultural environments.

O'Donoghue, et al. (2007) also alluded to the fact that the content that is presented in the class should not be treated as an isolated box of knowledge, but rather a fraction of a wider social entity which has both cultural practices and social norms. They stressed that for effective teaching of biological concepts, science teachers need to establish the learners' existing knowledge and challenge them directly for the learners to acquire meaningful understanding of scientific concepts.

Beskini, Yousuf, Awang and Ranjha (2011) further stress creating socio-cultural learning spaces allow learners to easily relate the scientific concepts that emerge from the topic taught in the classroom to what they experience or practice at home. This is believed to enhance concept development and deep understanding of biological concepts. Moll (2002) in his support for socio-cultural learning argues that teaching should not be viewed as an agreed-upon concept that leads to prescriptions and recipes for teaching practice but rather as a developmental mechanism which encompasses natural, social and cultural phenomena.

However, the challenge that is currently experienced by many teachers is how the socio-cultural practices can be translated into effective teaching and learning experiences. That is why O'Donoghue, et al. (2007) advocated that teachers need a sound subject expertise coupled with appropriate teaching strategies anchored in the socio-cultural perspectives for effective teaching of scientific concepts.

The social-cultural perspective is in line with the Namibian adopted framework of '*learner-centred education*' that places the child at the centre of every learning process and thus influence both curricula content and pedagogy of the classrooms (MoE, 2003). However, it is noted that many teachers still find it difficult to employ LCE fully because the teaching prepositions that need to be utilised during the lessons are not well articulated in the curriculum. Hence, the confusion and tensions that are currently experienced during curricula implementation (Namibian new National curriculum, 2003; Moll, 2002; Hodson & Hodson, 1998 a, b).

Wellington (1998) echoes the idea that teachers need to take note that each learner comes into a science classroom with unique pre-existing ideas or mental models that are highly

influenced by their past experiences. He emphasises that any new knowledge to be taught should be based on the learners' prior knowledge and experiences hence the need to develop these pedagogical skills among trainee teachers during training programme if they are to effectively implement them during teaching practices. It is against this background that the study tried to understand how trainee teachers engaged with prior everyday knowledge and experiences that would allow learners to merge science content with their past learning experiences.

### ***2.4.3 Social constructivism***

A classroom is viewed as societal unit where many social practices are constructed. In science teaching and learning, students may bring prior ideas to instruction. However, it is understood that in many cases these prior ideas may be in conflict with the scientific knowledge being taught hence this would affect the students' conceptual understanding (Roschelle, 1995). The classroom should provide conditions conducive for learners to socially interact as they debate, argue and explain their views to offset these contradictions.

In social constructivism, social interactions among learners are believed to be central to the cognitive construction of knowledge by individuals (Ndolo, 2011). Ndolo (2011) stressed that where learners have some prior knowledge on the concept to be learned, such information should be utilized to activate cognitive activities which enhance better understanding of the new concepts.

Social constructivism is a theoretical framework that asserts that knowledge is mediated through the social setting and interactions with the world around learners (Vygotsky, 1978). Stears and Malcolm (2005) concur with the above statement that in a social setting knowledge is actively constructed on the basis of experiences and previous knowledge. This provides the basis for understanding and serves the purpose of guiding the future teachers (Jaworski, 1993, p. 24). According to the social constructivist perspective, learning occurs through a process whereby lower mental functions such as conceptual thought and problem solving are transformed to higher level functions through collaborative interactions. This learning perspective draws on Vygotskian learning theory which views human cognition as transformational in nature and mediated by social interactions (Vygotsky, 1978). Its success

is dependent on taking cognizance of the Zone of Proximal Development (ZPD). According to Vygotsky (1978),

*The distance between the actual development level as determined by independent problem solving and level of potential development as determined through problem solving under the adult guidance or in collaboration with a more capable peer. (p. 86)*

This means in a science classroom, the learning activity set by a teacher should set up multiple overlapping ZPDs. For example, through collaboration in a successful learning activity, an individual response to a question will originate from his or her previous experiences but may pull other learners into their ZPDs. This means that there is shared ZPD, created in the learning activity but the process of internalization occurs in each learner's ZPD because the zones vary from learner to learner and each learner reflects this understanding at various stages of development.

Therefore, it is important that the teachers create learner-learner or learner-teacher platforms such as assigning challenging tasks, engaging them in small groups or whole class discussions whereby they are allowed to solve problems in a social interaction setting (Ndolo, 2011; Goos, 2004). Within these platforms, learners in their ZPDs can be easily aided by a more knowledgeable peer or teacher to solve problems that require higher mental functions than what they can perform individually.

Hodson and Hodson (1998) further commented that learning is a social approach that occurs through participation with others in a cultural milieu in a meaningful way. The subject of study is a contextualized individual, embedded within a society and formed through a dialectical relationship, thus the construction of knowledge should occur through interaction in the social world. The situated individual actively builds knowledge through the process of internalizing social knowledge. Hodson and Hodson (1998) further state that,

*Any function in the child's cultural development appears twice. First, knowledge appears on the social plane (an inter-psychological) and then moves on to psychological plane (an intra-psychological). (p. 36)*

In this case, they accentuate that peer assistance that occurs during collaborative interaction (known as scaffolding) plays an important role in science concept development. Scaffolding has been defined by Peterson (2009) as a "communicative context where in social interaction

a knowledgeable participant creates supportive conditions in which the novice participates and extends current skills and knowledge to higher levels of competence (p. 304).

It is recognized that this can be achieved once a teacher thoughtfully chooses pedagogical approaches that enable learning to occur by allowing learners to explore scientific concepts through social learning approaches like brainstorming sessions and group and whole class discussions. Observing learning and teaching from this perspective will help equip trainee teachers with skills to be able to create such learning environments where learners learn using their own social context (Keast & Cooper, 2011).

Therefore, science teaching informed by the social constructivist perspective should rely on the teacher acknowledging and identifying the learners' alternative conceptions and creating experiences and opportunities for them to experience conceptual change. The expectations are that learners may start to better develop an understanding of the abstract biological concepts as they move from their informal prior views towards the accepted school views (Fosnot, 2005).

Keast and Cooper (2011, p. 260) point out that the social constructivist perspective is based on the views that "learners interpret and interact with the physical world in their conceptualization of phenomena".

## **2.5 Conceptual Framework**

### **2.5.1 The nature of prior everyday knowledge and experiences**

The importance of prior everyday knowledge (which includes indigenous knowledge) has been acknowledged by many educationists. Otero and Nathan (2004) proposed that successfully teaching and learning scientific concepts requires bringing into consciousness the term '*prior everyday knowledge*' which stands out as the basic foundation for acquiring new information.

Roschelle (1995) for example claims that the teachers' subject knowledge and IK should be treated as mutually inclusive domains. He states that learning proceeds primarily from prior knowledge hence it is necessary for educators to understand how learners' prior everyday knowledge and their past experiences affect learning. He further points out that failure to amalgamate the two domains of knowledge may negatively affect the learners' performance in science subjects.

It is on this basis that many researchers in science education nowadays call for the restructuring of teaching and learning in the science classroom from teaching that claim that scientific knowledge is universal to that teaching that accommodates learners' lived worlds during science classrooms (Rennie, 2011; Beskini, et al., 2011). Beskini, et al. (2011) emphasise the importance of using prior everyday knowledge and experiences when teaching science concepts that learners come into a science classroom with a rich form of a 'library' of knowledge, though rather simple or sometime faulty that needs to be acknowledged during the teaching and learning process.

Likewise, Rennie (2011); Stears and Malcolm (2005) accentuate that bridging the boundary between school science and real life experiences enables learners to develop positive attitudes towards their engagement and interest in science education. This was further supported by Roschelle (1995) that prior knowledge actually determines what learners learn from past experiences. He highlights that learning does not occur in a vacuum by making reference that even scientists draw their scientific metaphors from everyday experiences. He adds that "scientific knowledge is not a special type of knowledge, but rather a refined product, for which prior knowledge supplied the raw materials and social interaction supplied the tools" (p. 4). His views illustrate that the content that is taught in the classroom should not replace or ignore prior knowledge, but rather re-use or refine it into a more encompassing structure.

Oloruntegbe and Ikpe (2011); Krause, Kelly, Corkins and Tasooji (2009) and Rennie (2011) also remark on how prior everyday knowledge and experiences shape learners' ways of learning science concepts including biological concepts. Rennie (2011, p. 18) enlightens that "students arrive at school each day informed by their experiences in the community which are closely related to the discourse of science they are taught in the classroom". On the other hand, Oloruntegbe and Ikpe (2011) point out that there is a good correlation between learners' achievements and the integration of science content to their everyday lives. They express this as border-crossing between school content and everyday knowledge and experiences. If learners cannot "relate what they learn in school to their daily lives, they are likely to experience difficulties in learning science concepts and become disenchanted with studying science" particularly at tertiary institutions (p. 266).

Science learning is regarded as a real-life experiences, therefore science teachers are urged to work in interdisciplinary ways to integrate content taught in the classroom with life experiences that learners experience outside the classroom (Rennie, 2001). In addition,

Krause, et al. (2009) clarify that failure to engage learners' initial understanding during instruction may prevent some learners from grasping the new information taught during the lesson and they may revert to their preconceptions that might be wrong.

This study was therefore geared to understanding how trainee teachers addressed these learning challenges. The challenges may affect how learners acquire knowledge, in particular the understanding of biological concepts.

Beskini, et al. (2011) also highlight that the integration of indigenous knowledge (IK) when teaching science concepts creates a holistic impact between formal science and society when learners relate content learned in the classroom to what they actually practice at home. This entails that the teaching of science concepts should not be a mere passing on of scientific knowledge but it should aimed at shaping individual learners' daily lives and adding value to the development of the society at large.

Odom and Barrow (2007) point out that both teachers and learners have different ways of how they understand and explain natural phenomena. They stressed that knowledge is known to be subjected to its own tests of time and application. In most cases these understandings are in contrast with the accepted scientific views. This means that knowledge taught in school should be localized and contextualized to the learners' own contexts for effective learning of science concepts to occur.

This places the onus on the science educators to ensure that they strategically look at the curriculum challenges, particularly how scientific concepts are constructed. One way to do this is by creating opportunities where teachers and learners discuss and clear out the misconceptions or misunderstandings that might arise and help both parties to reach a common sensible understanding.

Van Wyk (2002) views "learning as a social construction of knowledge in the sense that children make sense of their world through active exploration of their environment and social interchange with people around them" (p. 307). Kibirige and Van Rooyen (2006) further add that IK covers a broad range of human experiences. It involves 'trial and error' approaches in which intelligent reasoning sustained in societal practices, institutions, relationships and rituals nationally are embedded.

The role of science educators is therefore to scrutinize such teaching strategies and choose the best local practices including unpacking learners' prior everyday knowledge that will make

science appealing to all learners. However, it is also understood that to acquire such skills is not easy. Therefore, science teachers need proper training to help them to carry out their teaching more successfully (Kibirige & Van Rooyen, 2006).

Development and assessments of students' understanding of scientific concepts has been of interest to many researchers and teachers in the science education community (Otero & Nathan, 2004; Van Wyk, 2002; Kibirige & Van Rooyen, 2006). Otero and Nathan (2004) reported that integrating the new knowledge with knowledge that already exists in the learner's mind is an important aspect of learning. It involves proper utilisation of the teaching strategies to present new materials or concepts and the necessity to compare new information with the former materials (Otero & Nathan, 2004). This in turn makes learners to develop new knowledge more easily and helps them retain it.

In so doing, learners are allowed to compare and contrast science content with IK and how the two knowledge systems consolidate each other. During the teaching of new concepts, learners will be dissatisfied with their existing conceptions (Krause, et al., 2009). Acknowledging each learner's cultural capital or IK that she/he brings into the classroom is vital because learners are known to have different experiences, knowledge, values and ways of thinking. Through these deliberations, learners will point out scientific concepts that are associated with their local practices and discuss them more deeply to clear the possible misconceptions, thus facilitate developing a new conceptual change.

As Krause, et al. (2009) put it "learning is a conceptual change where students learn better by constructing their own knowledge through the modification of their conceptual framework" (p. 2). Rennie (2011) adds that learning outcomes for students only become powerful and worthwhile if there are effective school-community links.

Science teachers are therefore encouraged to align all their teaching with the learners' prior knowledge and experiences, values and cultural background. This will enable trainee teachers to broaden their content skills and to align their teaching strategies in such ways that enable learners to integrate what they learn in their everyday lives into the classroom (Stears, Malcolm & Kowlas, 2003; Oloruntegbe & Ikpe, 2011; Rennie, 2011).

### **2.5.2 The roles of prior everyday knowledge and experiences in teaching and learning biological concepts**

Eliciting and building on students' prior knowledge is a central tenet of contemporary learning theories. Roschelle (1995, p. 5), highlights the role of prior knowledge in teaching science concepts that "learning is a process that involves modification of new knowledge and past experiences of the world". He stressed that in most cases, learners integrate additional experiences with their existing ideas or experiences and that only in rare cases do they undertake major transformations of thought that affects everything including the way they see, conceive and talk about their past experiences.

Many researchers also call for structuring the science curriculum so as to connect school science to students' lives. Calls for 'contextualising instruction' by (Rivet & Krajcik, 2008), 'ability to relate science concepts with home experiences' (Oloruntegbe & Ikpe, 2011), 'blurring the boundary between the classroom and the community' (Rennie, 2011) are common features in today's science education reform initiatives. According to Rivet and Krajcik (2008), contextualizing science instructions with students' prior everyday knowledge and experiences fosters better understanding of challenging science concepts among many learners.

Prior knowledge that learners bring into a science classroom needs to be accredited because it enables the learners to make sense of the new concepts taught and helps them to understand their own world better. Failure to do so say (Settlage & Southerland, 2007) may lead many learners going away from the lessons with different understandings of the content taught which they refer to as knowledge. Settlage and Southerland (2007, p. 138) describe "knowledge as a product of putting all information together". Unlike the computer that can store and retrieve data as it is, knowledge can be modified in many different ways because it only exists in the mind. Knowledge is influenced by the individual's past experiences hence the importance of prior knowledge and experiences (Settlage & Southerland, 2007).

In science education (Biology in particular), prior knowledge is regarded as a basis for teaching and learning new concepts because in most cases such experiences may be in conflict with the scientific understanding to be taught (Scott, Asoko, Driver & Emberton, 1994). In this case, teaching and learning should play the role of fitting new ideas and experiences into existing ideas leading to negotiation of new meaning making (Stears & Malcolm, 2005). This is done in an active process and through social interactions between teacher and learners and among learners (Asoko, et al., 1994).

Odora-Hoppers (2001) commented on these ideas by saying that learners should not be treated as blank slates or *tabula rasa* ready to absorb knowledge but as potential co-designers of knowledge by bringing together ideas, interests and experiences. Helping learners to acquire such new knowledge is a crucial aspect of teaching and learning. It is contended that learners have different views about many science topics even before any formal education (Beskini, 2011). The authors claim that the past experiences that the learners hold before a new topic is taught may influence the way they learn new concepts. Yet, in most cases, teachers are unaware of the existence of such experiences. They said that it is common for learners to express their past experiences like ‘I know about this’ or ‘I’ve seen this before’ when a new topic is introduced to them in a class. These expressions indicate that learners’ basic preconceptions are sometimes helpful and need to be acknowledged.

### **2.5.3 Factors affecting effective teaching and learning of biological concepts**

While knowledge is viewed as being constructed in an active process, constructivist teaching that accommodates the use of learners’ prior everyday knowledge and experiences seems to be a daunting task to many novice science teachers. This study explores the factors that may hinder the way teachers effectively teach biology concepts.

Factors that relate to pedagogical strategies such as inadequate knowledge of subject matter, inadequate teaching experiences; misconceptions about the concepts on the topic taught and cultural conflicts that may arise between the science content and IK seem to have an effect on teaching when prior knowledge is incorporated with science in the classroom (Ndolo, 2011, p. 11). Ndolo stressed that unqualified teachers are known to be inflexible in their teaching styles and mostly stick to their prepared notes or textbook with minimal teacher-learner interaction (p. 20).

Further, the misunderstandings of the theoretical underpinning of constructivist theories that govern most classroom reforms are another hindrance. In most cases teachers ask questions which they already know the answers to and simply pose these questions to the learners to verify if they know the answer. Ndolo (2011) raises a concern that this tactic does not help learners to use their prior knowledge and everyday experience to develop conceptual understanding of the new information in the topic taught.

It is therefore important for science teachers to be able to select content and contextualized activities that can challenge learners. Ndolo (2011) reveals that the selection and delivery of

science content is affected by teachers' mastery of subject matter and their ability to transform this matter into content that is meaningful to learners.

Ndolo (2011, p. 19) urges science teachers to refrain from using objective questions that require predetermined responses but proposes that they should rather "use authentic questions that open negotiation and promote establishment of shared meaning in the classroom". She stresses that such answers help to enhance comprehension of scientific concepts. Questions that require discussion and dialogue are believed to promote conceptual change because they create room for learners to challenge ideas raised by other learners during the lessons.

Inadequate and insufficient teaching and learning materials are also factors that can hinder the teaching of biological concepts. Teaching and learning materials are tools used by teachers to facilitate the construction of knowledge including biological concepts in the science classrooms (Ndolo, 2011, p. 21). For learners to be actively involved there should be adequate and relevant teaching materials including textbooks (Czerniewicz, Murray & Probyn, 2000). In Namibia, like in many other African countries, most state-owned schools lack adequate teaching and learning materials which makes it difficult for many teachers to implement LCE.

However, it is argued that science teachers in such schools need to go the extra mile when they design their lesson plans. For example, in selecting teaching and learning materials, they should opt for the use of local resources related to the science topic they teach. The use of local resources has been applauded for its ability in helping learners cross cultural borders from their everyday practices into scientific practices. In turn, this aids the smooth development of biological concepts (Aikenhead & Jegede, 1999). In order not to short change learners, it is imperative that trainee science teachers should have the pedagogical content knowledge discussed below.

#### **2.5.4 The nature of Pedagogical Content Knowledge (PCK)**

Pedagogical Content Knowledge (PCK) is "an academic construct that represents an intriguing idea" (Loughran, Berry & Mulhall, 2006, p. 9) about teaching practice. This construct is rooted in the belief that teaching requires considerably more than just delivering subject content knowledge and that learning is substantially more than absorbing information for later accurate repetition.

The meaning of PCK is well documented by many authors who echo the work of Shulman's (1986, 1987) academic construct that describes aspects of professional knowledge and expertise developed by teachers (Rowan, Schilling, Ball, Miller, Atkins-Burnett et al., 2001; Kind, 2009; Loughran, et al., 2004). Rowan, et al. (2001) describe PCK as a "form of practical knowledge that is used by teachers to guide their actions in highly contextualized classroom settings" (p. 2). On the other hand, Kind (2009, p. 170) defines it "as a concept that represents the knowledge teachers use in the process of teaching" while Loughran, et al. (2004) state that PCK involves "ways of representing and formulating the subject that makes it comprehensible to others" (p. 371).

These ideas stress that in order to deliver meaningful teaching and promote meaning making of new concepts learned during teaching instruction; teachers should know how to arrange elements of the content for better teaching and learning. In my own view, teachers should develop, use or adapt certain teaching procedures and approaches to fit the teaching of a particular content. This includes the use of prior knowledge and experiences that learners bring to the classroom from their social contexts. This was the focus of this study.

Mishra and Koehler's (2006) thinking resonates with Shulman's idea of PCK by stating that teaching of specific content should include a thorough know-how of the teaching approaches that can best be used to teach specific content for deep understanding of the concepts. They reason that teachers need to develop expertise that enables them to blend the content knowledge about a specific topic with relevant instructional strategies.

However, Halim and Meerah (2002); Loughran, et al. (2006) point out that PCK is an expertise that develops over a time or through experience of teaching a specific topic several times. They also make it clear that PCK is not uniform for all teachers within a given content area. Loughran, et al. (2006) state that development of the teaching approaches that lead to a deep understanding of the content may be difficult for beginning teachers because PCK is constantly built up over time thereby making the recognition of PCK difficult during internship programmes.

Therefore, the focus of this study was to explore trainee teachers' PCK that might be helpful in refining their professional expertise in teaching science concepts. The PCK was used in this study as an analytical tool using 'prior everyday knowledge and experiences' to engage, inform and empower pre-service trainee teachers with effective science teaching strategies

that would enable them plan and implement meaningful biology lessons so that they could enhance deep understanding of biological concepts.

The existing trainee teachers' understanding of the concepts on the topic of nutrition, the likely conception and misconceptions that they had on this topic and the teaching difficulties that they might encounter during the development and implementation of such lessons were explored, documented and discussed during brainstorming sessions. This was followed by an orientation programme whereby an exemplar lesson on nutrition and balanced diet was designed and presented as a model to the trainee teachers to show how learners' prior everyday knowledge and experiences on specific content could be sorted and integrated with biology content to enhance meaningful understanding of biological concepts. Finally, the trainee teachers were requested to design and implement various biology topics of their choice and presented them to their peers during microteaching. The aim was to see how they manipulated their prior everyday knowledge and experiences as they used it as their PCK.

During microteaching the trainee teachers' abilities to elicit learners' prior knowledge and experiences on a specific topic; how to structure and represent academic content to learners were explored. Furthermore, the challenges that the trainee teachers encountered during the lesson development and presentations were also documented. The findings of these sessions are documented in chapters 4 and 5 and analysed and discussed in chapters 6 and 7.

## **2.6 Concluding remarks**

In this chapter, I outlined the theoretical frameworks namely social constructivism and sociocultural constructivism as well as the conceptual frameworks, prior everyday knowledge and Pedagogical Content Knowledge (PCK) that informed this study. Furthermore, the chapter discussed how trainee teachers were expected to transfer meaning making of biological concepts during Biology classroom. This was achieved by discussing relevant literature within the Namibian context as well as other international literature.

The next chapter discusses the methods used to generate data in this study.

## **Chapter Three**

### **Research methodology**

#### **3.1 Introduction**

This study aimed to understand how trainee science teachers engaged with learners' prior everyday knowledge and experiences with the view to help them acquire necessary skills needed to design and present meaningful content that enhanced learners' conceptual development and understanding of biological concepts.

In this chapter, I discuss the research design and procedures used in gathering the desired information, the research paradigm that the study adopted followed by an outline of the goals and questions of the study and then a description of the approach used which is a qualitative case study with elements of action research.

The research site, participants and the sampling strategies adopted are described. The data for this study were generated by means of the following techniques, namely: - document analysis, brainstorming and verbal conversations, orientation lesson development programme and reflections, observation of the four trainee teachers' microteaching lessons and semi-structured interviews. The chapter continues with a discussion of data analysis techniques as well as the ethical considerations addressed. Finally, it reviews the limitations of the study, its validity and then presents the concluding remarks.

#### **3.2 Research design**

##### **3.2.1 Research paradigm**

This research is qualitative and it is underpinned by an interpretive paradigm. According to Gay, Mills and Airasian (2011, p. 16), "the central focus of the interpretive paradigm is to provide an understanding of a social setting or activity as viewed from the perspective of the research participants". They further state that qualitative research information is gathered through the use of observations or audio-visual methods in a natural and non-manipulated setting. Cohen, Manion and Morrison (2010, p. 22) too add that the interpretive researchers begin with "individuals and set out to understand their interpretations of the world around them".

In this study, I explored how trainee teachers engaged with prior everyday knowledge and experiences during their classroom instructions by interpreting patterns and themes that emerged from data generated (Dupuis, 1999). To achieve this, as a researcher I entered “the participants’ world and seek the meanings through on-going interactions with the participants’ perspectives” as proposed by (Creswell, 2013, p. 194). This was done to understand the natural setting where the human behaviour and events occurred (Gay, et al., 2011).

To place events in contexts that were understandable to the participants as proposed by Babbie and Mouton (2001), trainee teachers were engaged in a series of learning activities during brainstorming session, orientation lesson and development programme using the topic of nutrition and balanced diet. The topic was chosen by the students. Subsequently, I tried to observe on-going learning processes to better understand how students actively constructed knowledge through interactions with physical phenomena (their prior everyday knowledge and experiences on local foods) and through social and interpersonal exchanges with fellow students during Biology lessons.

Creswell (2013) argues that the interpretive approach is often described as social constructivism. In social constructivism, individuals seek to understand subjective meanings of the world in which they live and work. Thus, the primary goal of this research was to understand how trainee teachers made use of the prior everyday knowledge that the learners might bring into the lesson in order to enhance their conceptual development and understanding of biological concepts (Jofili, Geraldo & Watts, 1999).

I believed that the interpretive paradigm was appropriate for this study because it enabled me to understand the situation and to interpret meaning within the social and cultural context of the natural setting of the participants (Cohen, et al., 2011).

To do this end, the study established how four trainee teachers designed and implemented four different Biology topics during microteaching practice. In this qualitative study, I tried to capture and explain some elements of action research displayed by trainee teachers during the orientation programme and microteaching presentations of the four teachers (Cohen, et al., 2011).

Cohen, et al. (2011) stress that researchers working in the qualitative paradigm assume that people’s subjective experiences are real and should be taken seriously since we can

understand others' experiences by interacting with them and listening to what they tell us. Thus, the orientation programme was designed to help me determine what constituted prior everyday knowledge and experiences of the trainee teachers on the topic of nutrition and balanced diet and how their knowledge could be introduced and used in the Biology classroom.

In the learning activities that I designed, I examined the extent at which this approach impacted the shifts between formal science and everyday knowledge as part of learning. In addition, the study tried to capture insights on the trainee teachers' abilities to plan and implement lessons that make use of learners' prior everyday knowledge and experiences to construct meaning of the formal science learnt in the Biology classrooms.

### **3.2.2 Research approach**

This study adopted a case study approach which is an empirical enquiry. According to Thomas (2011, p. 23), a case study is about seeing something in its completeness, looking at it in detail from many angles and not seeking to generalise from it". Cohen, et al. (2010, p. 254) also describe a case study as portraying holistically evidence on a particular situation by looking at a particular case in its real-life context.

The study started with data gathering through document analysis, brainstorming and observation and orientation programme with 18 students. During microteaching practice only four presentations were selected and analysed. The four trainee teachers who presented formed a sample that I interviewed during individual semi-structured interviews. One of the strengths of this approach was that it allowed me to acquire an in-depth understanding of the case because I was integrally involved with the trainee teachers' lived actions throughout the research process (Cohen, et al., 2011, p. 289).

As is the norm with case studies, the study was conducted within a bounded system in terms of space and time during which more than one technique was used (Cohen, et al., 2010, 2011). All participants used in this study were final year trainee science teachers from the University of Namibia Katima Mulilo Campus (UNAM, KMC) whom I was teaching Biology as component of the Integrated Natural Science Education (INSE) course module. The data gathered blended a description of events and relevant teaching practices that they portrayed during classroom instruction.

The case study method was chosen because it gave me an opportunity to observe and examine how four trainee teachers developed their teaching skills while observing their social interactions. Thus, this study enabled me gain insights into the issues that might affect trainee science teachers' teaching practices. Furthermore, I found this approach worth-while because it enabled me to gather data using multiple sources of information (Creswell, 2013, p. 96) which subsequently improved the validity of the data.

### **3.3 The research goal:**

The main goal of this research study was to understand how trainee teachers engaged with prior everyday knowledge and experiences associated with teaching and learning of biological concepts during Biology lessons for INSE course for grade 5-7.

#### **3.3.1 Research questions**

##### **Main question:**

How do trainee teachers engage with prior everyday knowledge and experiences associated with teaching and learning of biological concepts during Biology lessons?

