# AN EXPLORATION OF THE TEACHING PRACTICES OF EDUCATION OFFICERS AT A SCIENCE CENTRE IN PRETORIA, GAUTENG PROVINCE.

**BY**

**HASANI JUSTICE BILANKULU**

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**SUPERVISOR: PROFESSOR AWELANI. V. MUDAU**

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## DECLARATION

**STUDENT NUMBER: 32134541**

I, ***Hasani Justice Bilankulu*** declare that the dissertation entitled ***An exploration of the teaching practices of education officers at a science centre in Pretoria, Gauteng Province***. is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

**SIGNATURE** **DATE** **November 2018**

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## ABSTRACT

Education officers based at science centres and museums play a significant role in teaching the visiting learners science. However, little is known about their teaching practices at these centres. The purpose of this study was to investigate the teaching practices of education officers when teaching science in a science centre environment. The focus of this study was on the education officers' knowledge and instructional strategies used in teaching science at a science centre in Pretoria, Gauteng province. A qualitative case study approach was used. Data was collected from the three participating education officers using semi-structured interviews and observations. Data was analysed separately from each case using education officers' knowledge framework guidance. The findings from this study indicate that although education officers have shown an adequate content knowledge in teaching science at the science centre their teaching method was teacher-centred and non-interactive and show-and-tell strategies were more common amongst the education officers. The study also revealed that education officers did not use their resources/exhibits effectively in teaching science. It is recommended in this study that intensive training of education officers is required before they can interact with the visiting learners.



**Keyword:** *Education officers. Education officers' knowledge. Science centre. Teaching practices. Instructional strategies. Teacher-centred. Resources/exhibits.* Non-interactive. Training.



## TSHOBOKANYO

Baokamedi ba thuto ba kwa mafelong a maranyane le dimusiamo ba tshameka karolo e e botlhokwa mo go ruteng barutwana ba ba etileng dithuto tsa maranyane. Mme goitsiwe go le gonnye ka mekgwa e ba e dirisang kwa mafelong a. Morero wa thuto e ne e le go tlhatlhoba mekgwa ya baokamedi ba thuto fa ba ruta dithuto tsa maranyane mo tikologong ya lefelo la maranyane. Ntlhakgolo ya thuto e e ne e lebile kitso le mekgwa e e dirisiwang mo go ruteng maranyane mo lefelong la maranyane kwa Pretoria, porofensing ya Gauteng. Mokgwa wa boleng ba kgetsi thuta o dirisitswe.

Tshedimosetso e tserwe mo baokameding ba thuto ba bararo ba ba neng ba tsere karolo ka mokgwa wa dipotsolotso tsa seka-kago le tebelelo. Tshedimosetso e tlhatlhobilwe kgetsi le kgetsi go dirisiwa kgakololo ya lenaneo la kitso ya baokamedi ba thuto. Dipitlhelelo tsa thuto e di supa gore le ga baokamedi ba thuto ba bontsha kitso e e lekaneng mo go ruteng maranyane kwa lefelong la dithuto tsa maranyane mekgwa ya bone ya go ruta e ne e lebagane bone gape e sena kamano mo go dimo ga moo mekgwa ya go buwa le go bontsha e ne e le tlwaelo gareng ga baokamedi ba thuto. Thuto e bontshitse gape gore baokamedi ba thuto ba ne ba sa dirisi didiriswa ka natlafalo mo go ruteng maranyane. Kgakololo go tswa mo thutong eno ke gore baokamedi ba thuto ba tlhoka katiso e e utlwalang pele ba ka kopana le baithuti ba ba etang.

**Mafoko a kaelo**: *Baokamedi ba thuto. Kitso ya baokamedi ba thuto. Lefelo la maranyane. Mekgwa ya go ruta. Mekgwa ya taelo. Go lebagane Morutisi. Didiriswa/ditshupegetso. Tlhoka kamano. Katiso*.