##### **To achieve this goal the following sub-questions were asked:**

1. What understanding of prior everyday knowledge and experiences related to the teaching and learning of biological concepts do trainee teachers bring to a Biology classroom?
2. What teaching strategies do trainee teachers identify and consider effective to engage learners during Biology lessons to enhance conceptual development and understanding of biological concepts?
3. To what extent does identifying and implementing relevant Biology topics incorporated with prior everyday knowledge and experiences enable or constrain meaningful learning of biological concepts during classroom instruction?
4. How do trainee teachers design and implement Biology lessons integrated with learners' prior everyday knowledge and experiences to promote meaning making, conceptual development and understanding of biological concepts?

5. What challenges do trainee teachers encounter during the designing and implementation of Biology lessons that incorporate learners' prior everyday knowledge and experiences?
6. What factors enable or constrain the teaching of biological concepts in the curriculum?

### **3.4 Research site**

The research was conducted at UNAM KMC where I work. This campus is a former College of Education and it is currently one of the four educational satellite campuses of the University of Namibia. It is located in the town of Katima Mulilo, in the Zambezi Region and is approximately 1300 km far north-east from Windhoek, the capital city of Namibia. It was a convenient and purposeful site because it is where I work and I wanted to examine the professional development and teaching pedagogies of the science trainee teachers whom I teach Biology as a component of the Integrated Natural Science Education.

Upon completion of their studies most of these teachers will be employed to teach Natural Science for upper primary phases (grade 5-7) schools which consist of many Biology themes including the topic of nutrition and health. In Namibia many schools that teach the upper primary phase are situated in rural areas where the learners are familiar with local foods and their associated local practices.

In this study, I worked with my colleague as a critical friend who observed my orientation programme which entailed the teaching of a Biology lesson on nutrition and balanced diet to a group of eighteen trainee science teachers. I decided to involve a critical friend in my study in order to get more insight into how to make meaning when teaching the topic of nutrition. Furthermore, I was hoping that my findings would “promote understanding or inform practice for similar situation” (Leedy & Ormrod, 2010, p. 137).

### **3.5 Sampling of participants**

In this study, convenience and purposive sampling was used in selecting the participants for the study. Merriam (2001, p. 61) states that “purposive sampling is based on the assumption that the researcher wants to discover, understand and gain insight and therefore must select a sample from which most can be learned”. The final year trainee science teachers were

purposeful chosen because I believed that they had covered much content within their specialisation field (Science) and were thus more conversant with the content taught in their methodology courses. They comprised my sample for the case study.

However, for ethical reasons, all students were engaged in the orientation programme where they were introduced to ways to develop and present Biology lessons that incorporated the prior everyday knowledge and experiences of learners. But given the time-frame to gather and transcribe the data; only four trainee teachers were selected to plan and present lessons during microteaching practice. The four trainee teachers also formed a purposeful sample that I interviewed using semi-structured interviews. I decided to use these trainee teachers because I was their supervisor during their school based studies (teaching practice). I felt this would give me an opportunity to encourage the trainee teachers to implement some of the teaching strategies that we practiced during the orientation programme.

### **3.6 Research stages and data gathering techniques**

Six data gathering techniques were used to obtain information for my study; namely, document analysis, brainstorming and group discussions, an orientation programme (workshop) with worksheets, observations and reflections, microteaching presentations and semi-structured interviews. A variety of data gathering techniques were employed for triangulation purposes so that the different techniques could complement each other as well as to validate my research findings as proposed by Cohen, et al. (2010).

The research process was done in five stages. The first stage was document analysis where I reviewed documents relevant to my study, namely, the Namibian National Curriculum for Basic Education (NNCBE), the Natural Science and Health Education syllabus for grade 5-7 and the three prescribed Natural Science textbooks for grade 5-7.

The second stage of the research process involved a brainstorming session on the topic of nutrition where the trainee teachers thought about their understanding of how prior everyday knowledge and experiences should be incorporated during science lessons with the observation and reflection done using whole class discussion.

The third stage of the research process was an orientation programme that I modelled to the trainee teachers on how they could incorporate learners' prior everyday knowledge during Biology lessons. This session was observed by my critical friend who was also a participant observer during and thereafter we reflected on the lesson.

The fourth stage was the microteaching presentations where the four selected trainee science teachers presented to the fellow students (peers) and comments on their lessons were made by the entire class.

The fifth stage consisted of individual semi-structured interviews which I conducted with the four trainee teachers on the lessons they presented during the microteaching.

This exercise served as a practical preparation for the four trainee teachers who were selected to do microteaching presentations as well as for the trainee science teachers who were used as learners during the presentations because they were about to go for their final phase of teaching practice in the local schools. The initial idea was that the four trainee teachers were supposed to teach lessons using this approach in a real classroom situation with learners but this did not materialise due to problems which I discuss in detail in the limitations part of this study.

The five data gathering methods and stages used in this study are tabulated in Table 3.1 below. This is to show their coherence and alignment with the research questions and the theoretical framework that were adopted in this study.

**Table 1: Data gathering techniques and stages**

Stages	Method used to gather data	Data to be gathered	Purpose
<b>Stage 1</b>	Document analysis using curriculum documents:- NNCBE, NSHE syllabus, three text books for NSHE grade 5-7 and other documents such as external moderator reports	The data on the integration of learners' prior-everyday knowledge and experiences in the National curriculum and Natural Science and Health Education syllabus.	To understand curriculum expectations regarding the importance of incorporating learners' prior-every day knowledge and experiences in school science.

<b>Stage 2</b>	Brainstorming using observation checklist and whole class discussion sessions	Data about prior everyday knowledge and experiences as well as local practices related to the topic of nutrition and balanced diet that the trainee teachers' bring into science classroom.	To get some interpretations from the trainee teachers on how they feel learners' prior everyday knowledge and experiences should be elicited and incorporated during the instructional process to promote development of biological concepts.
<b>Stage 3:</b>	Orientation programme observation and reflections by participant observer (video-taped)	Identifying indigenous explanation of terms or local practices of the local foods mentioned. Discuss and explain them to give them scientific meaning. Discuss the misconceptions that evolved during learning process. Draw hierarchy charts using local foods to show nutrients found in local foods and usage in the body.	Modelling to the trainee teachers' one teaching and learning approach on how to contextualise biology content with prior everyday knowledge and experiences during science classroom with the view to equip them with some relevant teaching skills before they are engaged to develop own lessons to teach during microteaching practices.
<b>Stage 4</b>	Students' lesson plans through microteaching presentations, observations and reflections with trainee teachers.  Video-taped to capture what transpired during microteaching lesson presentations.	Exploring how trainee teachers elicit students prior everyday knowledge and experiences on the topics they teach; for examples the type of local materials used, relevance and reliability in terms how they clearly match with the lesson to be taught. What indigenous science emerged and how they can be matched with scientific concepts.	Explore the benefits of using prior everyday knowledge and experiences to enhance development and understanding of biological concepts during instruction setting.  Find challenges that teachers may encounter during the designing and implementation of lessons.
<b>Stage 5</b>	In-depth semi-structured interviews with the four selected trainee teachers.  (Note taking and tape recording)	Follow up on trainee teachers presentations of their teaching and learning materials and lesson plans and seek clarity on issues already observed; identifying the challenges faced by teachers, the benefits of the approach and opportunities for future change.	To clarify issues raised by means of the other methods of data collection; to prioritise challenges and identify opportunities for change

The data gathering techniques in the table above are discussed in greater detail below.

### **3.6.1 Document analysis**

Cohen, et al. (2011, p. 249) define document analysis as scrutinizing “any record of an event or process to provide an account of such event or process in question”. It is often used in conjunction with other sources of information such as interviews and observations (Hitchcock & Hughes, 1995). In addition, Elliot (1991, p. 78) defines document analysis as all written texts which “relates to some aspect of the social world and provide information which is relevant to the issues and problems under investigation”.

In this context, several public documents were reviewed to understand issues surrounding the education requirements, teaching methodologies and the value of integrating of learners’ prior everyday knowledge and experiences during teaching and learning repertoires (Elliot, 1991). I examined the curriculum documents such as the NNCBE, 2009, the NSHE syllabus for grades 5-7, sections from three Natural Science grades 5, 6 and 7 textbooks. In addition, an official external moderator report (2009) on Natural Science school-based studies was also reviewed. The documents analysed were coded to make it easy for data analysis and the coding system used for the documents is as follows:

- Namibia National Curriculum of Basic Education (NNCBE)- CD1
- The NSHE syllabus- CD2
- External moderator reports - CD3
- The textbooks- (textbook1 CD4a , textbook2 – CD4b; textbook 3 – CD4c)

The information gathered from these documents were compared and contrasted with information which I gathered using other data gathering methods in order to better understand this pressing educational issue and to verify the existence of the problem (Gay, et al., 2011)

### **3.6.2 Brainstorming and discussion**

Ellis (1997, p. 206) defines brainstorming as a “technique for finding solutions, creating plans and discovering new ideas in a short period of time”. On the other hand, Woolfolk, Hughes and Walkup (2005, p. 3 71) describe brainstorming as a process of “generating ideas without stopping to evaluate them or without being challenged”. They further explain that the basic

tenet of brainstorming is in its ability to separate the process of generating ideas from the process of evaluating them since evaluation often inhibits fluency and flexibility. Furthermore, O'Donoghue (2009, p. 375) describes brainstorming as an appropriate activity to start with when someone wants to generate more ideas about the topic under investigation because all people involved are given "equal opportunities to contribute without inhibition, suggestions or possible solutions to real or proposed problem".

In this study the brainstorming session was used to foreground the position of the trainee teachers' professional development and teaching practices that are emphasised in the curriculum documents and other resources analysed. This included how the trainee teachers understood the use of learners' prior everyday knowledge and experiences and active involvement of learners for comprehension of biological concepts; how their understanding might affect their classroom practices and the factors that they considered as hindrances to their abilities to build on learners' experiences during classroom instruction.

Trainee teachers were told to form small groups of five to six students each and they brainstormed different ideas which they considered vital when teaching Biology content that integrated with learners' prior experiences. Clear written instructions were provided to all participants in order to give them direction on the activity. For example, trainee teachers were cautioned to avoid evaluating or judging each other's ideas during the session as stated by Ellis (1997). This was done to allow all ideas of the participants whether wild, impossible or unworkable to be accepted and noted on the charts and to be presented later during discussion session. Ellis (1997, p. 206) commented that group brainstorming is a powerful technique because "it allows participants to create new ways of thinking about the old problems because all ideas are accepted and scrutinised later to choose the one that are workable".

After some experience in brainstorming within their groups, trainee teachers were then engaged in a formal whole class discussion directed by me where each group presented their group opinions or solutions to the problem under investigation to the whole class. In this case, the trainee teachers commented on each other's ideas exchanged their different viewpoints on the issue and elaborated on other opinions under my supervision as emphasised by O'Donoghue (2009).

According to O'Donoghue (2009, p. 373), "since the discussion process is open to all students and to all arguments, it is possible that unpredictable learning outcomes are generated". These social interaction processes inspired an interest in the topic among the

trainee science teachers and all the participants moved together toward a common understanding.

### **3.6.3 Orientation programme observation and reflections**

According to Gay, et al. (2011, p. 381), an observation is a “research technique in which the qualitative researchers obtain data in their natural environment as lived by the participants without altering or manipulating it”. Moreover, Cohen, et al. (2011, p. 456) argue that observation is more than just watching because it is “a systematic process which offers an investigator the opportunity to gather live data from naturally occurring social situations”.

Cohen, et al. (2011) further elaborate that observation is a powerful technique in qualitative studies because it allows the researcher to obtain primary data by looking directly at what is taking place *in situ* at a specific time rather than relying on secondary information. This suggests that the use of immediate awareness as the principle mode of research has the potential to yield more authentic data to the study.

In this case study, I was an active participant observer since I was part of and a participant in the situation being observed (Thomas, 2011). The session was observed by a critical friend who also participated by contributing to group activities while I was modelling various teaching and learning activities to my trainee teachers. Thomas (2011, p. 382), states that in participant observation, the researcher “participates in the situation while observing and collecting data on the activities, people and physical aspects of the setting”. The session was video-taped by a non-participant critical friend.

In this case study, I was observed while teaching a topic on nutrition and a balanced diet using my trainee science teachers’ prior everyday knowledge and experiences in order to model to them how we can relate science content with learners’ experiences during a lesson. Though, I was acting as a facilitator during the learning process, I was actively involved in the situation I was researching. This was beneficial to me as it allowed me to gain insider-insights and developed relationships with the trainee science teachers. Furthermore, it helped me to gather desired information simultaneously that helped me shape their teaching practices (Cohen, et al., 2011).

### **3.6.4 Microteaching presentation and observation**

As it has been alluded to above, observation is a “highly flexible form of data collection that enables the researcher to have access to interactions in a social context and to yield systematic records of these in many forms and contexts to complement other kinds of data” (Cohen, et al., 2011, p. 457).

In this stage, lesson observation was selected as a data gathering strategy because it allowed me to do a reality check and to look afresh at everyday trainee science teachers’ actions during the lesson execution. During the lesson presentations and observation, I analysed the four trainee science teachers’ classroom interactions in relation to how they used prior everyday knowledge and experiences and how they actively involved students during lessons in order to enhance development of biological concepts.

A lesson observation schedule with predetermined categories was used to record important facets of what occurred during the microteaching (See Table 8). According to Cohen, et al. (2011), a carefully prepared observation schedule avoids problem caused when there is a time gap between the act of observation and the recording of the event.

The observation schedule assisted me to capture the aspects of the lessons in relation to how trainee teachers made use of learners’ prior everyday knowledge and experiences when teaching biological concepts. It also helped me to take note of the observable factors that might promote or hinder trainee science teachers’ abilities to make use of this teaching-learning approach during their teaching practice. This allowed the context of the programme to be more open-ended, inductive and to discover things that the participants might not freely talk about in other data gathering techniques (Cohen, et al., 2011).

In addition to the observation schedule used, all lessons were video-taped to capture things that might be missed out during note-taking with predetermined themes on the lesson observation schedule. This first-hand information I gathered through observation aided me to enter my participants’ lived world (Thomas, 2011).

### **3.6.5 Semi-structured interviews**

Thomas (2011, p. 386) defines an interview as a “purposeful interaction in which one person obtains information from another”. He argues that interviews are valuable ways to gather

complementary data because they enable researchers to obtain information that is inaccessible through other forms of methods like observation, for example, the information about the past events. Menter, Elliot, Hulme, Lewin and Lowden (2011) add that in a semi-structured interview the researcher aims at explicating the interviewee's understanding of the research topic and therefore it is capable of producing much qualitative information. In addition, Cohen, et al. (2011, p. 409) remark that through the interview process "two or more people interchange views on a topic of mutual interest, thus getting the centrality of human interaction for knowledge production and emphasises the social situatedness of research data". This means that interviews allow researchers to discuss their interpretations of the world in which they live and express how they regard situations from their own opinions (Cohen, et al., 2011).

In this study, the interview was chosen because of its ability to enable researchers to gather in-depth data about participants' experiences and feelings as stated by Cohen, et al. (2010) and Gay, et al. (2011). I did individual semi-structured interviews with each of the four trainee science teachers and they enabled me to gather more information on their understanding about approaches in teaching biological concepts.

These interviews were carried out in a place free of disturbances for confidentiality purposes. An audio tape-recorder was also used to supplement to the notes I took during session. I preferred to use the tape recording method in addition to note-taking because it seems more convenient and reliable and ensured originality of data even after the interview session (Gay, et al., 2011). Therefore, the tape recording process allowed me to capture all the content of the sessions that I might have missed out during the interviews I had with four trainee teachers.

The interviews were done after I observed the four microteaching lessons. Since the semi-structured interviews are less controlled, more flexible as stated by Cohen, et al. (2011), an interview schedule containing predetermined issues (see Appendix 3) was designed to guide the interviews. Thomas (2011, p. 163) defines an interview schedule as a "list of issues rather than specific questions that the researcher intends to cover".

Nonetheless, the semi-structured interviews gave me an opportunity to balance the use of scripted issues with follow up questions (Settlage & Southerland, 2007). Furthermore, to improve the communication with my interviewees and facilitation of data gathering, I took

into account the nature of information being sought, the clarity of the questions I asked and sensitivity of the participants' views and beliefs (Gay, et al., 2011).

The use of the semi-structured interview allowed me to ask follow-up questions or probe the participants' responses where I needed more clarity during the interview process (Cohen, et al., 2011).

In short, the semi-structured interviews assisted me to explore the four trainee science teachers' understandings on how they made use of prior everyday knowledge and experiences when teaching biological concepts. It also gave me an opportunity to seek more explanation about the factors that they considered to be promoting or hindering the use of this teaching/learning approach during classroom instruction. Furthermore, I was able to understand the trainee science teachers' attitudes, interests, feelings concerns and values about this learning approach; hence it complemented the information I gathered during the microteaching observations.

### **3.7 Data analysis**

According to Cohen, et al. (2011, p. 537), qualitative data analysis involves "organising, accounting for and explaining the data". Briefly, it is described as a meaning-making of the data in terms of participants' definitions of the situation, noting patterns, themes, categories and regularities (Cohen, et al., 2011). Gay, et al. (2011) further state that "data analysis is a process of breaking data into smaller units, determining their importance, and putting the pertinent units together in a more general, analytical form" (p. 468).

Qualitative data is well known for its dependence on multiple interpretations of data gathered in order to search for meaning and to communicate the findings to others effectively (Cohen, et al., 2010). In this study the qualitative data were generated through the process of classifying or coding the pieces of data which were then grouped into themes or categories. This was done through a cyclical, iterative process of reviewing data for common topics (Gay, et al., 2011).

I used an inductive approach by describing what was going on during classroom settings with the focus on how trainee teachers engaged with prior everyday knowledge and experiences associated with the teaching and learning of biological concepts on various biology topics presented.

Through the inductive analysis, I established comprehensive descriptions of the participants, the setting and the phenomenon studied. I also identified themes by identifying ideas from the literature that were repeatedly evolving in the data gathered (Gay, et al., 2011). Through analysis of data, common aspects were identified and the linkages among the data pieces were established.

Thematic analysis in this case study was chosen because it enabled me to examine each new piece of information that emerged from the data in the light of a particular research question (Hancock, et al., 2006). Thus, the themes that emerged from the data were tentatively constructed into answers to the research questions.

A coding system was also used as a way of analysing qualitative data in this study. Coding is a process of marking units of text with codes or labels as a way of identifying patterns and meaning in data (Gay, et al., 2011, p. 478). Several colour codes were used to mark similar repeated information from the data sources. This was done by reading through the data collected several times, identifying categories into which data were grouped and identifying excerpts from the data that supported the category generated. The coding system helped me make sense of the data and enabled me to easily identify themes and patterns which were later combined into analytical statements. Cohen, et al. (2011) state that analytical coding as its name implies is more interpretive and draws together information thereby giving more explanatory and analytic meaning to a group of descriptive codes.

All the data from the audio-taped and video-taped recordings were analysed and sorted into categories. The data generated through interviews were transcribed into broad categories and subcategories. The information generated was then summarised in relation to the questions asked during the interview process.

Data generated through reviewing of documents and observations was also analysed inductively by writing up summaries and then interpreting it to seek for evidence of knowledge, comprehension, transformation, instruction evaluation and reflection.

The pedagogical scheme of analysis focused on how trainee teachers presented the lessons and was used to code data from microteaching lesson observations (See Table 8). My focus was on initiation or elicitation of students' prior ideas and experiences; provision of feedback (insertions); reflection of own ideas with ideas from others students (metacognition);

application of prior everyday knowledge into scientific knowledge and social interactions between teachers and students and students themselves.

This allowed me to obtain a general sense of the participants' understanding of how trainee teachers engaged with prior everyday knowledge and experiences during classroom instruction. During the process of analysis, each data source was re-examined several times to account for the apparent inconsistencies, contradictions, discontinuities and relatedness in actions in order to get a clear picture on what exactly emerged out of the study (Cohen, et al., 2010). Finally, this enabled me to reflect on the overall meaning of the research findings (Creswell, 2009).

### **3.8 Validity and reliability**

According to Cohen, et al. (2010, p. 133), “validity is an important key to effective research. It is a requirement for a qualitative research”. On the other hand, reliability is another component that comprises both validity and trustworthiness (Boudah, 2011). Boudah (2011) defines reliability as a “degree to which a study can be repeated and yield similar results if similar participants are used” (p. 64). Cohen, et al. (2010) state that validity can be achieved through honesty, depth, richness and scope of the data achieved, the participants approached, and the extent of triangulation. Gay, et al. (2011) describe “triangulation as a process of using multiple methods, data collection strategies, and data sources to obtain a more complete picture of what is being studied and to cross-check information” (p. 393). The validity of this study was strengthened by the use of more than one data gathering technique which allowed me to triangulate the results of the research across all data code sets (Bell, 2005). Creswell (2013, p. 251) further adds that in “triangulation researchers make use of multiple and different sources methods to provide corroborating evidence”. In addition, Boudah (2011) stressed that triangulation can “increase truth value of the study in the sense that the researcher attempts to get more than one perspective on a situation by using multiple data sources” (p. 79).

Typically, in this study I corroborated the research evidence by using different methods, namely; document analysis, brainstorming and observations, an orientation programme, microteaching lesson observations and semi-structured interviews to shed light on the analytical code or theme from different data sources (Creswell, 2013). Gathering information

using a variety of methods enabled me to strengthen the weaker method, thus helped me enrich the complexity and validity of the findings.

All verbatim transcriptions, written interpretations and summaries of discussions were made available to the participants in order to verify their responses through the process called member-checking (Boudah, 2011). He states that member checking is an important instrument to establish credibility of the study. In member-checking, the participants in the study actual review the patterns, characteristics, analysis interpretations and conclusions of the study. Creswell (2009, p. 191) further explains that the “use of member-checking is to determine the accuracy of the qualitative findings through taking the final report or specific descriptions back to participants and determine whether those participants feel that they are accurate”. In this study, the participants were allowed to review the observation reports, interview transcription and the conclusion of the study.

### **3.9 Ethical considerations**

It is well known that conducting qualitative studies have ethical implications because all participants involved are subjects and not objects of the study (Cohen, et al., 2011). Merriam (2001, p. 213) infers that “in qualitative studies, ethical dilemmas are likely to emerge with regard to the collection of data and in the dissemination of findings”.

Therefore, prior to conducting this study careful consideration with regard to ethical issues was employed (Cohen, et al., 2010, p. 246). This includes the ethical issues of informed consent, access and acceptance, confidentiality, anonymity, voluntary participation and the right to withdraw (Cohen, et al., 2011).

In view of this, official permission to undertake this study with the targeted trainee teachers was obtained from the University management of the research site (see Appendix 1). The letters were written and presented to the relevant authorities (Deputy Dean of the Faculty of Education and Mathematics and Science Education Coordinator). In the letters, the purpose of the study and the benefits that this study could bring to the institution (University Campus); to the trainee teachers (research participants) as well as a Physical Science Lecturer (critical friend) were clarified.

All the participants were informed about the purpose and objectives of the study to allow them to make informed decisions about their role in the study. They were assured of their

right to withdraw at any time should they feel uncomfortable to progress with the research. They were further informed of their anonymity and confidentiality by informing them that pseudonyms would be used to conceal individual identity in cases where references would be done during interpretation or data analysis.

Since all students at the university were above the age of 18, permission was not sought from their parents or guardians; however, they were informed to volunteer to take part in this study by signing a consent agreement letter (see Appendix 2). To establish a good rapport and trust with participants, they were assured that the findings of the study would not cause them any harm and the research would be available to them to do member-checking and that all information would be kept confidential.

The research study commenced after the permission had been granted from all the people mentioned above as well as after the research proposal had been approved by the Education Higher Degrees Committee (EHDC) from Rhodes University. I also found the EHDC's comments and suggestions on my proposal very informative and useful.

### **3.10 Limitations**

One of the major limitations of this study was that the results could not be generalized to a larger population because it was a case study where a small sample was used. In order to generalise the findings of the research, I suggest that the study could be extended to look into a bigger population of science trainee teachers engaging with prior everyday knowledge and experiences during science instruction.

In this study, only 18 final year trainee teachers were used as active participants, and only four trainee teachers were observed teaching different topics in ecology during microteaching practice. I felt that the results of the study might have yielded different results if all participants were observed teaching. It was also noted that the trainee science teachers were only given one chance to teach due to limited time to transcribe the data. Students had two recesses during the time when the data were gathered which disturbed the research plan. Since this study shows some elements of action research, I felt that trainee teachers needed to practice teaching more often than what actually happened. However, given the short time-frame to transcribe the data, their teaching practice was limited and that could negatively influence the results of this study.

I also felt that the four trainee science teachers' results might be influenced negatively by teaching peers who have more or less similar level of understanding of prior everyday knowledge as themselves. The results might have been different if they were given an opportunity to teach school learners in real classroom situations and given feedback from their actual teaching practices.

### **3.11 Concluding remarks**

In this chapter I outlined the approaches used to carry out this study as well as the topic and the goal of my research. It defined the properties of the research that made it qualitative and interpretive in nature. It also outlined the approach that the study employed which is a case study.

I discussed the criteria used to select my research site and the sampling strategies that were used to select the research participants. The chapter also described data gathering techniques utilised and outlined how and why each technique was used in this study. I explained how the data from the data-gathering techniques were analysed in order to arrive at the findings. It further deliberated on the motivation for using a multi-method approach in qualitative research with regard to triangulation since it was able to enhance the validity and reliability of the data.

The chapter also described the ethical considerations that are addressed throughout the research process. I also touched on the limitations which caused the research process and research outcomes to divert from the original plans of the study. The chapter also highlights how validity was enhanced in this study.

In Chapters 4 and 5, I present and analyse the data that emerged from my data gathering techniques.

## **Chapter Four**

### **Data presentation: Phase one**

#### **4.1 Introduction**

In this chapter I present the data sets that emerged from the different data gathering techniques used in this study, namely, selected curriculum documents analysis (see Section 4.2), a brainstorming session and group discussions (see Section 4.3), and the orientation programme (see Section 4.4). During the brainstorming session, I used the observation schedule (see Appendix 5.1) as a guide as well as the video-tape records for triangulation purposes.

During the orientation programme I was observed by one colleague who served as my critical friend and co-participant because he also participated in the teaching process. This session was also video-taped.

In this chapter, I present the data about trainee science teachers' experiences on how they engaged with learners' prior everyday knowledge and experiences during instructional practices looking at the following:

- Expectations of curriculum documents on teaching and learning practices within science mainstream teaching;
- The teaching/learning process using students' existing ideas and conceptions to enhance active involvement of the learners or peers in the lessons;
- The teaching approach that encourages learners or students to apply new concepts or skills into different contexts; and
- The teaching approach that enhances students' enquiry and co-operative learning among themselves.
- The challenges that the trainee teachers encountered during various learning activities.

## 4.2 Documents Analysis

The presentation of data used broad analytical themes in relation to the research questions. This includes documenting the expectations of the Namibian National Curriculum for Basic Education (NNCBE) followed by the findings from the brainstorming and group discussion session. Five documents, namely, the Namibian National Curriculum for Basic Education (NNCBE) (see Appendix 3.1), the SBS External Moderator report (see Appendix 3.2), the Natural Science and Health Education syllabus (NSHE) (see Appendix 3.3) and two Natural Science textbooks for grade 5 and 7 (see Appendices 4.1 & 4.2) were analysed to determine the expectations and intended teaching and learning outcomes and assessment practices for the Upper Primary Phase (grade 5-7) within the Natural Science mainstream.

### 4.2.1 Curriculum expectations

The NNCBE is a framework that serves as the official curriculum policy for formal Basic Education in Namibia. It serves as a guide for all teachers and provides a coherent framework to ensure that there is consistency in the planning, organising and implementation of the teaching and learning process. The curriculum has also been developed to give direction towards the realisation of the Namibia Vision 2030 which strives for a knowledge-based society, one where knowledge is created, transformed and used for innovation to improve the quality of life for all. It stresses that a knowledge-based society requires a learner-centred approach to teaching and learning (see Sections 2.3). Since my study is centred on social-cultural constructivist learning, the categories that address learner-centred education are tabulated in Table 2 below. They have been extracted from the section of approach to teaching; learning and assessment (see Appendix 3.1).

**Table 2: Themes, theoretical/conceptual frameworks and expectations from NNCBE Curriculum**

Themes	Theoretical/conceptual frameworks	What emerged out
1. Understanding of the concept prior everyday day knowledge (IK)	Prior everyday knowledge (existing ideas and experiences)	<ul style="list-style-type: none"> <li>- Point of departure should be always what learners already know and can do. (p. 4)</li> <li>- Teaching emphasise usage of varied processes and learning experiences rather than relying only teacher transmission of knowledge (p. 4)</li> </ul>

2. Active participation and cooperative learning	Socio-cultural constructivism & social constructivism	<ul style="list-style-type: none"> <li>- Learners are actively involved in the learning process through a high degree of participation, contribution and production. (p. 26)</li> <li>- Children are always exploring their social and material environment, and learn through communication with others. (p. 29)</li> <li>- Learning is both an individual and collaborative experience.</li> <li>- We are situated in a natural and cultural context with which we interact, which affects us and which we draw upon to construct understanding. (p. 29)</li> </ul>
3. Teaching/learning approaches	LCE	<ul style="list-style-type: none"> <li>- Teacher must use a variety of techniques such as direct questioning, eliciting, explaining, demonstrating, challenging the learners ideas, checking for understanding, supporting, providing for active practice and problem solving (p. 26)</li> <li>- Teacher is coach, a counsellor and organiser of learning. (p. 26).</li> <li>- Inclusive education is a learner-centred concept.</li> <li>- Must understand the importance of mutual respect and equal sharing of practical work (p. 28)</li> <li>- Developing the learners' familiarity with and ease in using, the terminology of the subject and its discourse (p. 29)</li> <li>- -Improvise teaching and learning materials from easily available and inexpensive objects in the immediate environment, such as sticks, string, and bottle tops (p. 27).</li> <li>- Learners use simple scientific models, methods and skills to make scientific sense of the natural environment; and themselves (p. 25).</li> </ul>

The themes that emerged were aligned to a socio-cultural perspective and social constructivist teaching and learning of science. The NNCBE curriculum stressed the teaching approaches that placed learners at the centre of learning process which are in line with LCE. It points out clearly that learners should be taught in a way which builds on the knowledge that they already know and to relate new concepts to the reality around them. What follows next is data which came from NSHE syllabus.

#### 4.2.2 The Natural Science and Health Education syllabus (5-7) expectations

The syllabus is the policy document that informs and shapes all teachers' teaching. It is developed to convey the ethos of LCE and presupposes that teachers have a holistic view of the learner, valuing the learners' life experiences as focal point of learning and teaching. The analysis of the Natural Science syllabus shows that the current curriculum requires change in teaching practices. Among the areas that require change are the approaches to teaching and learning and the type of teaching and learning resources.

The learning experiences in the Natural Science area are focused upon promoting knowledge with understanding and scientific skills (see Appendix 3.3).

**Table 3: Expectations from the NSHE syllabus**

Theme	Theoretical/conceptual; frameworks	What emerged out
1. Eliciting prior everyday knowledge and experiences	Prior everyday knowledge and PCK	- Select learning content and methods on the basis of the learners' needs within their immediate environment and community
2. Approach to teaching and learning	LCE approach and PCK	- Emphasise teachers to use more than the traditional explanations used in old curriculum to explain biological concepts i.e. use

		<p>cooperative and collaborative learning (p. 3)</p> <ul style="list-style-type: none"> <li>- Teachers to use a variety of activities such as brainstorming; group work, individual and pair work; designing, planning and carrying out investigations and practical work; observing; collecting data and problem solving just to cite a few</li> </ul>
<p>3.Learning resources/activities to enhance participation and cooperative learning</p>	<p>Socio-cultural constructivism and social constructivism</p>	<ul style="list-style-type: none"> <li>- The use of resource persons; charts; learners/students' existing ideas and experiences were applicable</li> <li>- Use of local context and content where appropriate to illustrate scientific concepts and processes (p. 3)</li> </ul>

The new learner-centred approach to teaching emphasises the need for learners' active involvement in the learning process, a practice that was not emphasised in the previous Biology curriculum. Furthermore, the need to build on learners' prior everyday knowledge and experiences is a new requirement that teachers have to adapt in their teaching practice in implementing the current Natural Science and Health Education Curriculum as it is stated that: "learning at school must involve, build on, extend and challenge the learner's prior knowledge and experiences" (p. 3). The themes and outcomes outlined above are strongly in line with socio-cultural and social constructivist theory. What follows is data from brainstorming.

### 4.3 Brainstorming session

This was aimed at finding biological concepts which could be incorporated with prior everyday knowledge and experiences with western science (WS) during Biology lessons. Four groups of the trainee science teachers were involved during the brainstorming session. They suggested using prior everyday knowledge on the topic of nutrition and balanced diet to demonstrate how biological concepts taught at school can be incorporated with prior everyday knowledge and experiences during classroom lesson.

An observation guideline consisting of nine questions was used (see Appendix 5.1). Questions 1 to 2 sought to understand the trainee science teachers' own understanding of the concept 'prior everyday knowledge and experiences on that topic. Questions 3 to 6 sought to find out how the students elicited or made use of the learners' prior everyday knowledge and experiences when teaching biological concepts. Questions 7 to 9 sought to find out the benefits and constraints that trainee science teachers might encounter when teaching biological concepts using learners' prior everyday knowledge and experiences. What transpired during the brainstorm session is presented below.

**Table 4: Data gathered from brainstorming session**

Major ideas sought by questions	Data that emerged out during brainstorming in each group.	Research questions answered	Conceptual or theoretical framework under which it falls
1. How students understand prior everyday knowledge (Q1-Q2)	In all groups, students mentioned that it is knowledge possessed by learners. However, group 3 and 4 added the ideas of prior everyday knowledge as coming from home and environment	Q1, Q2	Prior everyday knowledge, constructivism
2. How students engage with prior everyday knowledge (Q3-Q6)	The idea of LCE emerged from all groups in which learners were to be put in groups and allowed to discuss the concepts the teacher brought.	Q2, Q4	LCE, social constructivism
3. Benefits and constrains encountered (Q7-Q9)	Benefits mentioned by students ranged from improving participation as teachers will be equipped with PCK and PTCK. Learners are sanctioned to use language of science in the community to do border crossing from prior everyday knowledge to WS. The constrains were: learners cannot identify prior everyday knowledge on their own, whereas teachers will require content expertise to link WS and IK.	Q3, Q4, Q5	Social cultural theory; PCK

Generally, the trainee science teachers had a better understanding of the meaning of the concept prior everyday knowledge though only few students extended their answers that it includes the information brought into the science classroom from home. They mentioned involving learners in group discussions, question and answer techniques and practical activities as best ways to engage and elicit learners' prior everyday knowledge and experiences during Biology lessons. It was clearly observed that the trainee science teachers believed that active learners' involvement and full participation can be achieved through cooperative learning, however, they indicated having difficulties to show how these learning activities can be organised or monitored during classroom instruction. Therefore, the following orientation programme was used to model to the students how one can engage learners' prior everyday knowledge and experience with school science during Biology lessons.

#### **4.4 Data gathered from the orientation programme**

In this session, I designed a workshop where I modelled some teaching approaches on how to develop and implement science lessons that take into account learners' prior everyday knowledge and experiences. This was intended to show them that developing constructivist classroom practice is tied to teachers' understanding of how learners learn.

The orientation programme was presented following a series of learning activities using trainee science teachers' prior everyday knowledge and experiences on the topic of nutrition and balanced diet they identified earlier. I was interested in actions that promote building on their prior experiences to enhance the development and understanding of emerging biological concepts. The data were transcribed taking into account these main areas of inquiry:

- Trainee science teachers' understanding of the learners' prior everyday knowledge and experiences;
- The active participation of the trainee teachers during the lesson;
- The teaching methods that encourage students to apply new concepts or skills into different contexts as well as enhancing students' enquiry and co-operative learning among themselves; and

- The challenges that the trainee science teachers encountered during lesson preparation and presentations.

To achieve this, I adopted Ndolo's (2011) framework (see Section 2.5.1) to develop a scheme of analysis on how I worked with trainee science teachers' existing ideas.

**Table 5: Extract adopted from Ndolo's (2011) framework**

<b>Lesson development</b>	<b>Criteria that support conceptual development of biological concepts using learners prior everyday knowledge and experiences</b>
Introduction (Initiation/elicitation of prior knowledge)	Teacher introduces the lesson by drawing on the prior existing knowledge of the trainee teachers before introducing the topic itself. The teacher probes for more information on their conceptions.
Insertions	Provides feedback through essential information to trainee teachers' contributions in order to elaborate the ideas adds information answering questions, builds on trainee teachers pre-existing ideas.
Metacognition/ critical thinking	Links scientific knowledge to trainee teachers' prior everyday knowledge and experiences through the use of familiar examples.
Social interactions	Assigns individual and group activities that help trainee teachers to discover relevant knowledge, encourages teachers to express their opinions, students are free to ask and answer questions, gives students time to think before giving answers

The following is the presentation and extracts of what emerged during the orientation programme.

To locate trainee science teachers' prior conceptions as a basis for organising learning activities on the topic a worksheet was used (see Appendix 6.1).

Students were asked individually to list different type of traditional (local) foods that they ate in their village at different times of the day. A few examples of foods listed by students are tabulated as follows. Students were allowed to write some foods in their local language if they did not have scientific or English names.

**Table 6: Traditional food types listed by 6 out of 18 trainee science teachers**

<b>Breakfast</b>	<b>Lunch</b>	<b>Dinner/supper</b>
<p>Student 1</p> <p>-Oshikundu (traditional soft drink made from mahangu/millet flour)</p> <p>-Milk (omashikwa/omaere/amasi)</p> <p>-eembe (berry fruit)</p> <p>-oshikwiila /omungome (traditional ovambo bread made from the millet flour (mahangu flour))</p> <p>-Mahangu porridge</p>	<p>Student 3</p> <p>Maize pap with dry meat,</p> <p>Mundambi leaves (cooked sour)</p> <p>Vegetables grown in the village fields)</p>	<p>Student 5</p> <p>Delele (dried leaves with pap);</p> <p>Mangabwa (cooked pumpkin leaves);</p> <p>Salt and red Meat</p>
<p>Student 2</p> <p>Cooked sweet potato</p> <p>Fresh milk from the cows</p>	<p>Student 4</p> <p>Chicken with pap or pasta</p> <p>Dry fish with pap (maize )</p> <p>Meat(beef)</p>	<p>Student 6</p> <p>Omaere and pap (maize)</p> <p>Chicken</p> <p>Pap and beef</p> <p>Fresh cow milk butter (omagadhi/ fat)</p>

One meal (breakfast) for one student was used as an example to show students how they can use prior knowledge and experiences to teach biological concepts. Students gave traditional explanations why such food is eaten at a particular time of the day and matched the explanations they gave to the nutrient and scientific meanings of each food.

**Table 7: A traditional meal showing traditional explanations, biological concepts and scientific meanings**

Breakfast food	Biological concepts identified.	Traditional explanations	Scientific explanations
<p><b>Student 1</b></p> <p>-Oshikundu (traditional soft drink)</p>	<p>Carbohydrates, water, <b>'glucose'</b>, fibre, minerals e.g. phosphorus</p>	<p>Quench thirst and make someone strong.</p>	<p>Carbohydrates – for energy production</p> <p>Water- for metabolic reactions to take place.</p> <p>Fibre- prevent constipation</p> <p>Minerals- for chemical reactions to take place efficiently</p>
<p>-Milk (omashikwa/omaere)</p>	<p>Water, proteins, fats, calcium</p>	<p>As relish when mixed with thin porridge of mahangu or maize meal or as a soft sour drink</p>	<p>Proteins- for growth, body repair</p> <p>Fats- provide energy for the body and form structural part of the cell.</p> <p>Calcium- Strengthens the bone and absorption of Vitamin. D</p>
<p>-Berry fruits</p>	<p>fructose, water, fibre and vitamin C</p>	<p>Supplementary food between meals</p>	<p>fructose-energy</p> <p>Vitamin. C - strengthens blood vessels</p> <p>Prevent scurvy</p>
<p>-oshikwiila/omungome (traditional ovambo bread made from the millet flour (mahangu flour))</p>	<p>Carbohydrates, fibre, a little bit of water, salt</p>	<p>Main breakfast meal (oshiwambo culture)</p>	<p>-energy, fibre- prevent cancer of the colon</p> <p>Water- dissolves substances in the body (solvent)</p>
<p>-Mahangu porridge</p>	<p>Starch, fibre</p>	<p>Main staple food (oshiwambo culture)</p>	<p>For energy</p>

Though students appreciated the fact that they enjoyed identifying biological concepts and matching traditional explanations from local foods with scientific meanings, some students were still having some misconceptions why some foods were eaten at different times of the day.

For example, some students argued that fruit berries (*eembe*) were worth to be eaten during breakfast. These students adhered to an African culture belief that food is eaten to satisfy hunger or literally to make the stomach full. Little attention was paid to the type of nutrients that can be obtained from the food. These cultural beliefs contributed to poor eating habits which led to many unhealthy conditions such as malnutrition. These kinds of misconceptions were cleared out during group discussions and enhanced high participation among students during the session.

#### **4.4.1 Data gathered from my critical partner's and my own observations**

Students seemed to have difficulty in understanding some biological concepts such as saturated and unsaturated fats. The invited critical partner witnessed the data generation process and contributed a lot during the learning process. His contributions led the discussions of some scientific concepts such as saturated and unsaturated fats and helped students to understand these scientific concepts better. Here is an example of how he contributed:

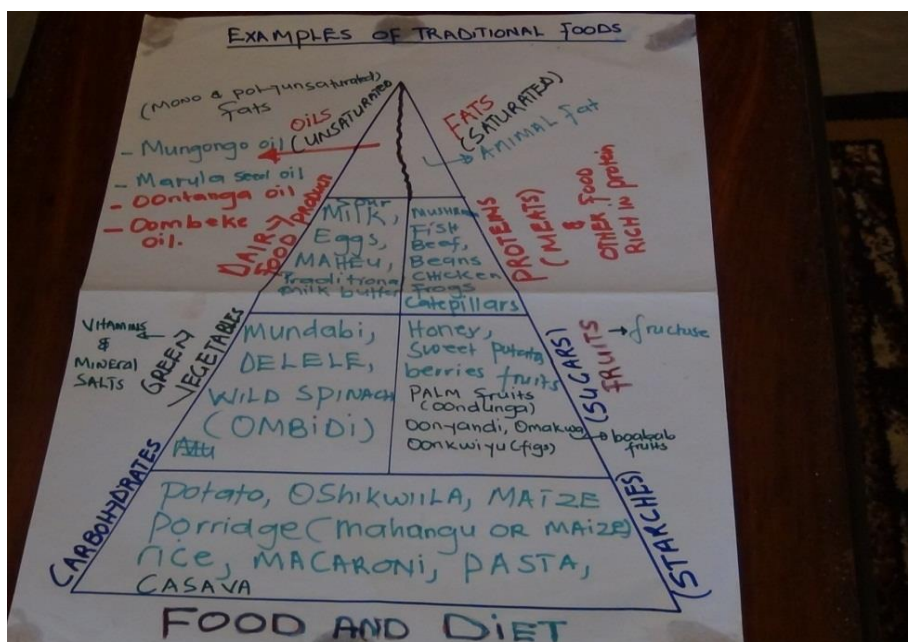
*Critical friend (Cf): Look here, the unsaturated one (pointing to structural formula of fat molecule on the chalkboard); they will have double or triple bonds while the saturated will have all the four bonds connected to four single particles. Carbon is supposed to have four bonds attached to four different particles. In such a case, it is a saturated compound (examples are methane, ethane etc.). In some other carbon compounds with triple bond, three bonds are used to connect to a single particle while the fourth is connected to another particle (the alkaline group). When there is a double bond, two bonds are connected to a particle and the remaining two can be connected to a particle or two different particles (the alkaline group). The last two are unsaturated (see Appendix 6.3)*

This stimulated discussion was of benefit to the trainee science teachers as it enabled them to explain further the differences between concepts such mono-unsaturated and poly-unsaturated fats using local produced oils and fats.

The lesson was concluded with a recap of the learning activities that were implemented during the lesson. Finally, a poster showing a hierarchy of local foods and biological concepts identified during this collaborative learning process was drawn by all students together.

The hierarchy was useful as it emphasised how the traditional knowledge of local foods can be used to explain challenging biological concepts in order to enhance learners' conceptual development of biological concepts during lessons. The hierarchy was used to explain why food nutrients are classified into two main groups, namely, the macro-nutrients and micro-nutrients. The wide base of the hierarchy shows the foods that the body need in large quantities (macro-nutrients) while the narrow part represents foods needed in small quantities (micro-nutrients). In addition, the hierarchy was used to explain the functions of each nutrient in the body and the associated deficiency diseases (see Chart 4.4.1).

**Figure 1: A chart showing an outline hierarchy of local foods and food molecules developed by students during an orientation programme**



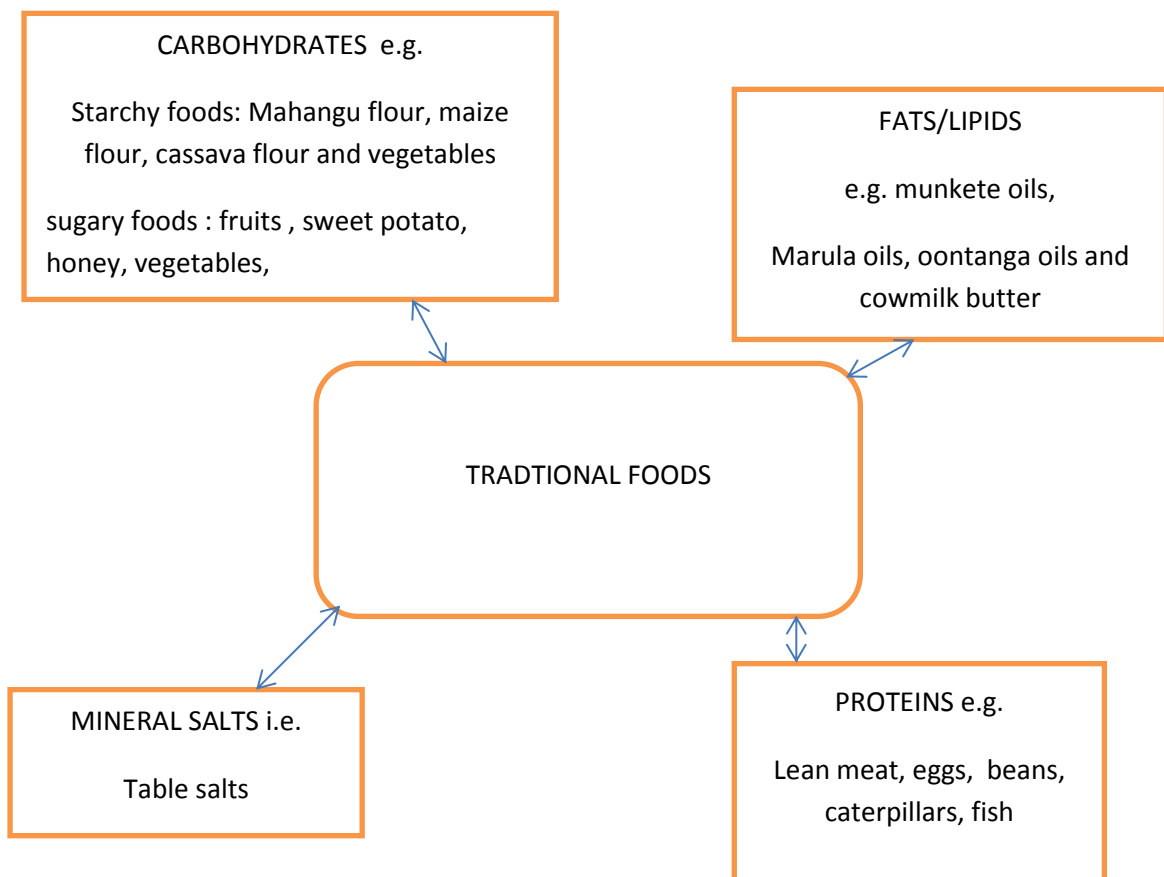
The above learning activity allowed students to develop identified concepts into flow diagrams and mind maps thus enabled them to iron out further misconceptions which were not yet cleared out.

#### 4.4.2 Flow diagrams and mind maps developed by trainee teachers

Using the concepts identified from the previous learning activity, students were requested to use the skills they were taught during their teaching methods courses to reorganise the

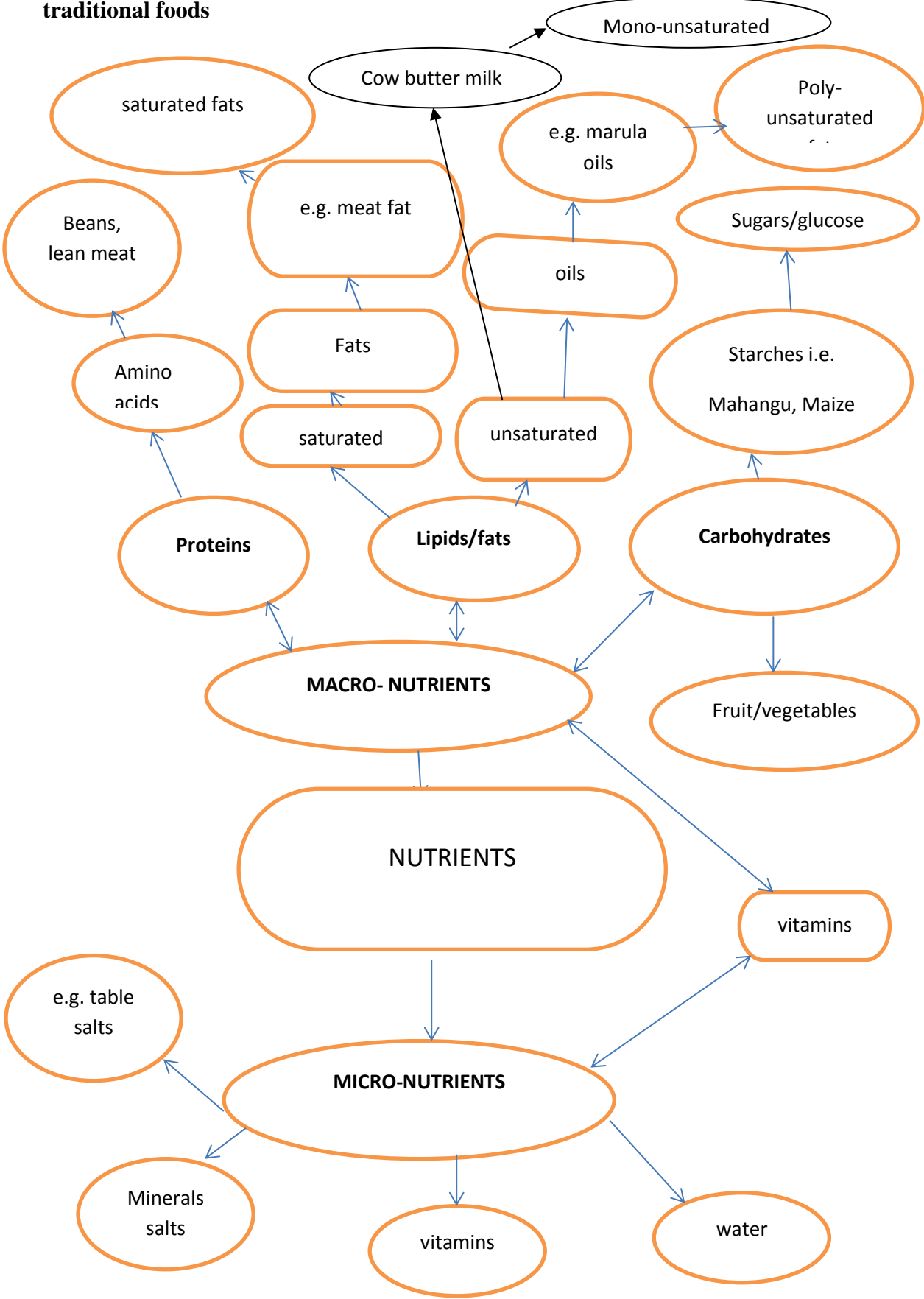
concepts they identified into a flow diagram, concept or mind maps. Flow diagrams and mind maps are some of the methods known to help learners see the connections between main scientific concepts or terminologies in a certain topic. By using these methods, I believe that the trainee science teachers' understanding of the role that prior everyday knowledge and experience have in teaching biological concepts to the science learners would be enhanced to a higher level. The following are few examples.

**Figure 2: Flow diagram developed by students to classify local foods into main food categories**



This group drew a flow chart showing a variety of traditional foods they mentioned and linked them to the main three main organic nutrients, namely, carbohydrates, fats and proteins as well as the inorganic nutrients such as mineral salts. However, the other group drew a more complex mind map where they showed in detail how the local foods can be aligned to nutrients. As a result they showed how prior everyday knowledge can be linked to scientific meaning during Biology lessons resulting in more enhanced biological concept development and understanding. The example of mind map below shows how these students engaged with their prior everyday knowledge on the topic of nutrition.

**Figure 3: A Mind map showing the links between scientific concepts and the identified traditional foods**



#### **4.4.3 Data gathered from the whole class discussions after the orientation programme**

After the orientation programme, trainee teachers had a whole class discussion on how they rated the learning activity and teaching strategies that I used to engage their prior everyday knowledge and experiences during the learning activities. The main aim was to find out whether trainee science teachers picked up some of the teaching strategies that can be used during Biology lessons to elicit learners' prior everyday knowledge and experiences so as to actively engage them in the learning process. Students were also asked to shed light on the factors that they thought might hinder the effective integration of these teaching approaches during instruction settings. Again, Ndolo's (2011) scheme of analysis framework described earlier in (Table 5) was used to analyse the trainee science teachers' responses.

##### **i) During the initiation/elicitation phase:**

To the question of what transpired during the initiation phase, the students' responses were summed as follows:

I introduced the lesson by drawing ideas from students' prior everyday knowledge and experiences on the topic to be presented before the start of the lesson presentation. This allowed them to mention examples of the foods that they eat in their communities. They stated that the learning activity enabled them to be actively involved in the learning process as everybody was thinking aloud about their own experiences. Everybody was at liberty to think about the different types of foods that they ate at their own homes.

##### **ii) Inception /Development Phase**

In this phase the teacher (researcher) allowed students to engage with the ideas which they put forth. A lot of cooperative learning was observed as students started to argue about other students' viewpoints. They stated that the deliberations enabled them to think critically of the reasons why some food types were eaten at different types.

They also appreciated the fact that the teacher did not provide them with direct answers whenever they asked questions but rather she gave them a clue or probed them with more questions which led them to be able to solve the problem themselves. *For example, when Calo asked why Ndaps ate those traditional berries (embe) during breakfast; you did not*

*give him an answer right away, instead you posed a question like what kind of nutrients do you get in berries.*

**iii) Metacognition phase/ student involvement in the critical thinking and problem solving skills**

Students revealed that they were actively involved in the construction of knowledge and development of conceptual understanding of the biological concepts that emerged during the learning process.

Students cited few examples that they felt can enhance critical thinking and problem solving skills including comparing of traditional explanations with scientific explanations or meanings, developing of flow diagrams and mind maps as well as the development of the hierarchy pyramids using concrete and familiar examples to teach food categories, nutrients and deficiency diseases.