## NKATSAKANYO

Vadyondzisi lava kumekaka eka ndhawu ya science na *museum* va tlanga xiphemu xa nkoka swinene eku dyondziseni ka vadyondzi lava va endzelaka ndhawu leyi. Hambi swiri tano, i swi ntsongo leswi tivekaka hi madyondziselo ya science eka ndhawu leyi. Xikongomelo nkulu xa dyondzo leyi akuri ku lavisisa tindlela ta madyondziselo ya vadyondzisi loko va dyondzisa tidyondzo ta science endhawini leyi ya tidyondzo science. Dyondzo leyi ayi kongomisiwile eka vutivi na tindlela leti vadyondzisi va letelaka ha kona vadyondzi edhawini leyi ya science ePitori, eka Xifundzha nkulu xa Gauteng. Maendlelo ya *qualitative case study* ya tirhisiwile eka vulavisisi lebyi. Vuxokoxoko byi hlengeletiwile ku sukela eka vadyodzisi vanharhu va science hi ndlela ya mbulavurisano na vulangutisisi bya vukheta swinene. Vuxokoxoko lebyi byi hleriwile hi ku hambana hambana hi kuya hi vutivi bya vadyondzisi lava vanharhu. Hambi leswi vadyondzisi lava va nga kombisa vutivi byo ringanela no twisisa tidyondzo ta science eka ndhawu leyi, swi kumekile leswaku madyodziselo ya vona aya pfumeleli vadyondzi ku va teka xiphemu eku tirhiseni ka swikombiso na switirhisiwa swo pfuneta ku twisisa tidyondyo ta science. Vadyondzisi a va tirhisa

ndlela yo vulavula no komba switithisiwa na swikombiso swo pfuneta tidyondzo leti ehandle ko pfumelela vana ku tirhisa swilo leswi swa science. Ku yisa emahlweni, swi kumekile leswaku vadyondzisi a va tirhisi switirhisiwa kumbe swikombiso swo va pfuneta eka dyondzo ya science hi ku hetiseka. Hi ku landzelela dyondzo leyi, ku tsundzuxiwa leswaku vadyondzisi va kuma dyondzo yo enta no enela ku suka eka va vutivi byo antswa va nga si nyikiwa mpfumelelo wo dyondzisa vana tidyondzo ta science.

***Maritonkulu***: *Vadyondzisi. Vutivi bya vadyondzisi. Tindlela ta madyondziselo eka ndhawu ya science. Tindlela ta vuleteri. Switirhisiwa/swikombiso.*

# TABLE OF CONTENTS

## LIST OF TABLES AND LIST OF FIGURES

**Page**

### List of tables



### List of figures

## APPENDIX LIST

# CHAPTER 1
# INTRODUCTION

## 1.1. Introduction

The teaching and learning of science does not only take place in a formal school environment. Out of school teaching and learning of science has become popular in South Africa. Both the government and private sector are involved in science education outside the school environment. This kind of involvement happens in non-formal settings, different from the school settings.

According to Cullen (2005), there are many specialist centres which are a rich source of science information, which provide teachers and students with a unique context of thinking about science and technology. He argues that these centres have valuable applications in school curricula to facilitate learning. Learners are able to experience deeper understanding of the sciences by visiting such places. The interesting question is how is scientific knowledge communicated to the learners and what instructional strategies are used to teach science at these centres.

Science centres and Museums are ideal institutions to play a role in science education outside the school environment (Adams and Gupta, 2017). The role of an out-of-school environment is not much different from that of a school environment because both involve presentations, demonstrations and hands-on activities. In order for scientific education activities to be successful, education officers must have sufficient pedagogical context knowledge (PCK) to guarantee a high quality of teaching and learning (Geveke *et al*, 2017). The purpose of this research is to explore in detail the knowledge and instructional strategies used by the science centres in the teaching of science.

## 1.2. Background of the study

The strategic framework of the Department of Science and Technology (DST) for science engagement (DST, 2014) is informed by the imperative of empowering its citizens to engage in processes and issues that have an impact on their lives. At the

core of this strategic framework is the strategic aim of “popularising science, technology and innovation as attractive, relevant and accessible in order to enhance scientific literacy and arose interest in science careers” (DST, 2014:49). The DST (2014) argues that for this aim to be achieved, among others, science for education support through science centres is imperative. Pfeiffer (2011: 16) argues that “a lack of interest by learners in science as a career is of critical importance to society as a whole, therefore an increase in learners’ interest in science is fundamental”.