**iv) Application phase**

Students indicated that the use of prior every day knowledge and experiences enabled learners to make meaning of school science. It helped learners to bring their cultural heritage in the classroom and thus aided them to do border crossing between social cultural and the western science. Moreover, it enabled them to clear out some of the misconceptions that the students brought into the Biology lessons from home. For example, the idea that all kinds of foods are traditional referred to as ‘*vitamins*’ can be cleared using this approach. Incorporating prior everyday knowledge and experiences during classroom instruction helps learners to iron out cultural misconceptions, myths and beliefs that they come up with from their immediate environments.

**v) Social interactions between teacher and trainee-teachers and trainee teachers and their peers**

Students agreed that social interaction was very high. All students were accorded an opportunity to present their findings and to comment on others students’ answers. The lesson activity was highly learner-centred and the learning activities were mediated through various group activities that enhanced teamwork and boosted cooperative learning among all students and teachers.

#### **vi) Challenges that can be encountered when designing such lessons or delivering them**

Students mentioned factors such as time-frame to finish the content stipulated in the syllabus as one of the major constraints the school teachers may encounter during the designing and implementation of such lesson plans. This is because teaching in government schools is bound to external set scheme of work and local common examinations. Students pointed out that such kind of lessons needed more attention in terms of planning and implementation (pedagogical content knowledge). Furthermore, the students also mentioned lack of novice teacher expertise was another constraint that might hinder effective implementation of the lesson plan particularly the difficulty in determining the level of learners' prior knowledge (what they already know) before they come to class.

#### **4.5 Concluding remarks**

This chapter presented the findings from the brainstorming and discussions, orientation programme and student discussion and reflections. It is evident from the presentations that the elicitation of learners' prior knowledge is something of crucial importance to the teaching and learning of biological concepts. It formed a strong foundation which gave a clear direction to the teacher to know the kind of learners he/she is working with.

The data revealed that the use of local knowledge and experiences could be a remedy to teach and learn some abstract biology concepts. The examples and explanations given by students during data gathering techniques indicated that the knowledge of the community and their cultural practices might well be usable in a science classroom. Though at this point the teaching strategy I used did not create all the experiences at that time in a real classroom situation provided for the trainee science teachers, the orientation programme modelled a good learning experience. For example, the flow diagram and the mind maps that trainee science teachers developed enabled them to experience how they could use learners' prior knowledge and experiences to articulate and explain science concepts during classroom lessons.

In the next chapter I present the second phase of data presentation and analysis.

## Chapter Five

### Data presentation: Phase Two

#### 5.1 Introduction

In this second phase of my data presentation, I present the data that emerged from the last two data gathering techniques, namely, the microteaching presentations by selected trainee science teachers and the semi-structured interviews.

#### 5.2 Data gathered during the microteaching presentations

Teachers were observed teaching different topics in the Biology component of the Integrated Natural Science Education. It is a curriculum requirement that pre-service teachers have to do for microteaching where trainee science teachers practice their teaching methodologies. The following are biological topics taught by the four trainee teachers.

Teacher 1: Ecosystem

Teacher 2: Common ecosystem in Namibia (Savanahs, Desert and Grassland ecosystem).

Teacher 3: Energy flow in the ecosystem

Teacher 4: Food chains and food webs

**Table 8: Shows how four teachers engaged with peers' prior everyday knowledge and experiences during microteaching presentations**

Phases analysed and themes emerged during microteaching session	Data that emerged out during microteaching presentations
<b>Initiation Phase</b>  Theme: Elicitation of prior knowledge	All teachers 1 to 4 show having limited knowledge of eliciting learners' prior everyday knowledge. The topics for T1-3 were introduced abstractly. Teachers either asked learners to define the terminologies or they start their lessons by writing the explanations of the main concepts on the chalk board. Only T4 tried to elicit the learners' prior everyday knowledge.
<b>Insertion Phase</b>  Theme: Teacher engagement with the peers during	Trainee teachers do not engage the learners much in the construction of knowledge. They were predominantly observed giving own explanations. Only few comments or follow up questions were observed. Teachers were solely producer of the knowledge while the learners were they recipients.

lesson presentation	
<b>Metacognition Phase</b> Theme: Teaching strategies or meditational tools used.	Mainly lecturing method and question and answer method. Knowledge construction was highly depending on the textbook information. In most cases, trainee teachers ignore learners' questions. Only T2 and T4 were observed engaging learners in debates or use learners' example to explain some biological concepts.
<b>Application Phase</b> Theme: Teaching approaches used (LCE or TCE)	Most of the lessons were presented in an abstract way without taking into consideration the learners' prior everyday knowledge. The only predominant teaching method used was group work with a few examples citing the question and answer methods. Even few cases were learner prior knowledge was sought; little was done to make linkages between the Indigenous Knowledge and experiences with Western science. The teaching approach used in many presentations was teacher-centered.
<b>Social interaction</b> Theme: interaction between teachers and students and students and the peers	In many presentations, trainee teachers used a one-way method of teaching (from teacher to the learners). There was very limited social interaction between teachers and learners or among learners themselves.
<b>Challenges encountered during designing and delivering of the lesson.</b> Theme: Trainee teachers' content knowledge and pedagogical content knowledge	Though trainee teachers seems to have a better understanding of role of prior everyday knowledge they shows that they lack the pedagogical content knowledge( PCK), the expertise on how to elicit these during classroom lesson. Trainee teachers also show that they have limited subject content (CK)that hinder them to choose appropriate teaching strategies in order to elicit learners' prior everyday knowledge and experiences during Biology lesson. As a result, they failed to make good links between IK and Scientific meanings. In most cases they were observed treating the two body of knowledge as separate entities. Inexperience to teaching (novice teacher find it difficult to deliver the content for the first time). Difficulties to point out local conceptions which are in conflicts with scientific concepts.

In summary, I came to understand that the trainee science teachers still lacked the strategies for finding out their peers' prior knowledge. Teacher 1, 2 and 3 not only lacked the teaching skills but they also indicated that they had limited subject content knowledge on the topics they taught.

Their lesson plans did not indicate how they would work with the information they would get from their peers (students). Hence, during their presentations they hardly engaged the students in discussions or any learning activities. From the four lessons I observed it became evident that trainee teachers learned about their learners' prior knowledge through unintended classroom interactions. Even in the few cases where a trainee science teacher tried to find out what her/his learners knew about the topic or what they expected them to know, they found it difficult to incorporate that in their instructional plans to accommodate students' ideas during the lesson.

For example, T4 prepared her lesson that tried to elicit students' prior knowledge, yet the lesson activities were not followed up during the presentation process. She struggled to

modify her teaching after eliciting the students' prior knowledge. Instead, she just scratched at the surface of the concept she was supposed to cover.

### 5.3 Data gathered from the semi-structured interviews with the four teachers after the microteaching presentation

After the microteaching, a post discussion in the form of individual semi-structured interview was conducted with each of the four trainee teachers to find out more about their lesson development and implementations. Semi-structured questions consisting of three main questions and follow-up questions were used during this session.

The three questions were based on the following categories:

- How did the trainee teachers understand students' prior knowledge and experiences of the topic they taught?
- What strategies did the trainee teachers use to elicit students' prior everyday knowledge and experience (in this case peers students) to enhance conceptual understanding of biological concepts? That is, how did they make a link between the scientific concepts and local knowledge/experiences; and
- What challenges did trainee teachers encounter during the designing and delivering of such topics?

In addition to this, classroom observation data from video-tapes was used to complement the findings that emanated from the individual semi-structured interviews.

**Table 9: Shows the questions asked and the responses given by four trainee science teachers during interviews**

Main questions asked during the semi-structured interview	Teachers' responses
1. What is your understanding of the students' prior everyday knowledge and experiences on the topic you taught?	<p>T1: To me prior knowledge is any information that students bring into a lesson before you teach. In case, of the topic I taught, that is <i>ecosystem</i> I expected them to be able to define the term ecosystem.</p> <p>T2: I believe that prior knowledge is whatever students have or know about the topic before it is presented to them. On my topic, <i>common ecosystems in Namibia</i>, I knew that all students at this level they know these ecosystems even though some might not have been there e.g. the desert.</p> <p>T3: Prior knowledge is the knowledge that the students have on the topic it can be from the previous lessons or from home. On the topic which I taught, <i>the energy flow</i> I know all students have heard or were taught before, how energy is flowing in the ecosystem.</p>

	T4: prior knowledge include the knowledge content the students have whether it is correct or not correct which they came with into the classroom. In my topic, <i>food chain and food webs</i> , I believed students have an idea of the two terms, food and chain or web.
2. What strategies did you use to elicit students' prior knowledge prior everyday knowledge and experience on that topic and to promote development and understanding of biological concepts?	T1: He asked students to define the term ecosystem and then I took it from the answers they gave me. I used group work and question and answer methods to probe them to clarify their answers. I add more of my own explanations of the terminology such species, habitat, biotic and abiotic and population  T2: Since part of the topic, the ecosystem was already taught by Simenda I just wrote the topic of day on the chalk board and then tell students to discuss one of the ecosystems in groups and present the findings. After that we discussed the findings and make comments. I use group discussion to open the topic to everyone. Students were given chance to brainstorm on one ecosystem and give feedback to whole class. T3: question and answer methods was used to deliver the content. T4: At least she tried to involve the students prior knowledge especially during the introduction of the lesson but she switch back to information giving during the insertion and application of the content.
3. Social interaction (how did you involve your students in development of biological concepts?)	T1, T2, T3 and T4all felt that students were fully involved except for T2 and T4 who extended that much can still be done to incorporate the students pre-existing ideas and experiences in any lesson.
4. What challenges do you encountered in designing and delivering of the lesson that might hinder you utilize students' prior everyday knowledge and experiences during teaching practice?	T1: Some topics in biology are too abstract. There is little you can do to incorporate the learners' prior knowledge that will force one to do lecturing T2: find difficult to see exactly what to do in order to fully incorporate all students, learners have different learning styles and are at different levels in a specific topic. T3 Time-consuming, one need to be experienced and have enough resources in deliver such lesson effectively. T4 It might be difficult to predict the learners prior knowledge if you do not share the same culture with the learners

In summary, as it is shown in the trainee science teachers' responses to question one, it seems that they had some understanding of the concept of prior knowledge and were also aware that students' prior knowledge affects how learners acquire science content. The trainee science teachers cited that if students are given less opportunity to discuss their ideas that they bring in the science class, it becomes difficult to build on their existing ideas. That will slow down the students' participation in the lesson. However, they agreed that they struggled to effectively create opportunities to engage their students' prior knowledge during their own microteaching presentations.

It was observed that the trainee science teachers used their own prior experiences to determine their peers' pre-existing knowledge. Factors such as lack of subject content knowledge, lack of teaching experiences (the ability to determine the students' level of understanding), lack of teaching and learning materials, the nature of science (abstract science concepts) and cultural conflicts (different ethnic explanations and backgrounds about

certain concepts) seemed to have had an effect on how these trainee science teachers presented their lessons.

#### **5.4 Concluding remarks**

This chapter presented the data that emerged from the second phase of the data presentation of my study. The tabulated data showed how trainee science teachers used prior everyday knowledge and experiences related to the phenomena they presented. It is noted that even though they acknowledged the fact that learners' prior everyday knowledge has a positive impact in the teaching of science concepts, they had difficulty presenting 'ideal' science teaching.

Yet, the curriculum emphasises that when teaching for conceptual understanding in Biology or other science concepts, teachers need to first understand learners' prior everyday knowledge and experiences, identify issues that may cause misconceptions and then create opportunities to integrate the existing ideas and science concepts. This entails that teachers should engage participants by bringing issues related to culture of the participants which talk of science. What also emerged from the findings was that the trainee science teachers preferred putting learners in groups or using the question and answer method and they still took ownership of the whole teaching/learning process. It could be argued that some factors that emerged contributing to the failure of trainee science teachers' adoption of the social-cultural teaching practices are: inadequate pedagogical content knowledge, less teaching experience and limited time for teaching a specific lesson.

In the next chapter I will present the analysis, interpretation and discussions of the results.

## **Chapter Six**

### **Analysis, interpretation and discussion of findings**

#### **6.1 Introduction**

This chapter deals with the analysis, interpretation and discussion of the data that I gathered and presented in Chapters 4 and 5.

For analysis purposes, I developed themes in relation to the data sources as well as the research questions described in Chapter 3. These themes were identified by searching for repeated key words and bits of information from the transcripts that had the potential for answering the research questions. In my discussion, I also link the findings to the literature reviewed in Chapter 2. The themes that emerged from the analysed data are summarised below.

#### **6.2 The themes which emerged from the data gathering techniques**

- Enablers empower trainee science teachers with teaching skills while constraints weaken them.
- Trainee science teachers possess some understanding with regards to the usage of prior everyday knowledge and experiences during Biology lessons.
- Trainee science teachers have some understanding of pedagogical approaches that are appropriate to teach biological concepts on the topic of nutrition and balanced diet.
- Eliciting trainee science teachers' prior everyday knowledge promotes student engagement, participation and stimulates collaborative learning opportunities resulting in them making links between scientific knowledge and indigenous knowledge.
- Designing and implementing biological lesson topics incorporated with prior knowledge and experiences enhance trainee science teachers' levels of pedagogical content knowledge (PCK).
- Inadequate teaching professional learning and experiences prevents trainee teachers from implementing effective classroom practices

The analytical statements in Table 10 below were formulated from the above themes, supported with claims or evidence from the data gathering techniques in relation to the research questions.

**Table 10: Relationship between data sources, analytical statements and research questions**

<b>Data source</b>	<b>Analytical statement</b>	<b>Research questions</b>
Document analysis: NNCBE, NSHE syllabus and three Natural Science and Health Education textbooks discuss the concept prior everyday knowledge on the teaching of science concepts.	<ul style="list-style-type: none"> <li>Enablers and constrains influence teaching of science concepts.</li> </ul>	What factors enable or constrain the teaching of biological concepts in the curriculum?
Brainstorming observation and discussion session	<ul style="list-style-type: none"> <li>Trainee teachers possesses some understanding on the usage of prior everyday knowledge and experiences during Biology lessons</li> </ul>	What understanding of prior everyday knowledge and experiences on the topic of nutrition do trainee teachers bring to a science classroom?
Brainstorming session; orientation programme and whole class discussion from insider researcher.	<ul style="list-style-type: none"> <li>Trainee teachers have some understanding on effective teaching strategies to teach biological concepts.</li> </ul>	What pedagogical strategies do trainee teachers identify as useful in eliciting learners' prior everyday knowledge and experiences when teaching biological concepts on balanced diet (nutrition) topic?
orientation programme and teaching observation from insider researcher and critical partner	<ul style="list-style-type: none"> <li>Eliciting trainee teachers' prior everyday knowledge and experiences promote student engagement and participation and stimulate collaborative dialogues thus enhances meaningful learning.</li> </ul>	Does the use of an exemplar lesson on the topic of a balanced diet incorporated with prior everyday knowledge promote students' engagement and participation in the lesson?
Microteaching lesson development and implementation; observation from the insider researcher and semi-structured interviews.	<ul style="list-style-type: none"> <li>Designing and presenting biological lesson topics incorporated with prior everyday knowledge and experiences illuminate</li> </ul>	How does trainee teachers design and implementation of biology topics incorporated with prior everyday knowledge and experiences enhance or hinder students' understanding of

	trainee teacher's levels of PCK.	biological concepts during micro teaching?
Microteaching lesson development and implementation; observation from the insider researcher and semi-structured interviews.	<ul style="list-style-type: none"> <li>Inadequate trainee teachers' professional learning and experience prevents them from designing and implementing effective classroom practices</li> </ul>	What challenges do trainee teachers encounter when designing and implementing biological topics that are incorporated with learners' prior everyday knowledge?

### 6.3 Analytical statements

The tabulated analytical statements were generated in view of how they attempted to answer the research questions of my study. The patterns observed under each aspect of these analytical statements were then discussed starting with the analytical statements which emerged from the baseline data as presented in Chapter 4 and then followed by the one presented in Chapter 5.

### 6.4 Discussion of findings: Analytical statements emanating from the baseline data

#### 6.4.1 Analytical Statement 1: Enablers and constraints influence teaching of science concepts

The six documents analysed were the NNCBE, NIED-MR and NSHE syllabus for grade 5-7 and three Natural Science textbooks for grades 5, 6 and 7 which are currently used in the Namibian Schools. The documents were analysed to determine the curriculum expectations about how teachers should organise teaching and learning environments which are meaningful to the learners.

The NNCBE advocates for the consideration of learners' prior everyday knowledge and experiences as a resource to foster LCE in teaching science concepts (see Section 4.2.1). In the Namibian context, LCE education is viewed as a transformative and liberating pedagogy (Chaka, 1997, p. 44) and it originated from the social-constructivist and socio-cultural perspectives (LCE, 2003, p. 29). It is promoted because of its ability to produce a knowledge-

based society, one where knowledge is created, transformed and used for innovation to improve the quality of life (New Namibian Curriculum, 2003, p. 9). As a result of this, the NSHE (5-7) syllabus urges all science teachers to have a holistic view of their learners and value their life experiences as a focal point of teaching and learning (see Table 3).

Bearing in mind the fact that each individual constructs their own knowledge (Chaka, 1997, p. 44), the trainee science teachers were asked what they understood by the term learners' prior knowledge and experiences (see Table 4). In their answers, they responded that it is comprised of all forms of knowledge (formal) that a learner brings into the classroom with few extending their answers to informal information acquired from immediate environments, for example, homes. However, they all pointed out that science curricula used in schools stressed that teachers should utilise teaching approaches that place the learner at the centre of the learning process (see Section 4.3). This indicates that the trainee science teachers have some understanding of what prior knowledge is and that it is intended to aid conceptual understanding during teaching Biology.

This is, what Ogunniyi and Ogawa (2008) stressed when they stated that teaching processes should link the western knowledge and local knowledge to help the learners reinforce the science knowledge they had constructed earlier. They said this would enable them to reconstruct the knowledge that they initially accumulated into a new understanding which is in line with what the teacher would have said. From this argument, one can deduce that IK sources can facilitate learning since they can work in harmony with western knowledge to promote meaningful teaching and learning.

#### **6.4.2 Analytical Statement 2: Trainee teachers possess some understanding on the usage of prior everyday knowledge and experiences during Biology lessons**

Interestingly, during the brainstorming discussion, the trainee science teachers indicated that in their experiences as science learners, they were less involved in the construction of knowledge and as a result that prevented them from understanding some abstract science concepts. The introduction of the new LCE propagates the incorporation of learners' past experiences within the curriculum content. This means that teachers should relate the new content taught in science classrooms with learners' prior everyday knowledge and experiences they bring to the science classroom for the learners to better understand new

concepts (Roschelle, 1995; Stears, Malcolm & Kowlas, 2003; Oloruntegbe & Ikpe, 2011; Rennie, 2011) (see Sections 2.5.1 & 2.5.2).

Some trainee science teachers stated that during the orientation programme teaching and learning of Biology concepts became easier when the content taught was related to the local practices in the community (see Section 4.3 & Table 4.3.1). The misconceptions that arose in the way they learnt some biological concepts through using traditional explanations and matched them with scientific meanings allowed them to understand the concepts better. The authors quoted above agree that the use of prior knowledge during an instructional setting has a positive impact on the learning process as it enables learners to make a link between what is taught in the class with what they actually experience in the community (see Section 2.5.2). This would make it easier for the learners to attach meaning to some abstract science concepts or terminologies (Roschelle, 1995). Furthermore, it was clear that those teachers who do not use learners' experiences in the classroom may constrain the teaching and learning of science concepts (Rivet & Krajcik, 2008). During this study one trainee science teacher gave an example to illustrate this:

*“As a science learner, I never understand how plants move. I was not informed of the sunflower issue. So, I thought plants move when they are shaken when the wind blows. This is all I knew up until when I went for SBS. I started asking questions first before I teach, then one of my learners gave an example of how the sunflower plants move by following the sunshine (phototropism), and then I become aware of the movement of ” (BS).*

Based on the justification above, the trainee teachers were in support of O'Donoghue, et al.'s (2007) ideas that science content should not be treated merely as western knowledge but rather as a social entity with elements of cultural practices and social norms (see Sections 2.4.1 & 2.4.2). Oloruntegbe and Ikpe (2011) add that, the fact that students are less interested in studying science subjects at a higher level might be due to the fact that they are not encouraged to see connections between science learned in school and the household chores they engage in at home, “despite daily exposure in both contexts” (p. 268). Therefore, this study tried to expose trainee science teachers to such valuable educational platforms that enable learners to make the connection between science concepts learned at school and science knowledge found in learners' everyday experiences as proposed by Rennie (2011).

Rivet and Krajcik (2007) concluded that the process of eliciting learners' prior ideas and linking them with western knowledge enabled learners to revitalise their awareness of their

previous experiences. It is through these contextualised instructions that science becomes more appealing to learners and thus fosters better understanding of the more challenging science concepts.

Another trainee teacher echoed the importance of using learners' prior knowledge and experience during instruction that:-

*“ .....you add more to the knowledge you already own whereas if teaching is done using only one way (formal science) then the little knowledge that teachers give to learners will be treated as if it is the only true knowledge that exists” (BS).*

From this point of view one can argue that incorporating prior knowledge and science content plays an important part in facilitating the conceptual development of biological concepts. Aikenhead and Jegede (1999); Ogunniyi and Ogawa (2008) emphasise that integrating science content with learners' prior experiences helps them to bridge the gap between their everyday life world and the world of school science. They call this process cultural border crossing (see Sections 2.4.2 & 2.5.1). Ogunniyi and Ogawa (2008) state that bridging this gap is vital in teaching and learning science content because both teachers and learners constantly “undergo cognitive border crossing daily as they interact within and outside the classroom” (p. 183).

Rennie (2011) points out that the teachers need to engage learners in familiar activities that enable them to connect what they learn in the classroom to the world-outside of the school. This resonates with Ndolo's (2011) views when she pointed out that teachers must be aware of their learners' prior conceptions and take note of issues that may cause confusion during instruction setting (see Table 3)

To achieve this in the classroom, the trainee science teachers pointed out that the teaching methods such as debate and group discussion which make learners to answer open-ended questions and encourage learners to give own opinions, make interpretations and apply them should be used.

### **6.4.3 Analytical Statement 3: Trainee teachers have some understanding of effective teaching strategies to teach biological concepts**

The nature of teaching and learning activities suggested in the Natural Science and Health Education syllabus requires active student involvement in lessons. The analysis of the Natural Science and Health Education syllabus showed that the current curriculum requires change in

teaching practices. Among the areas that require change are the approaches to teaching and learning and the type of teaching and learning resources (see Section 4.2.2).

In view of this, the teaching syllabus expects teachers to be able to select learning content and methods on the basis of the learners' needs within their environment and community. Trainee science teachers in this study highlighted some of the teaching strategies that could be used to achieve this. These were: revising previous work, use of analogies, question and answer, group discussions, debates and use of familiar examples.

All three Natural science textbooks analysed also emphasise the use of cooperative and collaborative learning approaches to enable learners to develop personal, scientific and communication skills so that learners could take responsibility for their own learning under the teacher's guidance (MoE, 2010, p. 3). That is why Oluruntegbe and Ikpe (2011) claim that accommodating learners' prior knowledge during teaching does not only help learners but it also enables teachers to refocus their thoughts about their teaching practices.

Despite the good understanding of the role of prior everyday knowledge in teaching biological concepts to the trainee teachers, in contrast, this was not the impression I got when I observed the four lessons that the trainee science teachers taught later during the micro teaching (see Table 8). All four trainee teachers were seen having difficulties in indigenising the science content. This was supported by Kasanda, et al. (2005) that many teachers do understand what curriculum is expected of them but they do not accommodate everyday contexts of their learners during teaching. Most teachers are still using the old traditional teacher-centred approaches to teaching. These can be theoretical exposition or teacher questioning.

#### **6.4.4 Analytical Statement 4: Eliciting trainee teachers' prior everyday knowledge and experiences promotes student engagement and participation, thus enhances meaningful learning**

Given the fact that novice teachers need expert mentoring to develop inquiry-based lessons and effective teaching skills, trainee teachers were actively involved in the intervention (orientation) programme whereby together with the researcher they developed an inquiry-based lesson that took into account their prior everyday knowledge and experiences.

The trainee science teachers were asked to select a topic of their choice to be used during this exercise. The topic of nutrition and balanced diet was chosen since it was the next topic in the sequence of the course outline. The trainee science teachers felt that it had a lot of prior everyday knowledge (both indigenous and western knowledge) which could be used to explain how biological concepts can be taught using prior ideas from the community (see Sections 4.3 & 4.4).

Taking into account the fact that in LCE effective teaching is not telling stories, I used a series of learning activities where the trainee science teachers' prior everyday knowledge and experiences were elicited and used to teach that topic (see Section 4.4.3). In this study, I also adopted Maselwa and Ngcoza's (2003) approach of predict, explain exploration, observe and explain (PEEOE) to design and implement socio-constructivist lesson activities where learner-centred approaches to teaching were highlighted.

In the first stage of the lesson (prediction phase), trainee science teachers were therefore asked to describe their prior ideas that they had on the topic of a balanced diet. This included asking them to write individually their own definition of the terms such as 'nutrition', 'balanced' and 'diet' and state what they thought a balanced meal constituted of. This was followed by an explanation phase whereby their prior ideas on a topic of nutrition and balanced diet were discussed. This stage helped to determine the level of their understanding. Almost all the answers they gave were informed by their prior formal teaching experiences. I subsequently used such knowledge to develop the lesson for the next level of intervention (see Table 7).

At this point, the trainee science teachers were asked to list different kinds of traditional foods including the nutritional drinks that are normally consumed in the community (emphasis in the village). This stage was easy as all students knew the traditional foods eaten in their communities. However, I observed that many students were not yet actively participating because they are used to a teaching methodology that follows the information found in the textbooks.

To boost their participation, each student was asked to categorize her/his foods under the four main groups of foods; either as fruit and vegetables; grains foods; dairy foods or as meat. They were told that the work should be undertaken from what they already knew or practiced at home without consulting textbooks.

During the exploration phase, the trainee science teachers presented their findings to the rest of the class where they discussed their initial ideas and began to explore some scientific meanings (see Table 7). During the observation phase, their biological conceptual understandings were fostered by identifying nutrients in the listed traditional foods and I compared traditional explanations with scientific meanings of each nutrient identified (see Table 7). Finally, the explanation phase enabled the trainee science teachers to further reflect on their initial conceptions and those of their colleagues through social interactions and dialogue. In this case, they were asked to arrange their foods in the hierarchical order chart and to develop flow diagrams and concept mind maps of the identified scientific concepts (see Figures, 1, 2 & 3).

It was observed that meaningful learning had taken place during this mediated constructive learning process. This was shown by the active participation on the part of the trainee science teachers. They were all eager to fill in their findings on the hierarchy chart and the lesson became even more interesting when they started to draw the mind maps. They began to see that the use of local knowledge and examples to teach science concepts might be helpful particularly to the learners in the upper primary grades whose language proficiency might be also a problem.

Khoboli and O'Toole (2011) stressed that these teaching approaches result in transforming classrooms, authority and power to move away from the teacher to learners. The teaching and learning process became more flexible because trainee teachers' participation was highly encouraged. It reflected what Lawson (2010) points out that learning becomes more meaningful if what is learnt is relevant to the learners' socio-cultural context.

This session created a rhythm of dialogue among trainee science teachers, provoking many questions as to why certain foods were listed in the colleague's (trainee teacher) tables. To solve this problem, they were asked to give traditional explanations why certain foods are eaten at different times of the day and attach scientific meanings (see Table 7). That is when they came to understand why certain foods are eaten at certain times in different communities. In other words, through interactive dialogue the trainee science teachers came to understand the difference between the domains of individual everyday knowledge and formal science content.

Malcolm (2003) used three framework levels of learner-centeredness to explain how teachers should handle their classroom practices. The first level is to establish a caring relationship

between learners and teacher; that is coming to know the learners' interests and needs and believing in their capability to learn. This is followed by the second level where teachers coordinate learners' interactions with content and context through different teaching methods. I personally believe that the appropriate teaching methods may include the utilisation of prior everyday knowledge and experiences and cooperative learning activities that enable learners to move and talk freely while helping each other. Thirdly, a change in the way teachers exercise their authority over learners in classrooms to pave the way for the development of learners who are responsible, independent, motivated and creative (Khoboli & O'Toore, 2011).

This is what is echoed by Stears, et al. (2003) when they stressed that in social constructivism the social and personal aspects of learning need to be acknowledged. They stressed that learners' prior everyday knowledge and purposes can be used either to "as a starting point for learning science, as reference point for thinking about the nature of science or as context for applying scientific ideas and skills" (p. 111).

At the end of the session, all the trainee science teachers agreed that there was substantial significance in the teaching that incorporated science content with prior everyday knowledge and experiences of the learners during teaching and learning process. They all agreed that this could be helpful to explain certain challenging scientific concepts and explanations or to clear certain misconceptions that learners might bring in the science classroom.

Beskini, et al. (2011) argue that it is important for teachers to be mindful of their learners' interests and needs during teaching and learning process. This can be achieved by creating socio-cultural platforms that enable trainee science teachers to relate science concepts that emerge from the topic to what learners actually experience or practice at home and therefore, enhance the development of biological concepts. Stears, et al. (2003) commented on this idea that "any constructivist learning programme should be designed or build on past learners' experience, interests and prior knowledge" (p. 109).

A typical familiar case mentioned during the discussion was that of adding salt to food (it is traditionally understood that adding too much salt to food will spoil the taste of the meal). The trainee science teachers argued that some of these traditional examples can be useful to explain scientific meanings of some biological concepts (for example, the concept *micronutrient*- type of nutrients that the body requires only in very small quantity).

However, at this point it was also observed that some of the trainee science teachers' mindsets were still confronted with their own cultural beliefs. One example is that of one trainee science teacher who asked a colleague as to why '*one should eat the fruit berries during breakfast*'. The fact here is that each individual trainee science teacher had unique views based upon what they came into contact with or what they actually practice and believe in their own community prior to this new learning (O'Donoghue, et al., 2007).

However, through exchanging ideas collectively, the trainee science teachers were observed starting to reflect on their own conceptions and subsequently modifying them (see Section 4.4). The knowledge of local foods was used to explain to them the scientific importance of each food/nutrient in the diet (see Table 7).

This was explained and consolidated through an activity where trainee science teachers plotted various local foods on one hierarchy chart (see Figures, 1, 2 & 3). After developing the mind maps they all found it easy to compare their initial conceptions with the scientific explanations and this helped them to re-elaborate their initial conceptions.

This experience also allowed the trainee science teachers to value their own experiences and those of others by relating what is practiced in their everyday life to what is learned in the classroom. This is what Jaworski (1993) refers to teaching as a "continuum process on which negotiation of meaning-making is the end point of learning" (p. 28). This also resonates with Rennie's (2011) suggestion that there is a need to close the gap between home experiences and school science. I too, I concur with this school of thought.

Instead of discussing how the community viewed natural phenomena related to foods and nutrients in general, trainee teachers further discussed new concepts related to this topic; for example, on fats with a some scaffolding from me and my critical friend (see Section 4.4.1). At this point trainee teachers made use of their traditional home-made fats and oils ideas (such as sour milk butter known as *omagadhi* and other traditional seeds pressed oils such *ondjove*, *manketi oil* and *oootanga oils*) to describe the difference between saturated and unsaturated fats as well as mono and poly-saturated fats. This was a worthwhile learning experience for many of the trainee teachers as they managed to use local food examples to construct scientific structural formula of fats where they show the chemical bonds in different fat molecules.

In my view, this was an example of co-construction of knowledge since it stimulated trainee science teachers' active participation and enthusiasm to talk about their own ideas, hear those of their colleagues, discuss and incorporate them. From such stimulation and practical experience, they started to understand the importance of the learners taking responsibility for their own learning (Kibirige & Van Rooyen, 2006; Roschelle, 1995). Roschelle (1995, p. 5) further argues that "learning is a process that involves modification of new knowledge and past experiences of the world".

What emerged from this session was that the use of prior everyday knowledge requires science teachers to have a proper training in order to equip them with the necessary skills to answer questions that might arise during such socio-cultural interactions. The series of lesson activities clearly showed the development of new concepts (see Section 4.4.3). Some trainee science teachers who in their initial understanding had the feeling that only staple foods such as *mahangu* porridge and maize porridge could be appropriate for breakfast had finally changed their initial views after collaborating with their colleagues. These participants were scaffolded to pass through the ZPD levels (Vygotsky, 1978) which require a higher mental function than they can actual perform at that stage (see Section 2.4.1).

This is further explained by Goos (2004) when she stated that socio-cultural learning platforms allows for social interactions between less capable and more capable peers that may be helpful to awaken a less capable peer's mental functions to a certain potential developmental level. In the example above, I structured learning activities that "allowed students to participate in joint activities that would otherwise be beyond their reach" (p. 262) if they were working individually. For example, those students lagging behind were mediated by more knowledgeable peers to make meaning of the concept which they could not initially understand.

This means that at the end of that activity the student who had a different conception about eating traditional fruits during breakfast could use his initial conception (immediate community beliefs) and attach to it a scientific meaning that had been elaborated by his peers (more knowledgeable peers) and then use it to form a coherent system of understanding (Goos, 2004).

It was observed that the construction of knowledge using the socio-cultural views of the trainee teachers was a slow process. In the previous topic taught, a lot of basic competencies

were covered in one session. But in terms of the quality of content learnt the opposite was true. Trainee science teachers themselves also recognised that learning in this way was more significant (see Section 4.4.3). In their own statements, they said they used *'to memorise the content taught and forget almost everything some few days later, except for those topics which are repeatedly taught'*. The importance of connecting science to students' everyday life experiences was also stressed by Oloruntegbe and Ikpe (2011, p. 267) in that this process could be valuable in improving the science learning environment.

For example, the trainee science teachers pointed out that there were no specific local names for some of the nutrients such as carbohydrates, proteins, vitamins, fibres. These are either called food while in some communities (Ovambo) they are all referred as vitamins. This could be quite confusing particularly to young grades 5 to 7 learners if these terminologies are not clearly explained during the lesson. As one teacher responded, *'it (referring to integration of IK during teaching and learning process) really works, it makes a good link between science content and traditional knowledge'* (see WP).

The trainee science teachers also pointed out that the last activities where they had to list local foods on the hierarchy chart and developing concept mind maps was very useful. It enabled them to visualise reasons as to why certain macro nutrients such as carbohydrates and proteins were plotted on the first wide block of the hierarchy while other macro-nutrients particularly fats and micro nutrients such as mineral salts, vitamins were plotted far at the tip of the hierarchy. One participant put it in her own words as follows:

*'I think that was a wise idea, one can use that hierarchy of food or developing mind maps using local examples to explain biological concepts such as macromolecules and micro molecules or to explain why we eat what we eat to the learners' (see Section 4.4.3).*

I found the analysis, interpretation and discussion of themes and analytical statements which emerged from the brainstorming session and orientation programme quite revealing. What follows is an analysis of themes which emerged from the main data and analytical statements constructed out of these themes.

## **6.5 Analytic statement emanating from the main data**

### **6.5.1 Analytical Statement 5: Engaging trainee teachers in designing and presenting biological topics incorporated with prior everyday knowledge and experiences illuminates their levels of pedagogical content knowledge (PCK)**

The information on this theme and analytical statement came from the microteaching observation and interviews conducted with four selected trainee science teachers. Generally, what transpired from the microteaching was that knowing a variety of teaching approaches while treating them separately does not qualify teachers to enable learners to develop scientific concepts during classroom teaching as stated by Rennie (2011). This resonates with Mishra and Koehler (2006) who argue that developing effective teaching approaches in constructivist teaching and learning requires teachers to have good pedagogical content knowledge (PCK). Successful science teachers need to draw on specialized pedagogical content knowledge (Shulman, 1987) in their instructional work with learners.

Shulman (1986) argued that having good subject content knowledge and pedagogical approaches, though necessary, might not be sufficient to capture the knowledge of good teachers. He emphasised that teachers will not enable learners to develop conceptual understanding of science concepts if they are employing subject content and pedagogical methods separately. In order to enhance learners' conceptual understanding, PCK of the teacher is very crucial. This may involve the ability to deal with all teaching processes such as the way one represents and formulates the subject in the sense that it becomes comprehensible to others (see Section 2.5.5).

Four trainee science teachers were observed teaching various ecology topics to their peers during microteaching and the findings that emerged out are presented in Chapter 5 of this thesis (see Section 5.2, Tables 8 & 9). During the brainstorming session and orientation programme, all trainee science teachers seemed to have an understanding of what prior knowledge and experiences are and what is entailed when constructing teaching and learning processes. However, during their microteaching presentations, the four of them showed that they still lacked the capability to develop, use or adapt certain teaching procedures and approaches to fit the teaching of a particular content.

For instance, almost all the lessons observed started with the teacher recapping only the work done in the previous lessons and not necessarily on the specific topic to be taught. Though

this is important, most of the topics taught were not directly related to the previous lesson. They did this by means of the question and answer method that directed students to give recalled answers.

During the interview with the individual trainee teachers, all participants indicated in their group discussion that prior knowledge originates either from past formal teaching or from informal learning experiences that their peers had. The findings also illustrate that even though the trainee science teachers indicated that teaching should start from what was already known to the unknown (Roschelle, 1995) (see Table 7), most of their presentations did not reflect that. They only referred to prior knowledge from the earlier lesson and paid less attention to the informal experiences or local practices that students might bring into the science classroom from home.

Meyer (2004) explained that when the novice teacher struggled to effectively create opportunities to understand their students' prior knowledge, they relied on their own childhood experiences to think about what their students might know about the topic. In this thesis T1, T2 and T3 showed this typical pattern.

For example, T1 was observed teaching the ecosystem topic. He asked students to define the meaning of certain terminologies such as ecosystem, ecology, habitat, population and species but did not engage the students in discussions about any of these definitions.

In view of this, Rennie (2011, p. 24) points out five dependent dimensions for effective teaching of science ideas and concepts namely, "the degree of teachers' confidence in their own knowledge and understanding of science content; teachers' conception of their own role; the teachers' use of discourse; teachers' conception of learning goals and the nature of classroom activities". She explains that effective teaching of science ideas requires teachers to establish learning environments where learners are fully engaged in the meaning-making process.

However, in this study it was clearly observed that the four trainee teachers did not realise their role in this way. For instance, trainee teachers spent much of their teaching on presenting factual knowledge and ignoring learners' background and experiences about those scientific issues. Yet, it is proven that many learners can learn more easily if the information presented in the classroom is linked to other resources from the world outside the school (Rennie, 2011).

Therefore, teachers need to assist learners to transform the knowledge learned in the science classroom into profitable skills that could be useful to them both physically, intellectually and emotionally. However, the study findings revealed that this requires considerable teaching experience (pedagogical content knowledge as proposed by Shulman (1986)) particularly for the novice teachers in order to determine what learners can actually do and then use the information they obtained from them to direct teaching and learning progress.

Although in this activity students failed to portray this expertise to the fullest, I still believe that the study was beneficial to all participants (the researcher and trainee science teachers) for use as a professional reflective process. It exposed the trainee science teachers to alternative teaching strategies that they could try out either during teaching practice or in their teaching profession. The study helped us to reflect about our own practice. Through microteaching presentations, the trainee science teachers revealed areas that still needed to be polished during the training programme. Rennie (2011) argues that the process of learning to teach is difficult to develop particularly for the novice teacher, hence the need to empower trainee science teachers to develop skills of transforming school science knowledge into meaningful knowledge that makes sense to the learners during science teaching repertoires.

### **6.5.2 Analytical statement 6: Inadequate trainee teachers' professional learning and experience prevents them from designing and implementing effective classroom practices**

The challenges to teachers' professional knowledge are significant for most novice teachers (Rennie, 2011; Aikenhead, 2006). This was not an exception with the four trainee science teachers observed during this study. This study found that to change the world-view of the novice teachers so that they bring the classroom and the community closer together is not an easy task.

The observations made during the microteaching presentations and the semi-structured interviews with four the trainee science teachers revealed that there are a number of factors that prevent trainee science teachers from effectively incorporating prior everyday knowledge and experiences into classroom lessons. In this study, I observed factors such as the degree of trainee science teachers' confidence during presentation and level of understanding of the subject content taught. All the trainee science teachers seemed to be less confident when they were presenting and had inadequate knowledge of the subject content presented.

For example, T1 (see Table 8) explained the term ‘species’ that ‘*all reptiles are one species*’. This was a clear indication that this trainee science teacher was not conversant with the subject content he presented. Another challenge observed was teachers’ conceptions of their own roles, as either a dispenser of knowledge or a facilitator of learning (Rennie, 2011, p. 24). To me T3 was realistic in that he viewed himself as a dispenser of knowledge which made him an authoritative teacher. This was observed through the comments he gave when the colleagues posed some questions (*that is what I read and this is what I give you now*). In this case the teacher was observed expressing a dictatorial teaching style. He was not ready to accommodate students’ ideas or views.

Ndolo (2011) asserts that when teachers are not well conversant with the content they are teaching, they are more likely become more rigid in their teaching styles and tend to transmit lesson content without taking into consideration the way in which learners perceive the phenomena. Rennie (2011) further adds that if teachers do not allow learners an opportunity to discuss their ideas, it becomes difficult to build on their existing ideas. This is what was observed when the four trainee science teachers were presenting (see Table 8). All lessons were presented abstractly and were not grounded in learners’ pre-existing knowledge.

In a few cases where trainee science teachers used the question and answer strategies to involve their peers in the lesson, most of the questions required a mere recalling of the facts. Herrenkohl and Guerra (1998) condemn such types of questions in the sense that they do not help learners to use their prior knowledge and experiences to develop conceptual understanding of new concepts that emerged during the lesson. Rennie (2011) suggests that teachers should allow learners to take control of their own learning by asking questions that encourage dialogue and promote the establishment of shared meaning in the classroom. In short, discussions would give students a chance to monitor their understanding personally as well as their peers’ ideas.

Rennie (2011) further noted that there must be considerably more opportunities for professional learning and resources to support such a change. This should be achieved by equipping the trainee science teachers with some teaching strategies that are necessary to organise and implement learning environments that stimulate learners’ eagerness to make sense of the science concepts taught during Natural Science lessons. By making use of their own prior everyday knowledge and experiences on local foods and through my participatory action research, I hope that I had helped to shape the trainee science teachers’ teaching skills.

The findings of this study show that the trainee science teachers still had a long way to go. It became evident that the process of turning a novice teacher into an inquiry teacher needs more expertise than merely equipping trainee science teachers with theoretical skills during their training programme. It is a continuing professional development that needs constant attention from the teacher educator. While all trainee science teachers acknowledged that the integration of prior everyday knowledge and experience was important during science teaching, they also pointed out that the process was not easy (see Section 5.3 and Table 9). According to their responses, they said the developmental process of such lessons was time consuming. They also stated that the planning of such lessons was difficult because science is specific. Therefore, it is sometimes difficult to systematise each learners' previous ideas. In addition, the trainee science teachers felt that some science concepts were too abstract which made it difficult to explain them with any indigenous connection.

However, I believe that the study has achieved its main goal which was to understand how trainee teachers engaged with learners' prior everyday knowledge and experiences to enhance development of biological concepts during science classroom.

### 6.5.3 Summary

**Table 11: Summary of the analytical statements in relation to the research questions, data sources analysis and the theoretical framework that informed them**

Analytical statement	Research question	Data sources and analysis	Theoretical framework
1. Enablers and constraints influence teaching of science concepts	What factors enable or constrain the teaching of biological concepts in the curriculum?	Document analysis: <ul style="list-style-type: none"> <li>• NNCBE,</li> <li>• NSHE syllabus</li> <li>• three Natural Science textbooks one for grade 5, 6 and 7</li> </ul>	Social constructivism and socio-cultural constructivism and LCE approaches

<p>2. Trainee teachers' possess some understanding on the usage of prior knowledge and experiences during Biology lessons.</p>	<p>What understanding of prior everyday knowledge and experiences associated with biological concepts do trainee teachers come with to a science classroom?</p>	<p>Brainstorming (BS) and Observation checklist (OC), orientation programme and observations from insider researcher:-</p> <ul style="list-style-type: none"> <li>• Prior everyday knowledge and experiences(PEDKE)- OC (Q1- Q2)</li> </ul>	<p>Social constructivism; social-cultural constructivism</p>
<p>3. Trainee teachers have some understanding of the pedagogical approaches effective to teach biological concepts.</p>	<p>What pedagogical strategies do trainee teachers identify as useful in eliciting learners' prior everyday knowledge and experiences when teaching biological concepts on balanced diet topic?</p>	<ul style="list-style-type: none"> <li>• Learner-centred education approaches (LCE) OC- Q3-Q9)</li> <li>• Prior everyday knowledge and experiences(PEDKE)-</li> </ul>	<p>Social constructivism &amp; sociocultural constructivism</p>
<p>4. Eliciting trainee teachers' prior everyday knowledge and experiences promotes student engagement and participation, thus enhances meaningful learning.</p>	<p>Does the use of an exemplar lesson on balanced diet with a focus on prior everyday knowledge enable or constrain trainee teachers' ability to promote meaningful learning of biological concepts?</p>	<p>Brainstorming and discussion session, orientation programme and microteaching observation from insider researcher and critical partner:-</p> <ul style="list-style-type: none"> <li>• Prior everyday knowledge (PEDKE)</li> <li>• Active participation (AC)</li> <li>• Collaborative learning (CL)</li> <li>• Western science (WS)</li> <li>• Indigenous Knowledge (IK)</li> </ul>	<p>Social constructivism; Socio-cultural constructivism</p>
<p>5. Engaging trainee teachers in designing and presenting relevant biological topics incorporated with prior knowledge and</p>	<p>How do trainee teachers design and implement biology topics that are incorporated with prior everyday knowledge and experiences during micro teaching?</p>	<p>Microteaching observation from insider researcher and critical partner and semi-structured interviews:-</p> <ul style="list-style-type: none"> <li>• PEDKE;</li> <li>• Trainee teachers' PCK</li> </ul>	<p>Social constructivism and socio-cultural constructivism</p>

experiences illuminates their levels of pedagogical content knowledge		<ul style="list-style-type: none"> <li>LCE approaches</li> </ul>	
6. Inadequate teaching' professional learning and experiences prevents trainee teachers from implementing effective classroom practices.	What challenges do trainee teachers encounter when designing and implementing biological topics that are incorporated with learners' prior everyday knowledge?	Microteaching observation from insider researcher and critical partner and semi-structured interviews: - <ul style="list-style-type: none"> <li>Trainee teachers PCK</li> <li>LCE approaches</li> </ul>	Social constructivism and socio- cultural constructivism

## 6.6. Concluding remarks

This chapter provided the interpretation and discussion of the analysed data presented in Chapters 4 and 5 by relating it to the research questions and cross referencing this with the literature reviewed in Chapter 2. Insights on the data gathered were reported according to a set of themes and analytic statements that were generated and discussed in detail. From the analysed data it was clear that the trainee science teachers' prior everyday knowledge and experiences on the topic of nutrition and a balanced diet were useful in teaching biological concepts. Furthermore, this study revealed that the socio-cultural views of learners are vital, thus they need to be acknowledged in any teaching and learning process.

It was also noted that the teaching methodology used to teach concept development was not only valuable to teach biological concepts as was the case in this topic but it can be worthwhile for the construction of new or challenging scientific concepts in other science subjects as well.

In the following chapter I comment on the findings, recommendations and reflections of this study. These will be drawn from what has been discussed in this chapter while also using the synthesized information in Table 11. An overview conclusion to this study will be discussed in Chapter Seven where I will also suggest the possible future areas of research that emerged from this thesis.

## **Chapter Seven**

### **Summary of the findings, recommendations and conclusion**

#### **7.1 Introduction**

The study was set to understand how trainee teachers engaged with prior everyday knowledge and experiences when teaching biological concepts during Biology lessons. It was prompted by the observations I made during school based studies which revealed that trainee science teachers struggle to incorporate learners' prior knowledge with science content during classroom settings.

This chapter highlights the summary of the findings drawn from the themes discussed in Chapter Six. It also presents the reflections on the research process; the research limitations; recommendations and suggestions for future research, an overview of the course and my personal experience. The chapter ends by presenting a conclusion of the study.

#### **7.2 Summary of the findings**

The analysis of documents, brainstorming and classroom observation, orientation programme, micro teaching and semi-interviews structured interviews provided the insight into trainee teachers' background with regards to how they engaged with prior everyday knowledge and experiences associated with biological concepts during Biology lessons. These were measured in terms of intended trainee science teachers' competencies, their content knowledge level, pedagogy methods used or any other challenges that they encountered during various learning aspects used. The patterns observed under each of these aspects were formulated into the analytical statements which facilitated the discussion of the findings of this study.

### **7.2.1 Enablers and constraints influence teaching of science concepts**

The six documents were analyzed to determine the curriculum expectations about how teachers should organize teaching and learning environments which are meaningful to the learners. All documents analysed advocated for the consideration of learners' prior everyday knowledge and experiences as a resource to foster learner centered education (LCE) in teaching science concepts. However, the documents do not explain how teachers should plan such activities that accommodate such prior everyday knowledge and experiences. The trainee science teachers observed in this study also did not make efforts to use learners past experiences and interests as part of building systematic science knowledge (Stears, Malcolm & Kowlas, 2003)

### **7.2.2 Trainee teachers possess some understanding on the usage of prior everyday knowledge and experiences during Biology lessons**

The trainee science teachers acknowledged the use of prior everyday knowledge during instructional settings and stated that it can have positive impact on the teaching and learning process. They stated that prior everyday knowledge played a role in learners' lives because it enables them to make good links between what is taught in the class with what they actual experience in their community. Rennie (2011) states that if learners are taught for conceptual understanding, then their school science curriculum needs to include significant interaction with the world outside the school. However, they indicated that in their experience as science learners, they were less involved in the construction of such knowledge. This prevented them from understanding some abstract biological concepts well and thus it had negatively influenced the way they taught biological concepts during Biology lessons.

### **7.2.3 Trainee teachers have some understanding of effective teaching strategies to teach biological concepts**

In view of this, the trainee science teachers were able to select some of the appropriate learning content and methods on the basis of the learners' needs within their environment and community. They highlighted some of the teaching strategies that could be used to achieve this. These were: revising previous work, use of analogies, question and answer, group discussions, debates and use of familiar examples. However, the study revealed that trainee teachers experienced difficulties in indigenising the science content during instructional settings. De Beers and Whitlock (2009) emphasise the importance of including indigenous knowledge in the Biology classroom as it helps learners to acknowledge their social identity. By acknowledging learners' cultures, science programs can turn learning into more positive

experiences particularly for those learners who are resistant to studying the westernized curriculum.

***7.2.4 Eliciting trainee teachers' prior everyday knowledge and experiences promotes student engagement and participation, thus enhances meaningful learning***

It was observed that meaningful learning had taken place during this mediated constructive learning process. This was shown by the active participation on the part of the trainee science teachers. For instance, they were all eager to fill in their findings on the hierarchy chart and the lesson became even more interesting when they started to draw the concepts maps. They began to see that the use of prior everyday knowledge and local examples to teach Biology concepts can enhance meaningful learning particularly to the learners in the upper primary grades whose language proficiency might be a problem.

This is because the language of science is 'cognitively demanding' and 'context' is reduced (De Beer & Whitlock, 2009, p. 210). De Beer and Whitlock argue that the scientific knowledge of indigenous culture, however, is less demanding because it is in experienced of reality and associated with vocabulary more accessible to learners. Incorporating prior everyday knowledge in the Biology curriculum will enable learners to better understand science content while accessing scientific language (see Table 7, comparison of the traditional explanations of local foods with scientific meaning & Figure 3, Mind map).

This session also created a rhythm of dialogue among the trainee science teachers, provoking many questions through the interactive dialogue. As a result, they all came to understand the difference between the domains of individual everyday knowledge and formal science content. They agreed that there is substantial significance in the teaching that incorporated science content with prior everyday knowledge and experiences of the learners during teaching and learning process. They also pointed out that this approach could be helpful to explain certain challenging scientific concepts and explanations or to clear certain misconceptions that learners might bring in the science classroom.

### ***7.2.5 Engaging trainee teachers in designing and presenting biological topics incorporated with prior everyday knowledge and experiences illuminates their levels of pedagogical content knowledge (PCK)***

What emerged from microteaching lesson development and presentations revealed that despite the fact that the trainee science teachers exhibited a better knowledge of variety of teaching approaches to be used during the science classroom, the implementation processes were still problematic (see Section 2.5.4). Shulman (1986) stressed that pedagogical content knowledge (PCK) is required for teachers to incorporate authentic, community issues into the classroom. The PCK involves ways of representing and formulating the subject that makes it comprehensible to others (Shulman, 1986). These ideas stress that in order to promote meaning making of new concepts learned during teaching instruction including Biology; teachers need to know how to arrange elements of the content for better teaching and learning that take into account even the type of questions that stimulate critical thinking and problem solving skills on the part of a learner.

For example, in this study all four lesson plans which were analysed reflected that the trainee science teachers' lesson content and activities followed exactly that of the textbook and syllabus. The common strategy observed across all the microteaching lesson observations was the question and answer method. The trainee science teachers asked more closed questions to elicit students' knowledge on the concepts previously taught. Microteaching was also dominated by lecturing which made students more passive and that could lead to memorization of facts. It was clear that the trainee teachers had already pre-determined learning activities prior to class intended to uncover certain facts from their students.

Rennie (2011) alluded that effective teaching of 'ideas about science' requires establishing a context in which it is possible for learners to engage in reflexive epistemic dialogue (p. 24). Stears, et al. (2003) point out that planning for such learning activities is not easy for many teachers. There are many reasons that can prevent teachers from grasping and building on learners' prior everyday knowledge and experiences such as often novice teachers are not well practiced in linking class activities to learners' experiences.

As indicated earlier, the participants in this study were pre-service trainee science teachers. They may not yet be well grounded in terms of their teaching expertise. Also, during the semi-structured interviews, they pointed out that as science learners they were less involved in making connections between home life and the science they learnt at school. These issues might contribute to trainee science teachers to seeing school science as separate from

learners' cultural lives. Furthermore, it can be that teachers are unsure of how to handle diversity within class, including the existence of different ethnic groups of students- Caprivians, Wambo and Hereros. These may be some of the factors that hindered the trainee teachers from eliciting and integrating their peers' prior knowledge.

#### ***7.2.6 Inadequate trainee teachers' professional learning and experience prevents them from designing and implementing effective classroom practices***

The challenges to teachers' professional knowledge are significant for most novice teachers. This was not an exception with the four trainee science teachers observed during this study. This study found that to change the world-view of the novice teachers so that they bring the classroom and the community closer together is not an easy task. The observations made during the microteaching presentations and the semi-structured interviews with the four trainee science teachers revealed that there are a number of factors that prevent them from effectively designing and delivering meaningful Biology lessons, namely, the inadequate subject content knowledge, limited usage of pedagogical content knowledge, lack of confidence during presentation and fear of losing control over classroom management.