The science centre in Pretoria where the study was conducted has a pillar for education support. One of its objectives is to support schools that visit the centre by providing education lessons that address scientific topics required by the school curriculum. The research focuses on how these lessons are presented to the school groups that visit the centre.

According to Ainley (2007), if science education is to be useful to learners outside of school the curriculum must move beyond the textbook and use community resources such as libraries and science centres to explore science-related community issues. The centre in Pretoria is one of those community resources used by schools to learn more about sciences. Cullen (2005: 27) argues that “if a visit to the science Museum is well integrated into school programs it can be a very valuable facilitator of learning and can enhance the development of multiple intelligences in learners”.

“Science centres and museums provide interactive and hands-on activities to the learners” (Gerber *et al* 2001: 81). They further argue that the use of hands-on and inquiry based activities develops team work, critical thinking and problem solving skills which make learning active and meaningful. Science centres and museums don’t only inject an element of fun for the entertainment of the visitors but also play an important role in science Education.

There is no doubt that fewer learners study science compared to other subjects and many find Science to be difficult. Many researchers have confirmed this in their studies such as Pfeiffer (2011), Eshach (2007) and Gilbert (1995). Science centres

are formed to encourage Science education. This study is interested in the education officers' teaching practices when teaching science at the science centre. According to Pfeiffer (2011: 16), "the teaching style is a major determining factor influencing learners' attitude towards science and more emphasis is needed to be placed on the teacher's role and their teaching styles in order to achieve an educational change in the constructivist direction". The role of the teacher in a constructivist learning environment can be considered to be that of a facilitator. Teachers and learners are partners in the learning process according to Eshach (Eshach, 2007). He argues that a social constructivist views the important role of the teacher in enhancing learners' learning by talking and interacting with them without taking over control of the learning process.

Education officers at science centres play a major role in making science interesting to the learners. "Improved teaching will lead to improved learning", as argued by Pfeiffer (2011: 17). He further argues that the education officers create the learning environment for the learners and they have a huge responsibility of deepening the scientific understanding and learning experiences occurring in their environment. A science centre is a different environment where learners interact with different exhibits that may not be available in a school environment. They are given instructions by other people who are not their everyday teachers.

According to Pfeiffer (2011: 18), "individuals have their own style of learning". He defines a learning style as personal qualities that influence a student's ability to acquire information, to interact with peers and the Education officer and otherwise to participate in learning experiences. This study focuses much on the teaching of science at the centre. It explores the knowledge and instructional strategies used by the education officers at the centre to communicate science to the learners.

School groups visit science centres and museums for a variety of reasons. One of the reasons for schools to visits these centres, as outlined by Eshach (2007), is the connection between lessons at the centre with the curriculum. Teachers see visits to the science centre as an opportunity to reinforce and expand knowledge related to the curriculum. The other reason is to foster learners' interest and spark

motivation and curiosity in science topics or concepts. For these reasons and others to be achieved is vital to explore how education officers at these centres interact with the learners.

## 1.3. Problem statement

The number of learners doing science at school level is declining (DST, 2014). Learners perceive science to be difficult and demanding (Mushaikwa, 2014). The DST (2014) states that learners choose other subjects that are seen to be less demanding and they believe they will be able to do better in those subjects. There is a decline in science activities that can arouse learners' interest in science careers. Learners see science and mathematics as abstract subjects which do not link well with their everyday lives. (Mushaikwa, 2014).

To fully understand how children learn science, one should look not only at the learning that take place in the school environment but also the non-formal learning that take place in other centres such as museums and science centres. Eshach (2007) argues that museums and science centres can greatly contribute to the understanding of science and encourage learners to further their interest in the subject.