### **7.3 Discussion of the findings**

The discussion considered the research question: How do trainee science teachers engage with prior everyday knowledge and experiences of natural phenomena associated with the development of biological concepts during Biology lesson? Analysis of curriculum documents and brainstorming sessions showed that the trainee science teachers related strongly to Biology content that incorporated their prior everyday knowledge and experiences with science content. They agreed that the Namibian education system emphasizes the importance of consideration of learners' prior everyday knowledge and experiences as a resource to foster the learner-centred approaches to teaching science concepts (Ministry of Education, 2010) because of its ability to produce a knowledge-based society; one where knowledge is created, transformed and used for innovation to improve the quality of life.

For example, during the brainstorming session and orientation programme, participation of the trainee science teachers was relatively higher during instruction setting. This could be because they were allowed to determine the topic of their choice to be discussed during these stages. They chose the topic of nutrition and balanced diet. This approach enabled trainee teachers to take ownership of the teaching and learning process and allowed free participation and expression and made it possible for individual voices to be heard. One consequence was

that the science content of the textbooks was aligned to students 'own lives and circumstances. For example, during the class discussions with students, comments such as the following were made:

*Wow, I never imagined that Biology can be such interesting!*

*This is the one of most exciting lessons I have ever had. I wish all our lessons could continue to be conducted using this approach.*

*I enjoyed the mind map and hierarchical chart development exercise. It makes me feel that I really contributed to the learning process.*

*It was interesting to look at the issue of nutrition from traditional perspective (local foods) compare it with the western science explanations.*

The comments above show a great degree of connectedness with the learning materials, the deeper level of engagement among students themselves as well as with the teacher. For example, during the orientation programme, participation was higher during learning activities on local foods. Students enjoyed sharing their different traditional foods with peers and discussing the nutrients that were found in each food. This indicates that the learning process was meaningful.

Due to the fact that students involved were from different ethnic backgrounds and cultural perspectives, there were few individual differences in the way in which students collaborated during the learning activities which resulted in few of them becoming reluctant to acknowledge other peers' views. Here is one example,

*A Herero student asking a Vambo student: "I do not see the reason why you eat the 'eembe' (traditional fruit berries) in the morning. They are too small and they cannot make your stomach full"*

But after other students gave a scientific reason that fruits whether small or big in size can provide enough energy to the body because they have a lot of fructose (carbohydrates), the student who were in denial began to rethink their initial thinking and begin to enjoy the part of discussion. The collaborative learning activities accentuate peer assistance (known as scaffolding) among students which is known to play an important role in science concept development (Peterson, 2009). This is also echoed by Stears, et al. (2003) that learning is mostly influenced by three worldviews: cultural worldview, science world view and a

personal worldview. Depending on the content, experiences and social context students sometimes engage in ‘border crossing’ that keeps the cultural knowledge and science separate, and sometimes seek for relationships, thus engaging in processes of collateral learning as described by Aikenheid and Jegede (1999).

In the lesson planning and microteaching presentation, the trainee science teachers demonstrated that they lacked the ‘know-how’ to incorporate learners’ prior everyday knowledge and experiences with the science content contained in the textbooks during lessons. Most trainee science teachers were generally less likely to grasp and build on learners’ prior everyday knowledge. They depended solely on the examples provided in the textbooks. As a result, this prevented most of the trainee science teachers from developing their own teaching and learning support materials. Even, in few cases where they managed to use a few examples of the learners’ life experiences, they were less likely to build on learners’ comments and ideas when such ideas arose unexpectedly.

Due to teachers’ dependence on the textbook information, social interactions between teachers and learners resulted in rote memorization of concepts by learners (Ndolo, 2011). Yet, it is believed that the learners’ acquisition of new knowledge is linked to their past experiences and social interactions with their immediate environments (Rennie, 2011). Rennie (2011) emphasise that closing the gap between the classroom science and students’ real world is worthwhile as it enables students see the relevance of science concepts and learn how to apply science to their everyday lives.

Therefore, teachers need to go beyond what the textbook says in order to assist learners to gain a better understanding of science concepts (Oloruntegbe & Ikpe, 2011). In their study, Oloruntegbe and Ikpe (2011) state that learners should be encouraged to see the connection between sciences learned in school and household chores that they engage in as it fuels context-based learning.

However, the findings of this study revealed that trainee teachers make less effort to accommodate prior everyday knowledge of the learners. This is perhaps because the trainee teachers did not wish to deviate from the planned lesson and focus on ‘school science’. This is consistent with Van Driel, Verloop and de Vos’s (1998) argument that the teaching experience for many beginner teachers is elusive as it is often associated with particular learners, events and classrooms. Part of the contributing factor might be that trainee teachers still see school science as somewhat separate from learners’ cultural lives or they are unsure

of how to handle diversity within each class (taking into consideration that the class was comprised of students from many different ethnic groups). Loughran, et al. (2006) point out in many cases the PCK of the novice teachers is elusive because such expertise is built over a time and depends on how many times a specific topic was repeatedly taught.

Nonetheless, the trainee science teachers seemed to appreciate the unit approach considering it more relevant to their lives and broader view of science than textbook-based and teacher-directed science education of their previous school experiences.

This study produced evidence that the use of prior everyday knowledge and experiences in a Biology classroom increases the levels of engagement and participation on the part of learners and enhances their conceptual development of biological concepts.

### **7.3 Reflections on the research process**

The data in this study were generated mainly through five data gathering techniques, namely; documents analysis, brainstorming and whole class discussion, orientation programme, microteaching lesson observation and semi-structured interviews. Throughout this research process I took field notes of the issues that I felt had potential to answer my research questions. Detailed procedures on how the data was analysed was discussed in Chapter 3.

I also lobbied the assistance of the two observers; one as a non-participant observer who helped me with the video-tape recordings and another as a co-participant partner and critical observer during the workshop programme and microteaching presentations. The next section discusses the reflections on the five phases of the process followed during this research.

#### **Phase 1: Documents analysis**

Three Natural Sciences textbooks together with the NNCBE and NSHE documents were analysed with reference to how they presented the topic on food and nutrition as well as ecology and ecosystem topics. These documents were analysed to foreground the curricular documents requirements and expectations in relation to how teaching and learning should occur within the Namibian new education system. These documents provided me with the guidelines that I used to organise and shape my research problem, research questions and

research process so that they were aligned to the expectations of the LCE and constructivist perspectives.

## **Phase 2: Brainstorming and discussion session**

The brainstorming session was aiming at laying a foundation for gauging the trainee science teachers' level of understanding of the concept of prior everyday knowledge and experiences and to determine how this could be employed during Biology lessons in order to enhance the development of biological concepts. First, I was aware that the trainee science teachers might feel insecure to participate freely in the study if they were asked to volunteer. Therefore, during the brainstorming session and workshop programme session, all eighteen students were involved. The informed consent to take part in this research was sought from all the trainee teachers prior to the commencement of the research process.

The involvement of the whole class in those sessions was done intentionally to ensure that all trainee science teachers would benefit from using this teaching approach. Further, this gave me ample time to select the purposeful sample that I used during microteaching presentations and individual semi-structured interviews. The brainstorming session was video-taped and observed using an observational checklist and whole class discussions were used for the trainee science teachers to reflect on the issues which were discussed during this session.

The trainee science teachers involved in this study agreed that prior everyday knowledge and experiences of learners can have positive effects on the successful teaching and learning of some biology concepts. The main data gathering tools were an observational schedule and notes taken during group discussions as well as audio and video recordings done by the observer. In order to filter the information gathered I used the analytical strategy as described in Chapter 3. This entailed that the data were generated through the process of classifying or coding the pieces of data which were then grouped into themes or categories and later assembled to form analytical statements used in this study.

### **Phase 3: Orientation programme**

The workshop was designed and presented to scaffold and model to the trainee science teachers how they could plan and implement relevant, accessible and contextualised biology lessons. This session was also video-taped and observed by a critical friend and further reflections were made by the trainee science teachers to follow on the issues discussed with the critical friend. All these data were transcribed using a thematic analysis by identifying ideas and repeated words or terms that evolved from the data gathered and later compared with the literature reviewed in Chapter 2 to form broader categories which were then sorted into one of the identified analytical statements.

### **Phase 4: Lesson development and microteaching**

After that, four microteaching lessons from different trainee teachers were observed in order to understand how these trainee science teachers engaged with the prior everyday knowledge and experiences when teaching biological concepts. This was done to seek more understanding on how they perceived the approach of teaching biological concepts. Furthermore, I also wanted to elicit the factors that enabled or constrained the trainee science teachers to plan and teach biological topics when using relevant examples from everyday experiences.

A lesson observation schedule with predetermined categories was used to record important facets of what happened during the microteaching. In addition to the observation schedule, all lessons were video-taped to capture things that might be missed out during note-taking with predetermined themes on the lesson observation schedule. Furthermore, all microteaching presentations were video-taped, analysed and sorted into categories.

### **Phase 5: Semi-structured interview**

Each of the four trainee science teachers was interviewed in order to follow-up on the issues that I observed during their lessons. The data generated through interviews were transcribed into broad categories and subcategories. The information generated was then summarised in

relation to the questions asked during the interview process. The next section discusses the limitations that emerged when carrying out my study.

#### **7.4 Research limitations**

One of the major limitations of this study is that the findings cannot be generalized to a larger population of trainee science teachers at the university or to other teaching institutions in Namibia or elsewhere in the world because the sample used was too small. In order to generalise the findings of this research, I feel that the study should look at a bigger population of trainee science teachers engaging with prior everyday knowledge and experiences during science instruction.

In this study, only 18 final year trainee science teachers who were doing the Basic Education Diploma and specializing to teach Natural Science for grade 5 to 7 were used as participants. Also, only four trainee science teachers were selected as focus group members observed teaching different topics in ecology microteaching practice. Therefore, the findings of the study could yield different results if all the participants were observed teaching.

I also felt that the findings from the microteaching presentations of the four trainee science teachers' results might be influenced negatively because they taught their peers. One could speculate that the results could be different if they were observed teaching primary school learners rather than their colleagues since they have a similar level of understanding.

Last, but not least, it was noted that the trainee science teachers were only given one chance to teach. The study revealed that learning to teach is a complex process and therefore, the trainee science teachers needed to practice the approach more often. However, given the short time-frame to transcribe the data, their teaching practice was limited and that could have influenced the findings of this study.

## 7.5 Recommendations

Based on the findings of this study, I recommend the following in order to help trainee science teacher engage better when they teach biological concepts that integrate prior everyday knowledge and experiences during classroom instruction.

- The findings of this study revealed that the trainee science teachers needed more complex views on how to deal with learners' prior everyday knowledge and experiences during science teaching. In order to achieve this, they needed to be exposed to more teaching opportunities so that they could develop teaching skills that would enable them to use this approach during instructional settings.
- I have claimed that the trainee science teachers were equipped mainly with theoretical teaching strategies and this prevents them from implementing these skills fully during teaching practice. I therefore recommend that teachers' training programmes need to emphasise and engage trainee science teachers in more teaching activities through which they become aware of how they can use prior everyday knowledge and experiences during science lessons. This will enable them to make better choices on the teaching methods to use for a specific topic.
- The teaching practice should model wide repertoires of the lesson activities needed to elicit learners' prior everyday knowledge and experiences and stress the role of explanation and meaning-making on the part of the learner. This can only be achieved if learners' everyday life experiences are involved during the construction of knowledge. Trainee science teachers should therefore be encouraged to use more open-ended questions during instructional settings. Also, more social interaction and collaborative learning activities should be encouraged in order to help learners to understand biological concepts. However, this research is only a beginning because it was done on a very small scale. Continued development of this approach has a potential for further research that particularly in the following areas.

## **7.6 Suggestions for future research**

This study focused on understanding how trainee science teachers engaged with prior everyday knowledge and experiences during science lessons in order to enhance the development of biological concepts. In this case, only the views of 18 trainee science teachers were documented and only the findings of the microteaching practices of four of them were highlighted. Though the findings of this study provide some insights on how trainee science teachers dealt with the subject, I feel strongly that a larger sample of research participants from other teachers' education institutions would yield better results.

This study was carried out at the university level where trainee science teachers used their fellow students as learners during microteaching to model their teaching practice. I therefore feel that it could be worthwhile to carry out a study whereby trainee science teachers were observed practicing this approach in an actual classroom situation with learners. This could yield a real picture on trainee science teachers' engagement with learners' prior knowledge and experiences during science lesson.

Some of the factors given by the trainee science teachers related to learners' cultural backgrounds. It would be interesting to find out what learners might indicate as factors that affect their active involvement and participation if Biology lessons were built on their prior everyday knowledge and experiences.

Furthermore, this research only focused on the trainee science teachers' engagement with prior everyday knowledge and experiences during classroom settings. It could be interesting to find out on how teacher educators engage with the topic during teaching training programs. The results from this area could inform teacher educators on how to provide better mentorship to the trainee teachers so that they could be able to use this approach during their teaching practice.

## **7.7 An overview of this Master's course and my personal experiences**

Conducting this study has been an enriching experience for me. It is through completing this course that I came to realise that one cannot claim to be educated until one carries out a research study. In this course I was introduced to many theoretical lenses that enabled me to understand how a research study is conducted. This helped me to identify an area in my field of specialization (Science education) where I finally located my research problem. In the first year (2011), we were introduced to the coursework module that was coupled with many assignments. These helped us understand the process of research. Also during that year, we were requested to start thinking about the research topics for our individual studies to be carried the following year (2012).

One of the striking learning aspects in 2011 that happened to me was that I was introduced to research writing by doing a pilot study on my research topic. This task introduced me to the actual research process and paved my route to doing actual research. As a novice researcher doing a pilot study was worthwhile as it empowered me with some of the research skills that I used in this study.

Further to the contact sessions that I had with my supervisors, the research was designed in such a way that a number of academics and experts in the field of research were invited to listen and critique our research topics and research process during symposium conferences. To me this was very rewarding. It is through their reflective criticism that my research proposal was approved by the Education Higher Degree Committee which allowed me to start my research study in 2012.

On my personal experience I should start by stating that this course was very challenging to me. There was a time where I lost the momentum to continue and felt I should just drop the study. As a mother, a wife, a lecturer, time management was a big obstacle for me. However, I should point out that if it was not for the motivation I received from my supervisors, my fellow students in this course and my family I could not have finished this research. Their encouragement revived me and kept me going in this process. Another, motivation was that I managed to collect my data in time and I did not want to disappoint my supervisors and my participants who sacrificed their time and energy to be part of this study.

My students and participant observers in this study were always cooperative and did not give me any problems. As a novice researcher I should point out that I have learnt a lot in the

process. For example, to keep time schedules, and to keep records of the data gathered using different devices to cover for any unforeseen circumstances proved to be helpful. Also the need to analyse data immediately after it was gathered while most of the information was still fresh in the mind of both participants and researcher was useful. I strongly believe that the core centre of the research process lies in the data gathering, data transcriptions and analysis process because these can impact on the final results of the research negatively if they are not carefully done.

The fact that I came into contact with many academics including my supervisors and my research editor who to me are well conversant with research processes made me academically rich. Through this study I also shared views, ideas and asked questions related to my study in order to shape my research topic and research questions. All these put together made me who I am today and proud. I know that if I could be given a chance to do more research, I would definitely approach it from a different angle.

In sum, though this research was conducted with a small sample, it was beneficial to me as a novice researcher in that it enabled me to reflect on the level where trainee science teachers were with regard to how they engaged with prior everyday knowledge and experiences during science lessons. It enriched my teaching profession in that the findings of this study will guide me in future to focus on the areas that need more attention during teacher training programmes in order to help trainee science teachers improve their teaching practice. Furthermore, this research equipped me with skills that will help me carry out more research in future.

## **7.8 Conclusion**

This study is an attempt to warn against a scenario where teachers revert to a situation where they view information prescribed in the syllabus and textbooks as all that is valid without paying due consideration to prior everyday knowledge and experiences of the learners as well as without taking into account whether learning had actually taken place. As it is stated in the previous chapters, trainee science teachers can articulate the importance of using learners' existing background knowledge (particularly indigenous knowledge) in teaching science. However, the empirical results of the study showed that although trainee science teachers can

articulate this idea quite clearly, few of them have the pedagogical content knowledge (Shulman, 1986) to use learners' background knowledge effectively in their teaching.

Therefore, the study advocates for more vigorous pre-service teachers' training that provides opportunities to the trainee science teachers to model 'good' science teaching approaches (which includes using learners' prior everyday knowledge and experiences) during science lessons in order to make teaching and learning more effective. In addition, I believe that far more practice of teaching actual learners and receiving feedback from the lecturers is needed to ensure that trainee science teachers can utilise different teaching strategies which accommodate all learners' cultural backgrounds and learning diversity.

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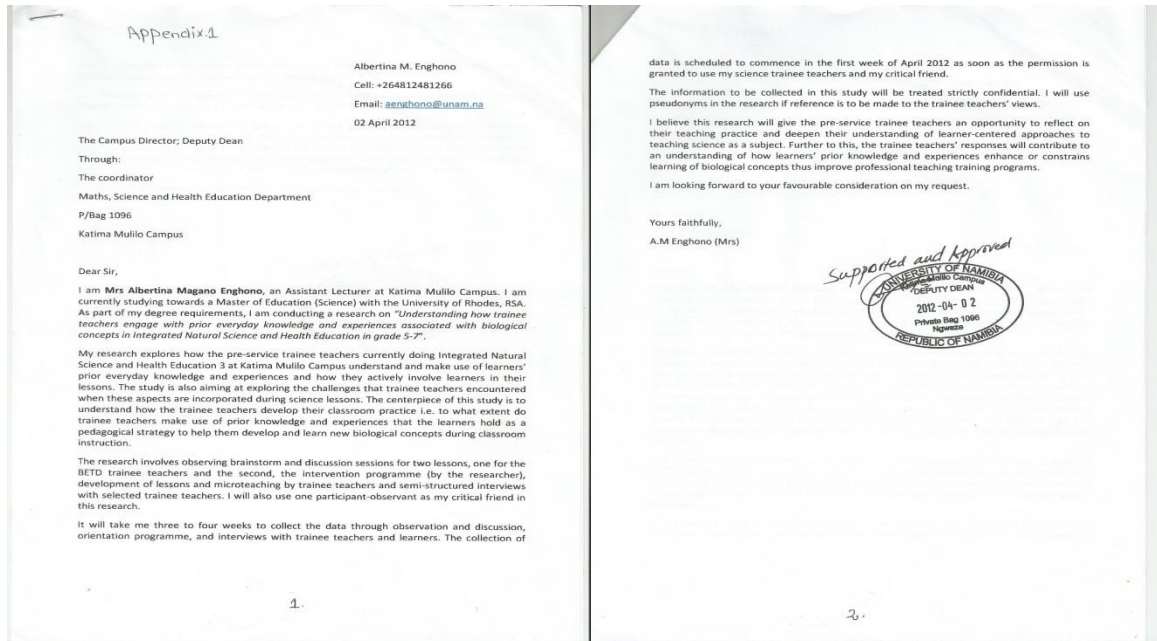
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# List of Appendices

## Appendix 1:

Clarification and approval letter from the research site management (Katima Mulilo Unam-Campus)



## Appendix 2

### INFORMED CONSENT FORM FOR THE TRAINEE TEACHERS (PARTICIPANTS)

I .....consent and volunteer to participate in this study conducted by Mrs Albertina Magano Enghono on understanding how trainee teachers engage with prior everyday knowledge and experiences associated with biological concepts during Integrated Natural Science and Education (5-7).

I understand that no negative consequences will arise as a result of my participation in this study and that the study is conducting for the purpose of improving the teaching of biological concepts in Natural Science. I authorise the material of this study to be used for research of teaching only.

I further consent to be observed and interviewed while teaching Biology topic to the fellow students as part of this study. I understand that I have the right to review the notes made of my teaching and that everything I will say will be kept confidential by the researcher. Also, any persons (students) used during my teaching will be identified by a pseudonym in the research report.

Signature : .....

Date : .....

## Appendix 3

Fig 3.1 The extract below describes the NNCBE (CD 3.1) teachers' expectations on the approaches to teaching, learning and assessment of grade 5-7 Natural Science subjects (NNCBE, 2010 (pp. 4-6).

**1.1 THE APPROACH TO TEACHING, LEARNING AND ASSESSMENT**

Preparation for a knowledge-based society requires a learner-centred approach to teaching and learning. This means that the point of departure is always what the learners already know and can do, then acquiring new knowledge through ways of working which are relevant and meaningful for them, and learning how to apply their knowledge creatively and innovatively. Knowledge is not learnt for its own sake, but must always lead to new understanding and new skills and the creation of new knowledge. At each step of the way, learners must show how competent they are in what they understand and can do.

Competence is knowledge with understanding, and skills, and the will to use them appropriately

An integral part of this approach is the integration of ICTs as a tool to enhance teaching and learning. The curriculum and syllabuses describe the competencies which they should attain, so that teachers know exactly what to assess in order to be sure that the learners are progressing and achieving. Teaching emphasises the varied processes and learning experiences needed for the creation of knowledge, rather than relying predominantly on the transmission of knowledge by the teacher.

Basic Education also prepares for the society envisaged in Namibia Vision 2030 by being inclusive. Learners with special educational needs and other individual needs will be included in mainstream schools and their needs will be given particular attention through differentiation of methods and materials as needed. Learners who are so severely impaired that they cannot benefit from attending inclusive mainstream classes and schools will be provided for according to their needs in special units, classes or schools until such time that they can join the mainstream. The curriculum, teaching methods and materials will be adapted to learners with special educational needs.

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*The National Curriculum for Basic Education*

between the world outside school and what is taught and learnt in school. Teaching should always begin with helping the learners realise what they might already know about something, or what ideas or questions they might have about it even if they do not know, and by relating to the environment within and around the school. Learners' guesses, assumptions, hypotheses and interpretations do not have to be correct at the outset, even in those few situations where there might be one right answer; these may all be the start of an enquiry. They can be reviewed later at a suitable point to reflect on what has been learnt in the interim, or at the end of a teaching unit, and some guesses and hypotheses might give fresh insights and new answers. Learning in school must constantly relate to, involve, and extend the learners' prior knowledge and experience, and this must be complemented and challenged by the knowledge that school provides from beyond the immediate sphere of the learner.

The direction of a teaching/learning process must always be to develop higher-order thinking skills. Newer understanding of children's problem-solving strategies shows that children acquire information, develop knowledge and understanding, and analyse, synthesise and evaluate in a cyclic process, in their own way and at their own level. The teacher can help develop learners' thinking by engaging the learners in problem-solving activities where increasingly broader knowledge is applied to ever more complex problems and situations.

**Figure 3: The knowledge cycle**

**6.2 LEARNING: EXPERIENCE, REFLECTION, KNOWLEDGE CREATION**

Children are always exploring their social and material environment, and learn through communication with others - playing, experimenting, experiencing things, and by reflecting on them. If there is no reflection, there is no human learning, merely activity or instinctive or habitual response. It is by reflecting on what has been experienced that understanding grows. That understanding will then be added to and modify previous experience and understanding, and the new understanding will lead to further activities and explorations of reality - knowledge creation. The learner is simultaneously learning how to learn.

Understanding and the ability to create new knowledge and acquire new skills do not happen in isolation. We are situated in a natural and cultural context with which we interact, which affects us and which we draw upon to construct understanding. Learning is an individual and collaborative experience at the same time; in school, whatever is done or whatever is presented or how, will be a common field of experience from which each learner will select what to learn (appropriation). In addition, each learner will learn about learning. If they are taught by rote memorisation, some will remember what they have repeated many times, most will forget it sooner or later, but they will all have learnt that memorisation and knowledge for its own sake is meaningless. If they are taught in a way which builds on what they already know and have experienced, and relate new knowledge to the reality around them, they will learn that learning in school can be meaningful.

Learners do not come to school like empty buckets to be filled with information. They have many experiences and are already learning. Teaching which does not build on that experience and learning will limit the learners' thinking, and the learners will not see the connection.

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**6. TEACHING, LEARNING AND ASSESSMENT**

This chapter sets out some basic didactic considerations in learner-centred education in the Namibian context.

In a knowledge-based society, existing knowledge and skills are being constantly evaluated and new knowledge and skills acquired, with a view to transforming knowledge in order to innovate to improve the quality of life. A knowledge-based society needs independent thinking and creativity as well as highly-developed communication, social and teamwork skills. The development of the core skills depends on the approach used to teaching and learning. The optimal approach to develop the core skills is learner-centred education.

**6.1 TEACHING**

The challenge in preparing learners for a knowledge-based society is to provide well-managed flexibility in the approach to teaching and learning, and provide learning experiences which motivate the learner to learn more. Some of the implications of this are the following:

**6.1.1 A wide repertoire of teaching roles**

Learners learn best when they are actively involved in the learning process through a high degree of participation, contribution and production. At the same time, each learner is an individual with their own needs, pace of learning, experiences and abilities. The teacher must be able to identify the needs of the learners, the nature of the learning to be done, and the means to shape learning experiences accordingly. Teaching strategies must therefore be varied but flexible within well-structured sequences of lessons: learner-centred education does not mean that the teacher no longer has responsibility for seeing that learning takes place. It means that the teacher has to take on a wider repertoire of classroom roles. These include being a manager and organiser of learning, a counselor and a coach, as well as being an instructor. Consequently a variety of techniques will be used, such as direct questioning, eliciting, explaining, demonstrating, challenging the learners' ideas, checking for understanding, helping and supporting, providing for active practice, and problem solving.

The teacher has to exercise professional discretion in deciding when it is best to convey content directly, when it is best to let learners discover or explore information for themselves; when they need directed learning; when they need learning support (remedial or enrichment); when there is a particular progression of skills or information that needs to be followed in sequence; or when the learners can be allowed to find their own way through a topic or area of content.

**6.1.2 Variation in working methods**

The teacher's roles are complemented by the way work is organised in the classroom. Work in groups, in pairs, individually or as a whole class must be organised as appropriate to the task in hand and the needs of the learners. Wherever possible, co-operative and collaborative learning should be encouraged and in such cases, tasks must be designed so that pair or group work is needed to complete it, otherwise the learners will not see any relevance in carrying out tasks together. As the learners develop personal, social and communication skills they can gradually be given increasing responsibility to participate in planning and evaluating their work, under the teacher's guidance.

Textbooks and other learning resources can be used in a variety of ways. Instead of just reading a section as homework or in class, the

Fig 3.2 The extract below shows the external moderator (CD 3.2) report during SBS observation done on trainee teachers teaching Natural Science and Health Education (5 to 7) in several government schools in Katima Mulilo township (SBS BETD Moderation Report, 2008 ( p. 46).