More than 200 000 learners visit the science centre in Pretoria every year as part of their education excursions. The science centre aims to encourage learners into science education by presenting an exciting and relevant educational experience to the visitors. This raises the question of how science is communicated to the visiting learners. This study investigates the knowledge and instructional strategies used by the education officers to communicate science to the learners that visit the centre.

## 1.4. Aims and objectives of the Research

### 1.4.1. The aim of this research is:

- To identify the nature of the education officers' content, pedagogic and resource knowledge as well as their instructional strategies in teaching science at a science centre.

### 1.4.2. The objectives of the research are:

- To explore the content, pedagogic and resource knowledge of education officers in teaching science at a science centre.
- To explore the instructional strategies of education officers at a science centre.

## 1.5. Research Questions

The following research question guided the study

What is the nature of education officers' teaching practices at the science centre?

The following sub-questions helped to unpack the main research questions.

a. What is the nature of education officers' content knowledge in teaching science at the science centre?
b. What is the nature of education officers' pedagogic knowledge in teaching science at the science centre?
c. What is the nature of education officers' resource knowledge in teaching science at the science centre?
d. What instructional strategies are used by the education officers to teach science at the science centre?

## 1.6. Rationale and the purpose of the study

One of the strategic aims of the science centre where the study will be conducted is to raise learners' interest in science education by providing a new learning experiences and promoting a lifelong love of learning. "Science centres and museums have the potential to engage learners and teach them by stimulating their understanding of science and, most importantly, to help them assume responsibility for their future learning" (Eshach, 2007: 171). This study should help the centre to improve on their facilitation strategies in order to address their strategic goals. It should also help other science centres to learn good practices and improve on their instructional strategies.

According to Eshach (2007: 175), “teachers see a trip to museum and science centre as opportunities to reinforce and expand the classroom curriculum by providing additional perspective and meaningful connection to what is happening in the classroom”. In this study the researcher examined the teaching practices of education officers at the centre.

This should help the centre and other science centres, when developing their lessons, to consider the needs of the school curriculum. The study should inform education officers at other science centres on the practices of others in presenting science topics to reinforce and expand the classroom curriculum. It should also assist policy developers to look at the contributions of science centres and museums when developing the school curriculum.

## 1.7. Delimitations of the study

This study focuses on one science centre in Pretoria because it is visited by more than 200 000 learners annually. The centre was easily accessible to the researcher. The focus was on three education officers who were interested to participate in the study. Education offers are the facilitators who interact with schools at the science centre on a daily bases. The study focuses on the knowledge and instructional strategies used by the education officers to teach science at the centre. Each education officer was interviewed and observed on lessons of his/her choice. This was done to make sure that all participants were comfortable during the study.

## 1.8. Chapter outlines

**Chapter one** is an introduction that gives an overview of science education in a science centre environment. The chapter outlines the background of the study, the problem statement, research aims and objective, research questions and rationale and purpose of the study. Delimitations of the study are also discussed in this chapter.

**Chapter two** discusses the literature review of this study. It looks at the role of science centres and museums in science education, instructional strategies in science education and the knowledge required by education officers to teach science at science centres and museums. The conceptual framework on which this study is base is discussed in detail in this chapter.

**Chapter three** outlines the research methodology used in this study, which includes the nature of the research, research context, sampling methods and data collection techniques. The pilot study, data analysis method and ethics are also discussed in details.

**Chapter four** presents the collected data, the discussions and findings from each participating education officer in order to draw conclusions.

**Chapter five** presents the summary of the findings, the teaching of science at the science centre and the instructional strategies used by education officers to teach science at the science centre. The main contribution of the study, its limitations and recommendations are also presented. Lastly a conclusion is provided.

## 1.9 Conclusion

This chapter presented the introduction and the background of the study as well as its aims and objectives, including the research questions. The next chapter presents the literature review together with the conceptual framework that underpins the study.

# CHAPTER 2
# LITERATURE REVIEW

## 2.1. Introduction

Previous research on schools visiting science centres and museums has focused mainly on students' learning experiences (Eshach, 2007; Harington, 2001; Hofstein and Rosenfeld, 1996; Bencze and Lemelin, 2001; Fortner, 1997). Less has been said however, about the teaching practices of education officers at science centres and museums. Science centres and museums are also environments in which teaching occurs where education officers play a significant role in the institutions' education agenda (Tran, 2006). Limited attention has been paid to the role and practices of science centres and museum education officers (Tran and King, 2007). The literature review presents three main sections that helped the researcher to understand the content and the context of the teaching practices of the education officers at the science centre. The first deals with research on the role of science centres and museums in science education whilst the second section reviews research on the instructional strategies used in science education. The final section reviews the knowledge required by education officers to teach science at science centres and museums.

## 2.2. The role of science centres and museums in science education

Science centres and museums are categorised as non-formal institutions that play a major role in science education (Eshach, 2007). According to Fortner (1997) science centres and museums offer excellent opportunities for science learning outside of formal classroom learning. These centres are characterised by a non-formal learning environment where visitors can actively explore scientific principles and phenomena (Harington, 2001). Ramey-Gassert (1997) argues that non-formal science learning environments allow learners to observe and investigate natural objects and live specimens in ways that a textbook cannot. They can also engage with and excite learners to experience science in ways that are uncommon to the

formal classroom by offering science through real world objects and natural phenomena. Fortner (1997) notes that formal classroom features sustained exposure to learning materials while exposure in non-formal centres are usually short in duration. At science centres and museums learners may visit learning settings for a shorter period whereas in formal setting learners are likely to revisit the same classroom for a semester or a school calendar year.

The concept of non-formal and informal learning can be debated. According to Geveke *et al* (2017) non-formal and informal learning are part of out-of-school learning. Out-of-school learning can be defined as the sum of activities that comprise the time individuals are not in the formal classroom, which can be divided into non-formal and informal learning. Gerber *et al* (2001) argue that formal learning environments such as schools are characterised by their highly structured and evaluative nature, whereas out-of-school learning environments are less structured. Eshach (2007) uses the diagram below to illustrate the difference between informal learning and non-formal learning environments. He argues that informal learning happens spontaneously and is likely to occur in places within our day-to-day routine, such as homes or streets and even at schools, mostly at break times, whereas non-formal is made up of structured and well-prepared visits to institutions such as science centres and museums. Both informal and non-formal are out-of-school science learning environments.

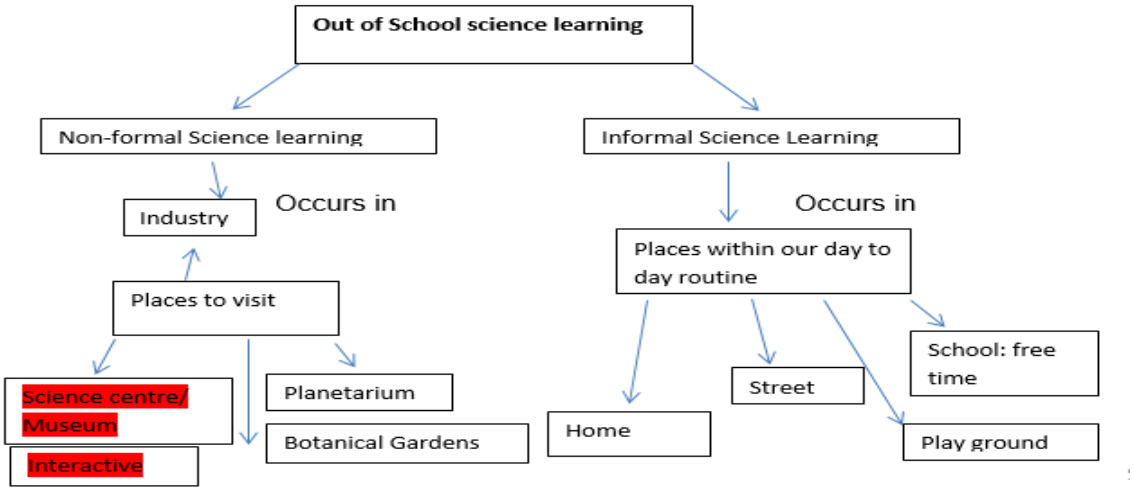


Figure 2.1. Informal and non-formal science education by Eshach (2007: 175)