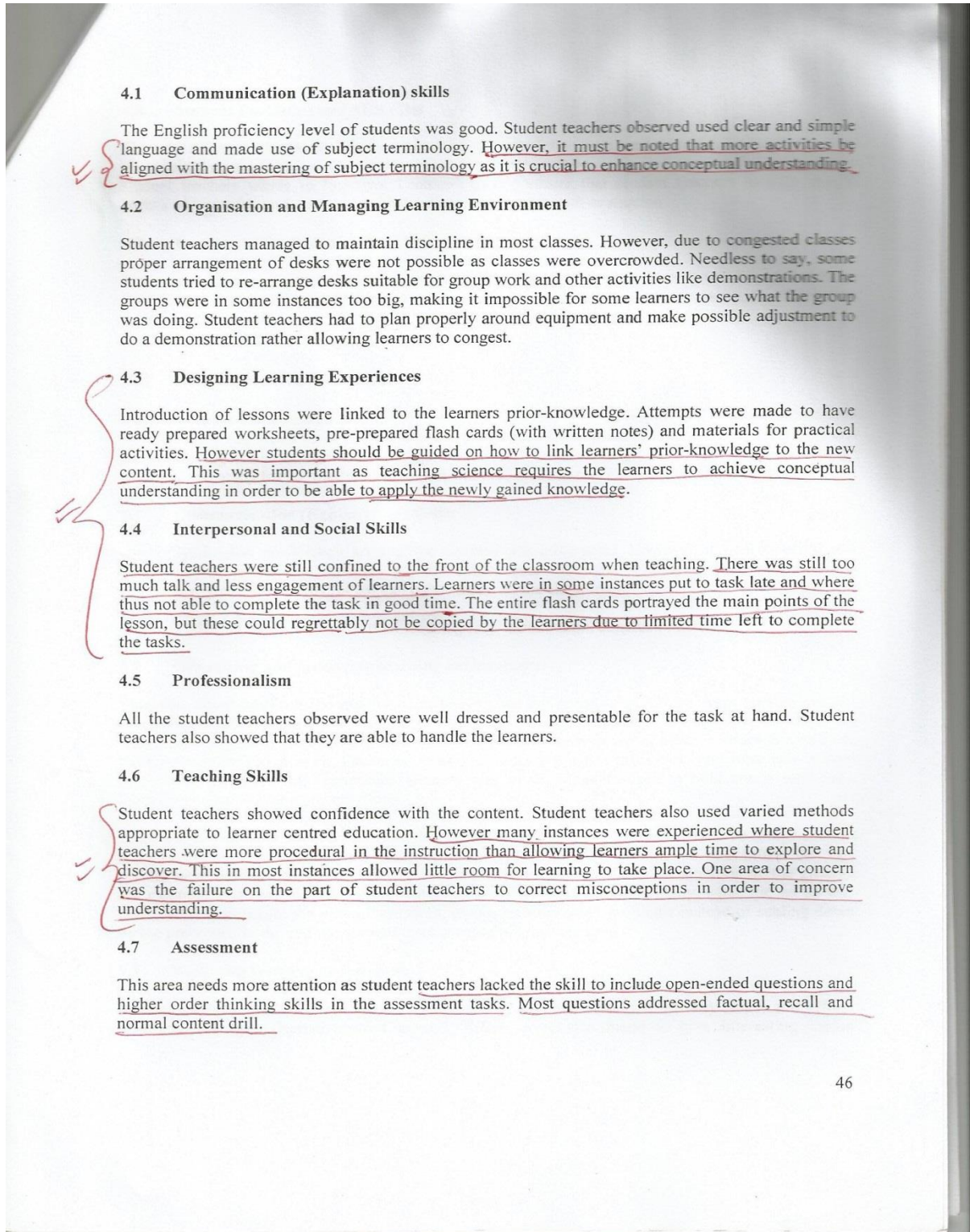
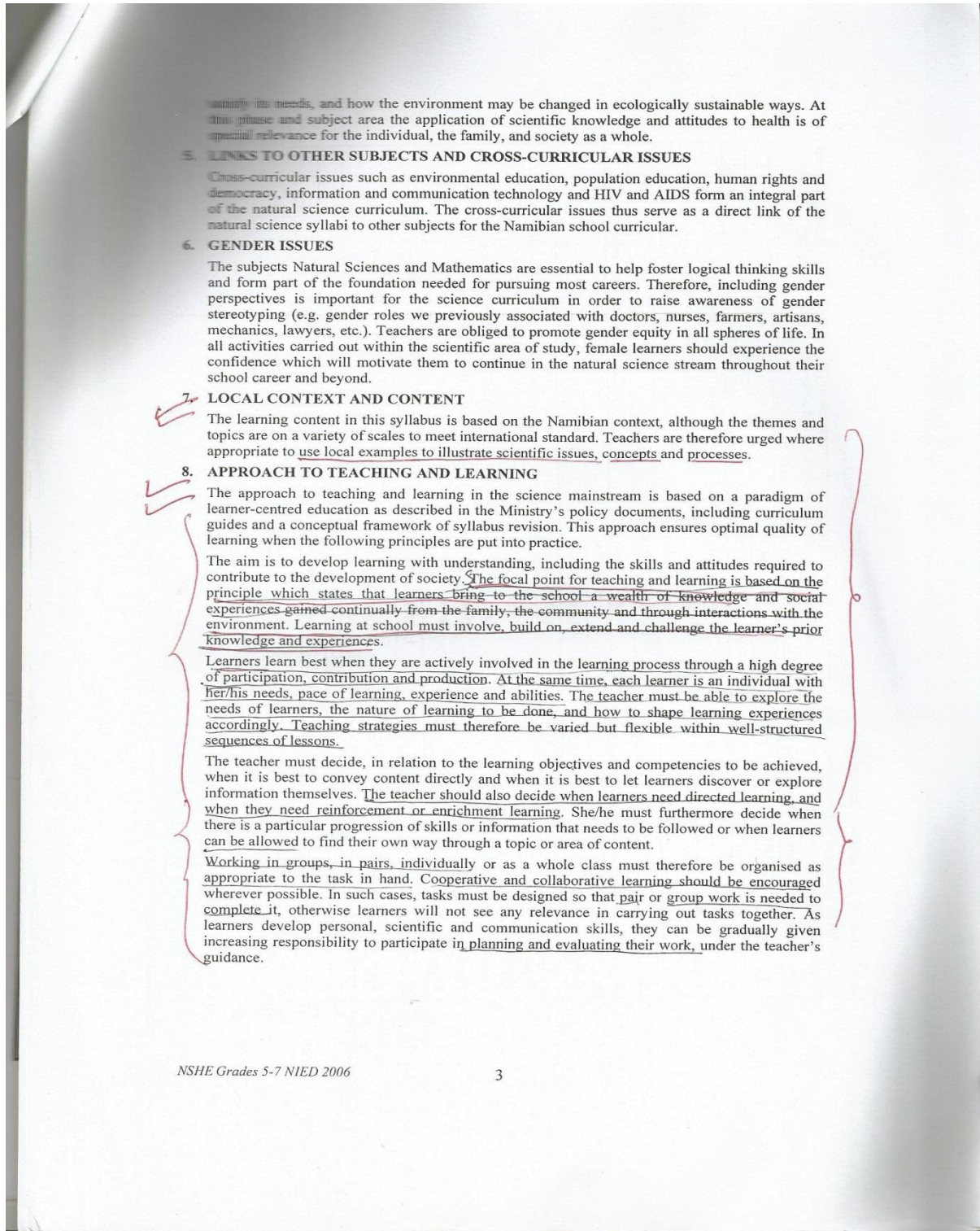


Fig 3.3 The extract shows the NSHE syllabus (CD 3.3) teachers' expectations as described under the components of local context and content as well as the approaches to teaching and learning Natural Science subjects (NSHE syllabus grade 5-7, 2010 (p.3).



**Appendix 4: Namibian Natural Science and Health Education textbooks for grade 5, 6 and 7.**

Fig . 4.1 a The extracts below indicate the foreword notes to science teachers taken from the grade 5 Natural Science textbook (CD 4.1) ( Elphick, R., Olivier, N. & Tyson, N. (2008) Natural Science and Health in Context. Namibia: Longman).

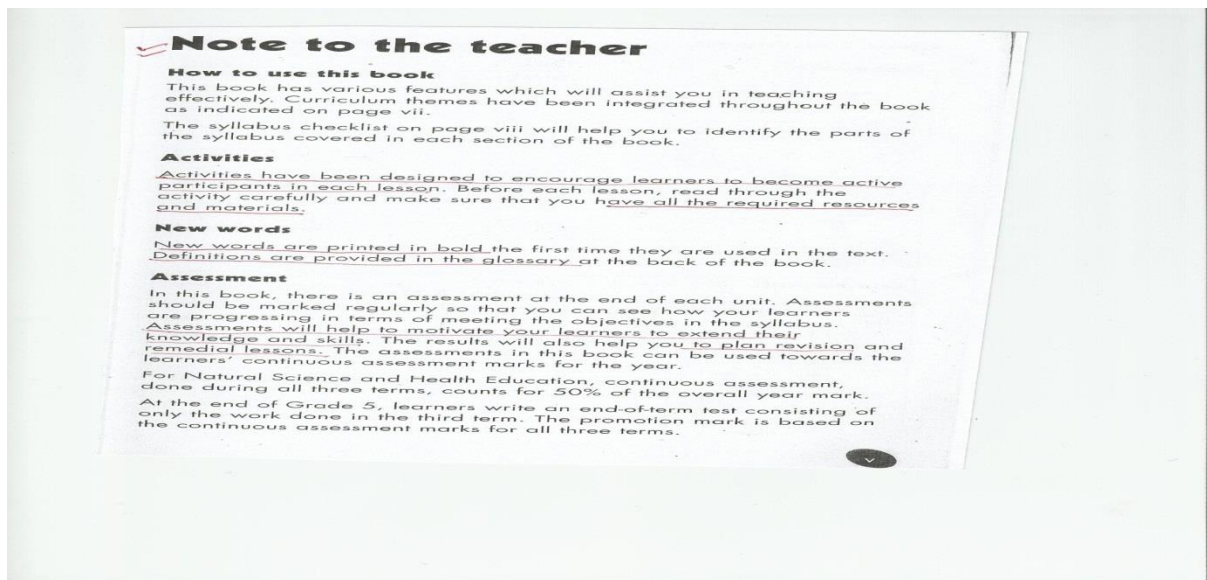


Fig 4.1 b Shows extract indicate how the topic ecosystem is presented in the Natural Science textbook CD 4.1 (grade 5). The topic indicates diagrams of the Namibian ecosystems, the bolded concepts and pre-set activity.

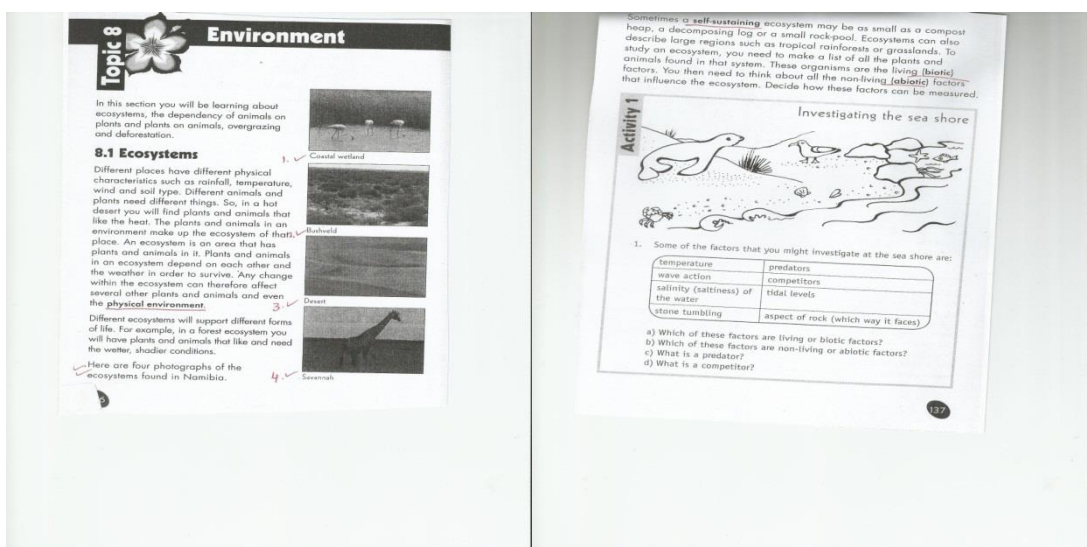


Fig 4.2 Show an extract from NSHE textbook CD 4.2 (grade 6) on the topic of ecology (Nicanor, N. & Speelman, H. (1997). Discovering science. A primary course for Namibia. Windhoek: Heinemann Educational Publishers).

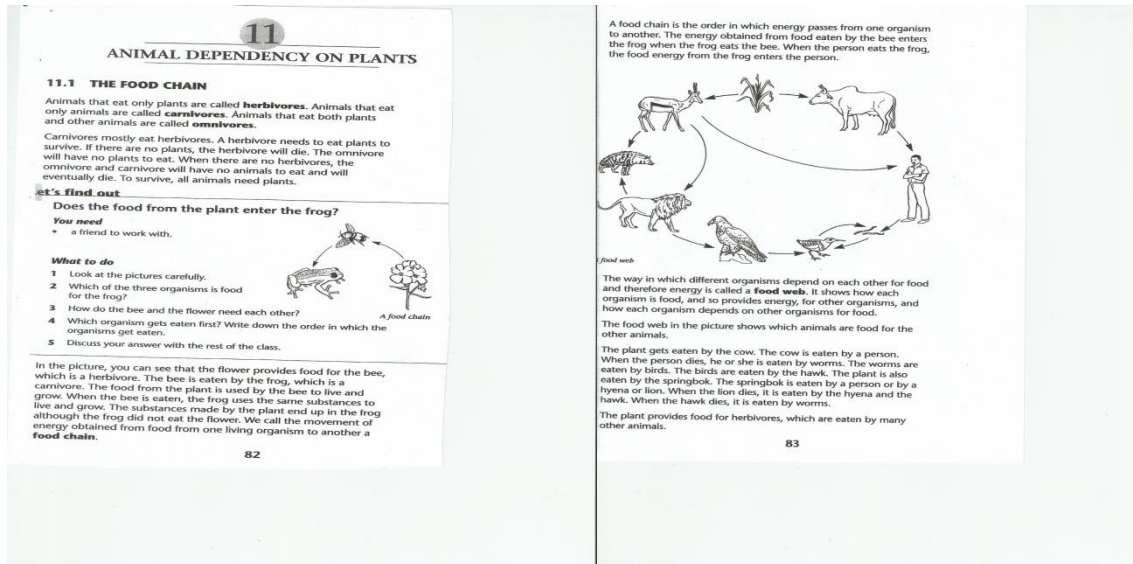
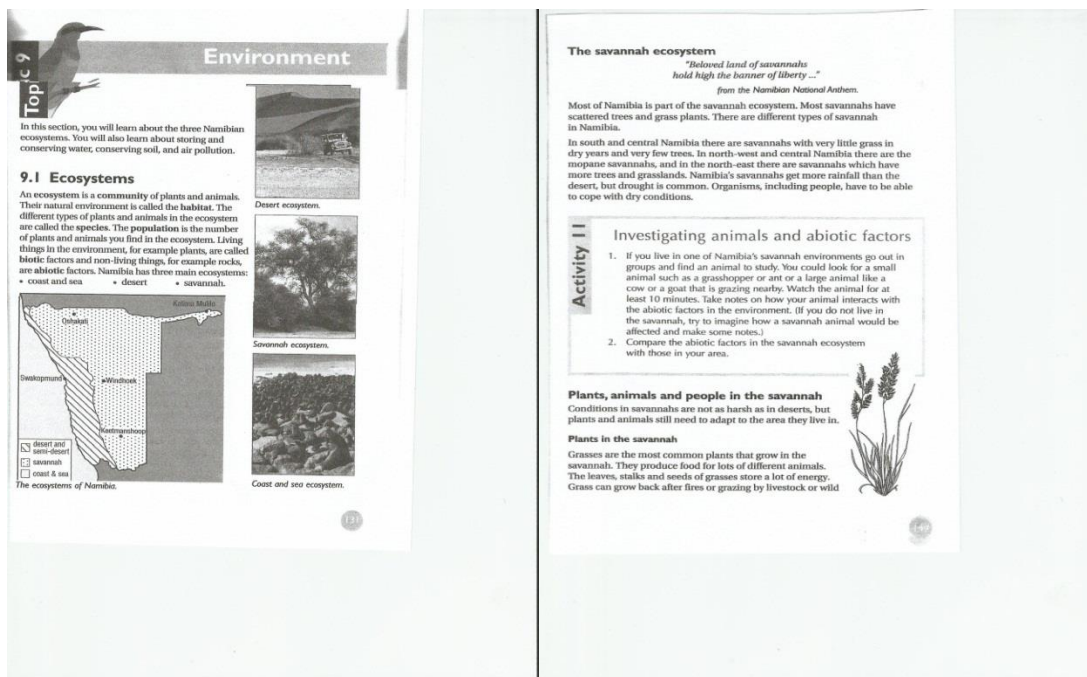


Fig 4.3 Show an extract from NSHE grade 7 textbook (CD 4.3) on the topic of common ecosystem in Namibia. (Elphick, R., Olivier, N., Tyson, N. & Samantha, B. (2005). Natural Science and Health in context. Windhoek: Longman).



## Appendix 5 Brainstorming session (BS)

Fig 5.1 Observation schedule (OS) and transcript of the brainstorming session

Questions asked to guide the brainstorming session	Reasons why it is asked
1. What do you understand by the term learners' prior knowledge and experiences?	To elicit the own trainee teachers' understanding on the concept 'prior knowledge and experiences' of learners ( Research question1)
2. What kinds of the prior knowledge based on the topic 'balanced diet' would you expect your learners to come with into a classroom?	To find out if trainee teachers can demonstrate real-life examples that shows the relationship between home knowledge and scientific concepts in case biological concepts learned at school.
3. What strategies would you use to elicit your learners' prior knowledge and experiences during the lesson presentation?	To find out what kinds of mediational tools do teachers use to ensure that they acknowledge learners' prior knowledge and experiences.
4. What do you do to engage your learners in the lesson development so that they develop and understand biological concepts well and attain the competence of the learning outcome of the topic?	To find the extent to which the trainee teachers use active learners involvement strategies and find out what they considered as active learners' involvement strategies. Also to find out the reasons for not involving learners in the teaching/learning process.
5. Who will you deal with the new concepts and misconceptions that your learners might have on the topic during teaching?	To find out how they deal with new concepts that emerged during the teaching process. Also to find out how teachers deals with learners misconceptions
6. What teaching strategies do you consider effective to teach this topic when you incorporate with prior everyday knowledge and experiences?	To find out what strategies do trainee teachers consider more effective when teaching topic of 'balance diet' using prior knowledge and experience of the learners.
7. Do you think that using prior knowledge and experiences of learners when teaching biological concepts might enhance or constrains learning meaningful learning? Justify your answer	To find out whether trainee teachers perceive the use of prior knowledge and experiences of learners as suitable in enhancing the development of biological concepts.
8. Based on your answer in (Q.7), what are the opportunities that a teacher might have when teaching biological concepts considering the learners' prior knowledge and experiences?	To find out what opportunities do trainee teachers think they can get when teaching biological concepts making use of the learners daily life experiences
9. What challenges do trainee teachers might encounter when designing and implementing science content that are incorporated with learners existing ideas and past experiences?	To determine what factors do trainee teachers perceive as deterring their abilities to use learners' prior everyday knowledge and experiences during teaching biological concepts in natural science lessons.

Questions	Category	Data that emerged out during presentations and whole class discussion
Q1 to Q2. Trainee teachers understanding of the concept prior everyday knowledge and experiences	Understanding of the concept prior everyday knowledge and experiences	G1 and G2 stated that Prior everyday knowledge is the types of knowledge that the learners already have before the content is presented to them.
	G2	It is the background knowledge that learners already know on a particular topic. Let me say a phrase or something, whatever you are going to teach to the learners. First you must ask the learners what they know. Or to add on to what they know. As you know learning starts from known to unknown. If you start with the thing which they don't know, then they will just be confused. So it is good to start with those things that they know already and then you add on.
	G3	Prior knowledge is the existing knowledge that the learners bring to school from home. Mmh... In other ways is the knowledge that they are exposed to when they are not in school.
	G4	Prior knowledge... what we discussed is that ... We deduces that prior knowledge is the information that learns come with at school. Mhh... When the learners do come to school it does not mean that they don't know anything. There is something that they come up with to school that they learn from their parents. That is what we call prior everyday knowledge and experiences.
Q2. Types of prior knowledge on the topic a balanced diet that trainee teachers expect the learners to bring to the classroom (e.g. local practices, examples, illustrations, demonstrations and analogies)	G1	Here we think that learners know the definition of a balanced diet.....the meaning, the six nutrients found in the balanced diet, the food sources that can provide us with a balanced diet
	G2	At this point we are assuming what the learners know a balanced diet. I want to pick here their prior knowledge what they know on a balanced diet. They might say or might think a balanced diet is eating healthy food. We expect that from them. They might also say eating different types of food. They might also say getting delicious food because they hear from their elders..... (Code switching to local language).
	G3	The simplest thing that the learners know when you talk about balanced diet is, the first thing that comes to their mind is food. So, immediately when you say the topic for the day is about balanced diet, they already know that they are going to talk about food. The different types of food that they eat at home.
	G4	Like we say on our answers that learners will say what they eat, different meals on a day. So talking about balanced diet it means eating different foods. So learners will come in the class will tell you that for breakfast we do eat porridge, for lunch..... we eat 'pap and meat', and supper we go for rice. The combination of those three will constitute different types of the meal, is that will make up a balanced diet. If you ask about thing they will know that you are talking about the balanced diet
Q3. Elicitation of learners existing ideas and experiences (what meditational tools stated)	G1	Start asking questions relating to the topic i.e. balanced diet, then put them in groups and let them discuss new ideas.
	G2	We have to probe the learners to answer. For example you can even bring different types of food and ask learners to come up with the menu and give reasons for their answer. Here you can bring a hamburger in the class, so when learners see the hamburger, they will think, they will relate that you will talk about a balanced diet.
	G3	You ask them what they know before presenting the given topic and then you put them in groups and ask them to mention different types of food they eat at home.
	G4	This is where you get the learners to mention or give you types of food that

		they know that will produce nutrients when you eat them. And then in pairs, you can put them in pairs, each of them they will discuss, I mean they will share ideas, sort of on types of food they eat at home that will give certain nutrients in certain proportions, what we call balance diet.
Q4. How learners could be engaged in the teaching/learning process to enhance conceptual development of biological concepts	G1	By making sure that all learners are actively involved in the lesson,..mmh.. in the lesson activity. For example when you divide them into groups, you make sure that every learner is given a duty. You make sure that all learners in groups are participating. It does mean that once they are in groups, Noma, Charlie are all given a duty to do. For example if Waka is not doing anything she must be given a chance to present.
	G2	We say we give....emmhh... group discussions. As group discussions everyone will be involved, everyone has to participate, everyone must open up or say something. So by doing so, learners will be active....eemh... and everyone will be involved in the lesson and give a responsibility to each group member. So like every group member, you give a responsibility to everyone, like every member will be given equal chance to present. So we just go at random when we give feedback. So everyone will be prepared. By so doing every learner will participate, they are getting involved in the lesson. ...mmh... The second point, we say identify non-participating learners and give them a chance to say something. For example, if you see that one of the learner is quiet since you came in the class, that learner is still quiet, at least point out that learner, give her chance to give out or say something, just to involve her in the lesson.
	G3	Through LCE approach, learners are put in groups and interact with each other and share ideas on a given topic. Mhh... like if learners are put in groups, let say not in groups but let say give them pairs work whereas like in group work, mmh may be you might not close to the other person in your groups,...let say you are not close to other person in your group, you may not be comfortable when you are there. So like in pairs there is no where you can excuse yourself. The other person says something, you also have to chip in, and you give your ideas because I don't think that the other person would let you to be sitting there while the other person is doing the work alone.
	G4	Alright mmmhh... In this case the lesson should be more practical now. It is unfortunate that we don't have some ideal equipment or set up in our grade five classes but at this time the lesson should be more practical in a way that you give them certain food types. On those food types, learners should be able to know the types of the food they are given, they identify them and then they discuss them in groups. Probably you give each group you give a different food sources; some of the food sources might have different nutrients and other have different nutrients. In their group they discuss, they identify food that they are given and also come up with the nutrients that they obtain from the given food that they are discussing about. Isn't it? And one more thing... is that after the discussions learners will give their findings to the whole class. Once they give their finding to the whole class, it when it is when the teacher will come in, just to add on or clarify some of the issues that are mix up.
Q5. Dealing with new concepts and misconceptions during teaching practices	G1	Here, you write the new concepts on the chalkboard then you ask them to explain. Like you just come in the class then you write the concepts on the .... it is the activation of pre-knowledge of what the learners knows already. Then ask them to explain, using their own knowledge, the teacher will supplement on the learners feedback,...mmh this is what I have said.  On the misconceptions, the teacher will allow learners to elaborate more on his/her idea, for example, you have just asked Calo what is food? ..... It is clothes; you see the learner is giving you a wrong answer. So, you asked a learner to elaborate more; to tell you what you mean is clothes.....on their idea, then after a learner has done, then you will explain the concept to the learners; what is real meant by food, because the learners do not have a clear definition of the topic. So the misconception, you allow the learners to elaborate on their idea then as a teacher you will link their idea to the topic you taught.

	G2	<p>There on misconception, is like learners they know something but then you want to divert them, they know something but not exactly the way you want them to know it. Then it like you diverting them from what they know into your way. For example if they say balanced diet is eating different food. <i>Then you ask them, which kinds of food.</i> The learners would name them as rice, meat and ...emhhh... those kinds of thing, and then in that case you are diverting or probing them to the answer. Ok, then just to add on misconceptions because some learners might know different types of sausage, here it is also important for us as teacher also to know how we reinforce our learner's answers. For example if someone gives a wrong answer, we shouldn't just go straight by saying that wrong ....emhh...you are wrong.. You are....., 'all those words' as you know them we are mentioning them a lot during SBS(school based studies). So the best thing here is to say those thing like ....emhh... we say those things like .... even though the answer is not good, eh, but thanks for trying and then you say someone to help him/her or who can add on. By doing that <i>ideas develop finally</i>, that is when probing comes in.</p> <p>Student: The meaning of probe? Ok, Probe is like to guide. Like learners do not know the answer, you give them <i>tips</i> which direct them to the right answer. Like if I say, do you know ndaps? Ndaps, yeah I know her, a brown girl....emhh you describe her ... a cute girl, all those things.</p> <p>In another way I am describing a person to you, who she is and then you find out ooh, is ndaps. It like it is a series of questions follow each other continuously that the leads you to the answer you wanted. Just what you said, it very correct.</p> <p>Another student : just to add on, you see for example I remember once a <i>teacher was leading us to the answer in the class.</i> It like the answer she was expecting us to give was 'perpendicular by sector', you know what she did, she say what is the answer... tell me, you see now you are giving a tip with the arm, here you are forming a ninety degree here, what is the answer? (<i>showing it</i>), like that you are giving a tip, probing (pause).... not bribing.</p>
	G3	<p>Mh...especially when it comes to misconceptions, learners can tend to make unnecessary noise, just to be naughty.. What can you do to make your lesson more interesting, you have to combine the concepts and misconception and ask them point out which are correct and which are wrong. But then, still you find that there are some others are too convincing, there are those learners are too convincing even though the person knows that what he say is nonsense and convince other that what they say is true. So as the teacher it is when you can come in and give the correct answer and support your answers so that the others who are already misguided can also understand that this person was just trying to misguide us, so this is the correct, the correct concept.</p>
	G4	<p>Right.... still come back again to the point that ...ahhh... we consider prior knowledge. Learners are not perceived as empty... empty vessels but they are perceived that they also have something when they come to the class. When a learner ask a question or do not understand something, you go back to the learner, as the given so.... you probe. You ask the learners what you understand yourself about the word that you ask. You ask the learner because we believe that they are not empty, they come to class with something that they know. From that they know, what they give you it where you build up according to their understanding. In the line in which the learner understands a certain terminology, it is the line which you will take to explain that terminology for further understandings.</p>
Q6. What predominant pedagogical strategies stated as effective ways of teaching biological concepts	G1	<p>Here we just write question and answer, group discussion, teachers' expositions.</p> <p>What do you mean by teachers' exposition?</p> <p>By teacher exposition I mean when a teacher gives information to the learner.e.g.when the teacher gives the definition of the balanced diet. That is teachers' exposition.</p> <p>Follow-up question: Does it mean when a teacher give a definition, then he do teacher exposition? But in this case, the lesson it must be learner-centred! student from the presenter group: It is, because you have to come in when ...mmh... the learners don't know anything.</p> <p>Another teacher: But you are....you are putting knowledge, you are spoon feeding isn't?.</p> <p>Student: No, you are using those questions and answers and group</p>

		<p>discussions.</p> <p>Another student: And here, I think when you are talking teacher exposition, here we mean like the teacher is going to reveal the content to the learners,... may be the teacher is going,..... aren't we have lesson stages you don't just come in the class and give the content to learner, at least you have do it stages by stages isn't it, here may be teacher is going to expose or reveal what is going to be taught on that day.</p>
	G2	<p>Ok, on the strategies, we came up with group discussions where everyone will be involved like I have already explained, pair discussions. Discussions should be done in pairs and then brainstorming and then followed by individual work, now learners will do individual activity.</p> <p>Another student: (pose a question) How are going to make sure that everyone is participating in those groups discussions or pair work?</p> <p>Presenter: You have to monitor, that means you must give instructions. You must tell those learners everyone.....must be on full force (taping his hands).</p> <p>Student: you know what I think you can do like in those case if you are giving work, if you are having like six questions, at least group learners in groups of four...four in each group and then tell them one of you should do this question; everyone should do....like you have to say to learners in group you, are doing question 1, and you question 2 and so on.... By doing so, everyone will be involved because no one would like to remain like having a wrong answer; everyone would like to give a correct answer. May be in this we will always have a good participation when we give group work.</p> <p>Presenter : you have just reminding me of what I did during my action research, whereby I came up with a point that discussions are more effective when in small groups than in large groups like you say a group four will do or so. Anyhow this is a good answer.</p>
	G3	<p>You can consider group discussions whereas they discuss in groups or they talk in groups, then there is whole class, individual work, pair work, teachers' exposition.</p>
	G4	<p>So it will be a demonstrative lesson; in fact that you demonstrate to the learners' types of food that should they eat. You also go further as given pictures of people suffering from certain disease. For example, you take a picture of kwashiorkor, you show kids..... you see this child is suffering because her/his diet lack certain types of nutrients, isn't it? You show gums, bleeding gums, you explain to them a child is suffering because in his or her diet there is a lacks a certain nutrient.</p> <p>Student : You said that your lesson will be demonstrative.....who is going to demonstrate; is it you or learners considering the fact that the lesson should be learner-centred?</p> <p>Presenter: You demonstrate to them; it is like showing what is going on. In that case you are showing different kinds of food. You give them different types of food and let them to sort them into categories like which one have proteins, which one have carbohydrates and which have fats. So it is them sorting not you as a teacher.</p>
Q7. Does incorporating prior knowledge and experiences during teaching biological concepts enables or constrains learning?	G1	<p>Us here we say yes, when you are using the existing knowledge of learners by involve the learners it will enhance learning process because learners are actively involved in the lesson, they will able to recall what was discussed in the class.</p>
	G2	<p>Yes, because learners' interest will be aroused because once you use their prior knowledge they will be happy, eh, it's like learners' interest will be aroused and teachers also, here the circulation will also be also the teachers because teachers are also not expected to know everything. Here, learner-centred will force learners to be more involved and give more ideas and here teachers will also get new ideas from the learners and learners will get new ideas from the teacher and from the peers.</p>
	G3	<p>It will enhance because it is difficult for learners to understand something that they don't have any ideas about it. So, with prior already existing knowledge...mhh... okay, I will just explain it in my own words. It will enhance because it is difficult, we all know that it is difficult to understand something that you do not have any idea about. If for instance you grew up at the village, you don't know anything about the mountains you will be confused when people talk about the mountains. You will be thinking that the</p>

		anthill behind your grandmother house is the mountains the people talking about. But if you already know what the mountain is you will, already when a person start talking about mountain you already know what you are talking about. So it going to enhance learning because you already have existing knowledge. And then it will mean that you will understand more, you add more on what you already know whereas for those who 'don't know anything' the little that they get from the teacher, may be will be the first time that they are even hearing of such things. Which means the people who already know something on the issue will know a lot.
	G4	Very good, considering prior everyday knowledge in biology is very.....very important and this will enhance learning. It is because biology is about the studying living things in our environment. When we are studying the living things; living things are part of our daily lives. So no learner will come to class without knowing what is going on within our living environment, isn't it?
Q. 8 What opportunities do trainee teachers have when teaching biological concepts using learners' prior knowledge and experiences	G1	The teacher will enjoy teaching because the learners will participate more and more teachers' work will be easy. Here we mean that ...emh...as the teacher use this whether it is learner-centred approach or prior knowledge, it will be easy for the teacher to... to. Deal with the learners because learners they are able to participate or give what they know rather than the teacher just come in the class, what is soil erosion? Soil erosion is water wash away. You just give information to the learners, you don't ask the learners what they know, may be the learner know a clear definition than what you know.
	G2	Yes, very much like it is stated by the previous presenter learners get the opportunities to share different viewpoints. By so doing knowledge is constructed socially.
	G3	The lessons will be easier for both teacher and learners because the learners have an idea of the lesson. For instance, sometimes back last year when went for SBS, us at school teachers used to tell us a plant moves when the wind blows. We didn't know the issue of sunflower, I was not told of the sunflower issue. So I was thinking plants move when the wind blows. Is only that I heard ... started asking questioned first before I started teach, then one learner tells me about the sunflower, then I understood that...oooh, the plants move following the direction of sunlight. That is when I understood, I didn't know even know of that issue before. In that way the lesson will be easy for both teacher and learners. In that way I am not going to cheat, I am going to teach.
	G4	Opportunities.....good, this is a nice question; we learn from one another. There are facts that are more tradition; there are facts that are more modern. Most teachers will teach the information that has been introduced or published; the information that are noted in the books. But the learners will come with this prior knowledge that they know traditional from home and from their parents before they are taught. The combination of the two will benefit both teacher and learners.
Q9. Challenges that might be encountered when designing and delivering lessons that incorporate prior knowledge and experience.	G1	Teachers might find what learners already know as challenge. Mhh.... Student: How? What do you mean when you say it might be a challenge? Teacher: Yes, it might be difficult because not all of the learners in the class will be able or willing to participate, meaning it will be difficult to determine the knowledge that learners already have, .....mhhh.....I mean what the learners already know about the content you gonna teach. For example, may be in your class there are learners who are able to give a clear answer or may be willing just to participate. Like you find to it that we might be thirty in the class but it is only one learner is raising his/her hand to give the answer. So, if you are using prior knowledge only one learner will be able to be helped because he is only learner who is gives what he/she already know? But most the learners maybe some of the learners they have something but they just pulling out, they don't want to participate. So, it is a kind of a challenge because the learners,..... I mean the teacher will not know whether the learners they got something or they come in empty headed and then they went out same thing.
	G2	Here we said some of the learners might not be exposed to science concepts and that environment because you know that in science we use almost the language which is 'abstract'. Those terms or concepts might be new to some learners, so they might find it hard for them to get the meaning of those concepts.

	G3	Mhh...Science is specific, so it becomes difficult to consider every child's point of view. You find that others learners know a bit but not too much and some must just know that when the sun is somewhere there (point up) it is 1 '0 clock. But they don't know how is it that it is one o'clock, so with science it is a bit more specific whereas with existing knowledge it is just something you know but you don't understand fully.
	G4	Yes... the challenges... Somehow, the problem is when you are designing this lesson; you wouldn't know what information your learners possess and to what level do they know this information that they got. So when you planning that lesson you wouldn't know where to start and where to stop and again learners among themselves, the level might differ. They have different levels of thinking. So it will be a bit difficulty at what level should you takes your students upper, lower or mediate. That is a challenge on its own unless otherwise consultation prior to planning.

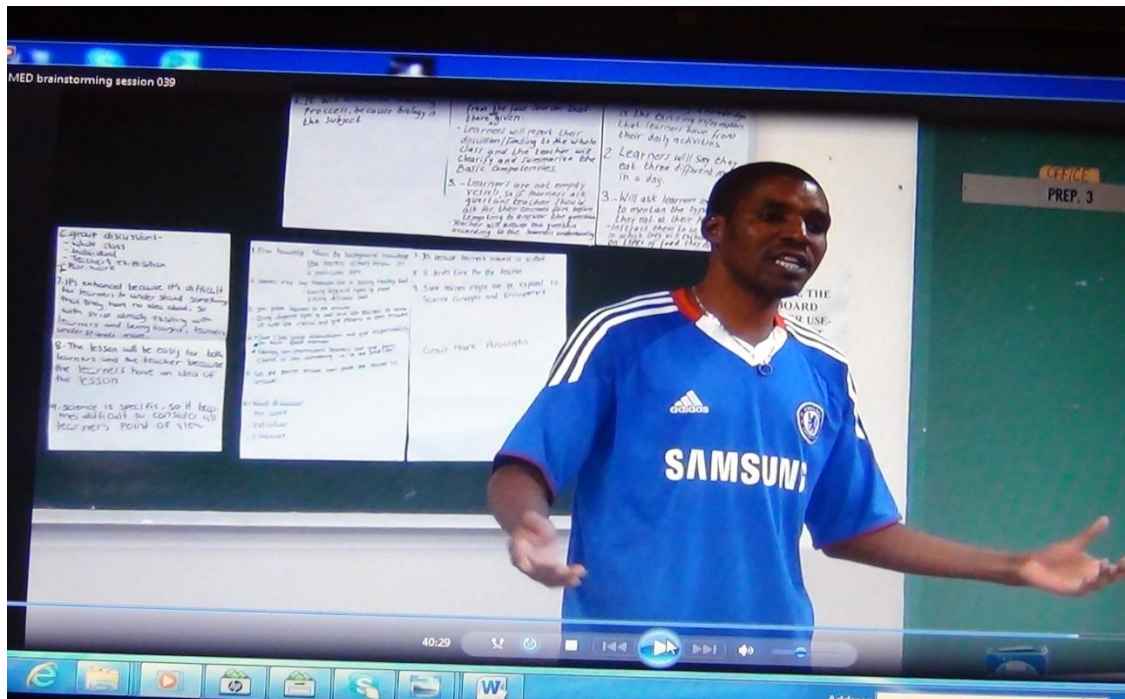
Fig 5.2 a. Show the researcher (standing) engages with one group of the trainee teachers during brainstorming session.



Fig. 5.2 b. Trainee teachers' exchange views within their groups during brainstorming session



Fig 5.3 Shows the trainee teacher presenting the group findings (views and ideas) on how they make use of learners' prior everyday knowledge and experiences on local foods to teach biology concepts on nutrition topic.



## Appendix 6 Orientation programme (OP)

Fig 6.1 Worksheet:

Demonstration lesson plan that incorporated trainee teachers' prior every day knowledge and experiences into science content to enhance development of biological concepts during science lesson.

### New concepts: Nutrition, diet and balanced diet

1. If you are teaching a grade 5 learners the topic of nutrition. How do you introduce them these new concepts in your class; **nutrition, diet and balanced diet**

.....  
.....  
.....

2. Make a list of all the traditional foods (including the nutritional drinks) that you normally eat and drink at home (*emphasis at the village*).

3. Classify the foods you listed under the following groups: Fruits and Vegetables, Grainy foods, Dairy foods/products and Meat.

Grainy foods	Meat	Fruits and vegetables	Dairy Foods	Local non-alcoholic drinks

4. Indicate your foods into either organic nutrients or inorganic nutrients. Classify your foods into main food molecules and give reasons for your choice:

**New concepts: Carbohydrates, proteins, fats, vitamins, mineral salts, water or fibre.**

FOOD NUTRIENTS	NAME OF THE TRADITIONAL FOOD	TYPES OF FOOD MOLECULE	REASONS
<b>1. Organic Nutrient</b>			
<b>2. Inorganic Nutrient</b>			

5. From the foods you listed, select a few examples and draw different menu of the meals you normal ate in the village.

<b>Breakfast Meal</b>	<b>Lunch Meal</b>	<b>Supper Meal</b>

6. Do you think that you use normally to eat a balanced diet or not. Justify your answer.

.....  
 .....

Example 1: Student worksheet



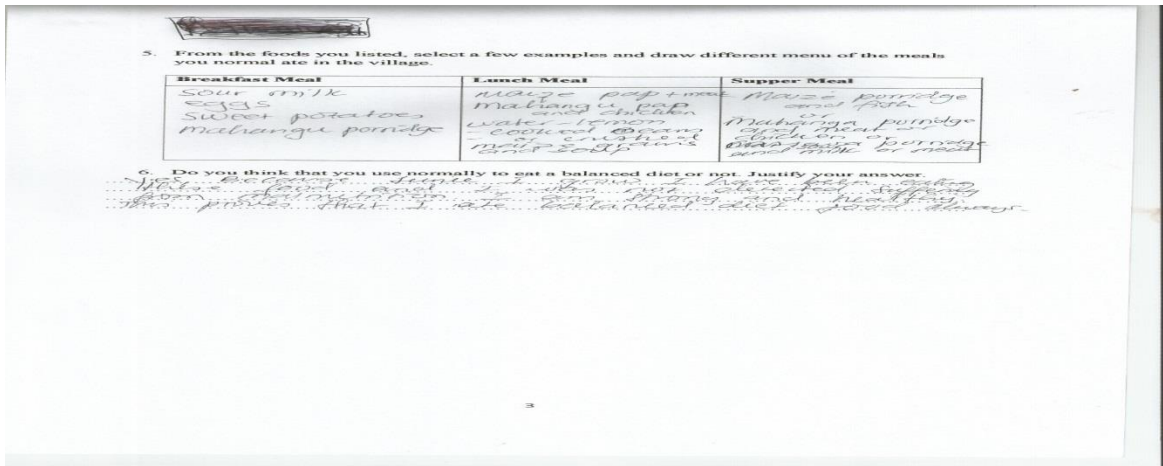
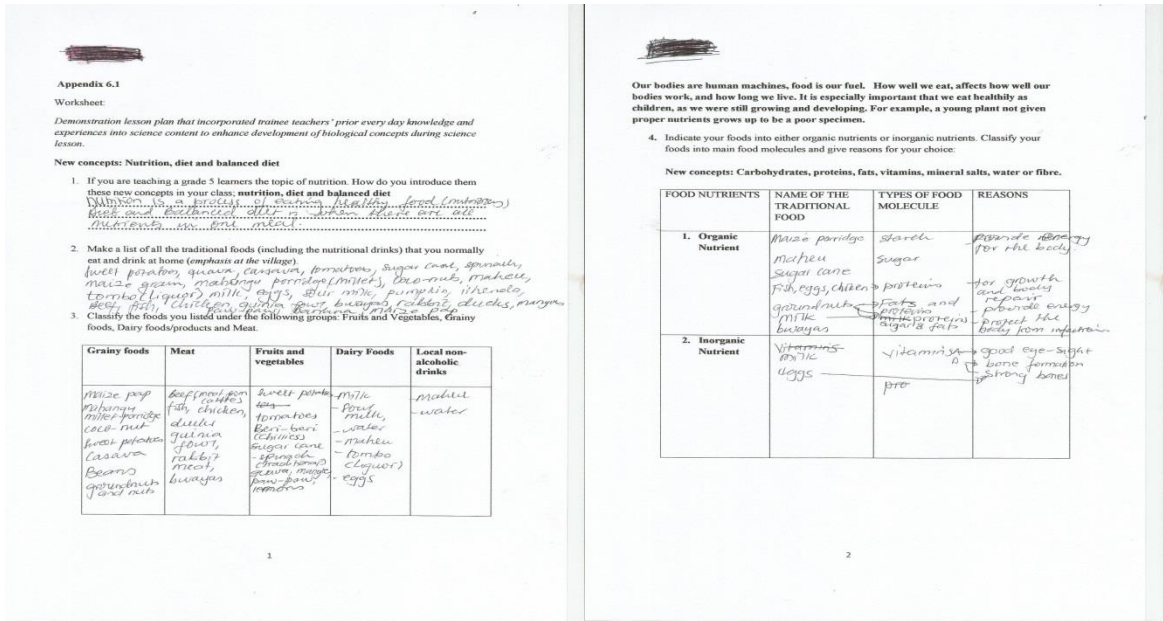


Fig. 6.2 Show the researcher gives instruction to students on how they make use Hierarchy tables and mind maps to reorganise the information listed on the chalkboard.

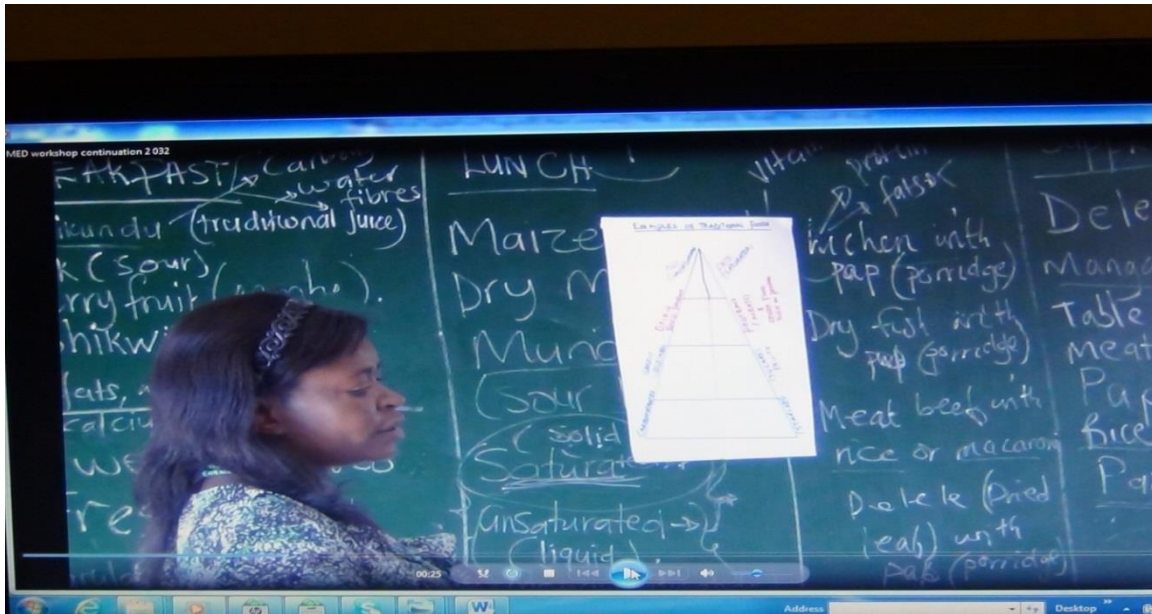
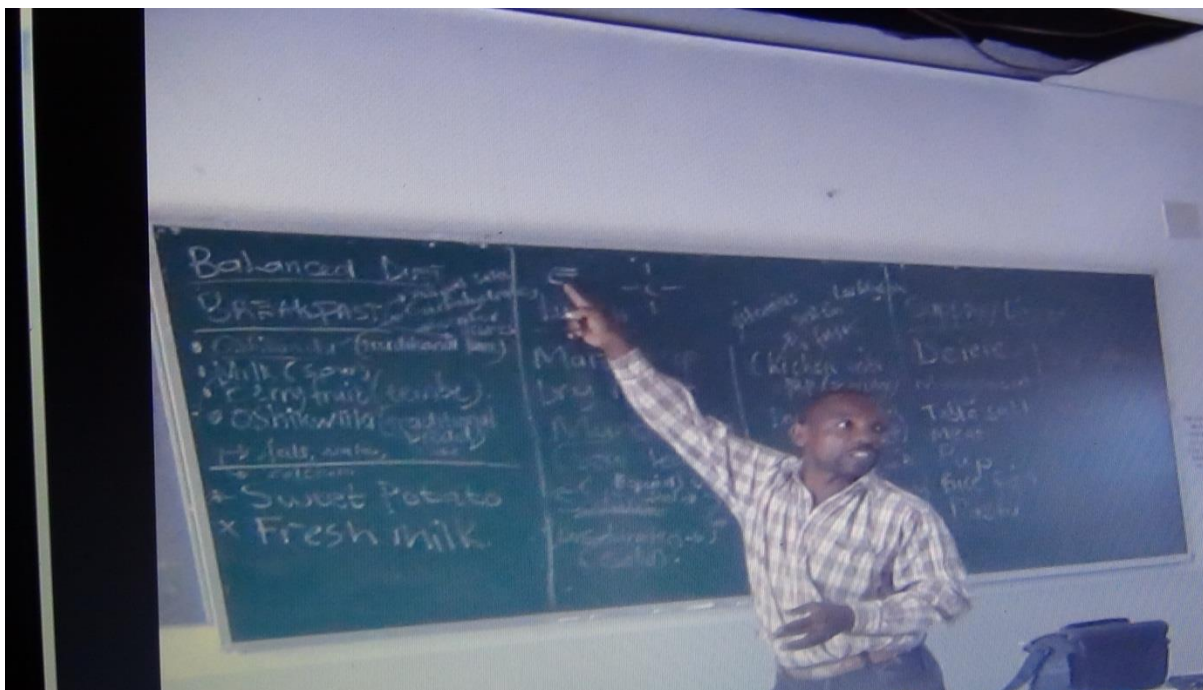


Fig 6.3 Show the co-participant and critical friend use students' information provided during the session to draw chemical structural formula of the mono-unsaturated and poly-unsaturated fats.



Appendix 7 Microteachings by the trainee teachers

Fig 7.1 Show T3 use his expertise to explain how energy is flowing within the ecosystem on the chalkboard

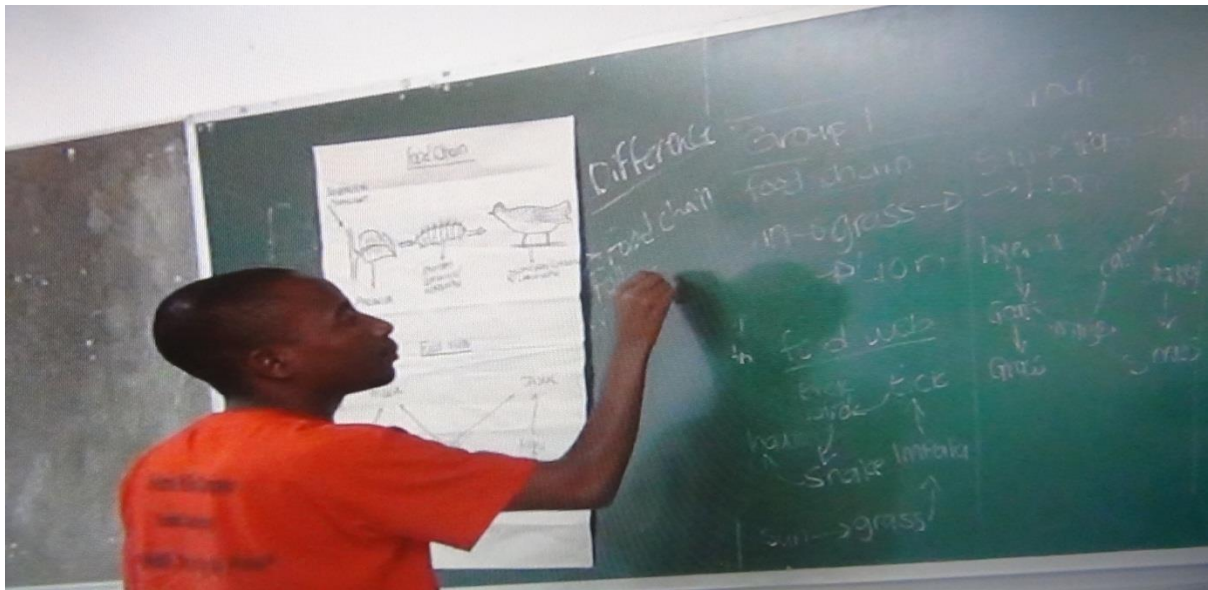
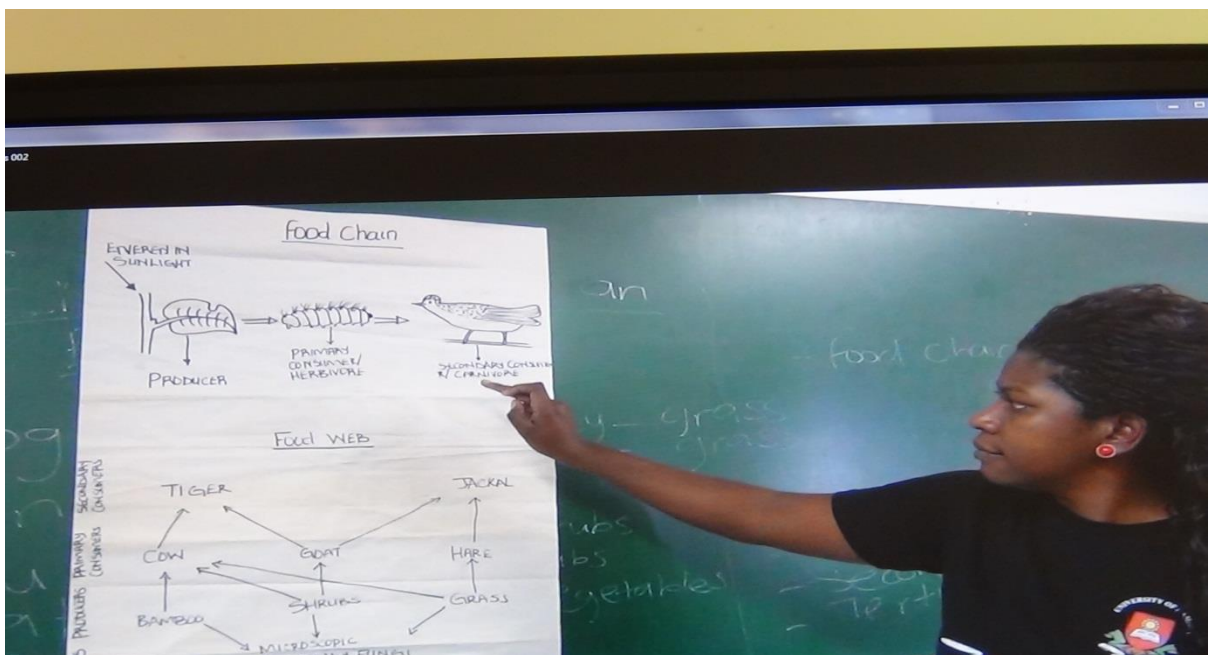


Fig 7.2 Show T4 uses the chart she prepared before the lesson to explain the differences between food chain and food web.



Appendix 8 schedule with pre-determined issues used during individual semi-structured interview with the four trainee teachers

**Part One: Using students' prior knowledge and everyday experiences to enhance conceptual development of biological concepts during Natural Science lesson**

Natural science syllabus (5-7) suggests that when teaching life science, teachers should use learners' prior knowledge and experiences as resources during the lessons.

Pre-determined questions asked	Trainee teachers responses
1. What kinds of prior knowledge and everyday experiences do you expect students to have in the topic you taught	
2. Do you think you used any of the students' prior knowledge in the lesson that i have observed? Give some examples	
3. What teaching strategies (meditational tools) did you use to elicit your students prior knowledge in the topic that you taught?	
4. Was it necessary to seek for the students' prior everyday knowledge and experiences in the topic that you taught?	
5. In your opinion, does the use of students' prior everyday knowledge and experiences enable or constrains you to teach new biological concepts? Give me some few examples	
6. What challenges did you encountered during the designing and presentation of the lesson that incorporates students' prior knowledge and experiences?	

**Part B: Active participation and involvement of students during the lesson**

The Namibian National Curriculum for Basic Education also emphasises the use of learner-centred approaches during teaching/ learning process

Pre-determined questions asked	Trainee teachers responses
1. In your own opinion, what does it mean for learners to be actively involved during the science lesson?	
2. Do you think that you actively involve students in the lesson that you taught?	
3. If your answer is yes to question 2, at what stage of the lesson do students were actively involved in the lesson. Give some examples of teaching and learning activities that exhibiting students' involvement during the lesson?	
4. If your answer to question 2 is no, why students were not involved? Explain what prevent you to involve the students during the teaching/ learning process.	
5. To what extent did you make use of the students' prior everyday knowledge and experiences to link the Western science to students' everyday knowledge and experiences? Give some examples from the lesson that I have observed.	