According to Eshach (2007) and also confirmed by Rennie and McCleffety (2016), Informal learning applies to situations in life that occur spontaneously, for example such as the learning that happens within family circles and the local neighbourhood or community. Rennie and McCleffety (2016) argue that informal learning is distinguishable from the other two (non-formal and formal) by having no structure at all and with no intended outcome. As opposed to informal learning, non-formal learning institutions such as museums and science centres include to a larger extent, interactive science activities that are structured and intended for specific objectives. Non-formal learning occurs in a planned but highly adaptable manner in institutions or organisations which are beyond the sphere of formal education. It shares the characteristics of being mediated with formal education, but the motivation of learning may be intrinsic to the learner (Eshach, 2007).

Science centres and museums have now positioned themselves in society's collective knowledge and as sites for public education. They function in a way as to complement formal education by promoting citizen literacy (Bencze and Lemelin, 2001). They argue that it is vital therefore, that learners that are also enrolled in formal schooling be encouraged to make frequent visits to science centres and museums so that they may develop habits of lifelong learning. They are unique science educational environments that provide resources for lifelong learning as well as complementing the learning that takes place in the school environment (Griffin, 1998). Griffin (1998) argues that these institutions not only provide current information but also offer the opportunity to place science knowledge and its development in a wider environmental and cultural context. These popular institutions provide interactive and hands-on activities to the learners. Science centres and museums can provide hands-on, exploratory science learning in a non-evaluative and relaxed context (Ramey-Gassert, 1997). They are seen as sites for public lifelong learning which promote social inclusion. They are able to support formal schooling by helping learners to think independently, critically and creatively. These centres for example, can engage visiting learners in activities which enable them to conduct scientific inquires and enhance critical thinking (Bencze and Lemelin, 2001).

Science centres and museums provide opportunities for active science in a non-evaluative and non-threatening environment that also invites girls to take on the challenge of a subject that is traditionally viewed as male-dominated (Ramey-Gassert, 1997). Therefore science centres and museums may play a significant role in inculcating positive attitudes towards science among all learners. There is a strong association between attitudes towards science and learners' performance in the science classroom. It was found for instance, that learners with more positive attitudes towards science show increased attentiveness to classroom instruction and participate more in science activities (Eshach, 2007).

Science centres and museums that focus on interactive exhibits which are simulative and have touch-feel experiences are being celebrated for their ability to engage visitors (Watermeyer, 2012). He further argues that interactive lessons and exhibits are credited for being hands-on, which is pedagogically superior to traditional way of transmitting knowledge. Science centres and museums offer a model of experiential learning that has a direct encounter with the phenomena rather than merely thinking about the encounter (Barry, 1998). It is a unique platform for public engagement with science and technology (Addison, 2002). Watermeyer (2012) argues that the *modus operandi* of science centres and museums encourages social interaction and lived experience which evokes scientific discourse.

Visits to science centres and museums have become a way of life as a society (Griffin, 1998). Teachers and learners visit these centres for variety of reasons. From her research Griffin (1998) identifies six reasons why schools visit these centres, namely: 1. to learn about science and technologies that are relevant to the curriculum by reinforcing or expanding classroom lesson. 2. Exposure to new learning experiences which have a positive impact on learners' development and future learning of science. 3. An opportunity for a memorable learning experience. 4. Raise learners' interest and curiosity in science topics. 5. An opportunity to get out of the classroom and change the routine. 6. To promote lifelong learning.

A visit to a science centre or museum is often a lasting impression to learners and it promotes a deeper understanding of the experimental, analytical and interpretative approaches that underpin science and the way in which the world around us works (Braker, 2008), he argues that outdoor classrooms provide a link between theoretical aspects of science and issues which affect our homes, communities and the world around us. He (Braker, 2008) further argues that science centres can help to develop understanding, attitudes and values, and lead to a more enlightened, committed and actionable population in areas such as citizenship, climate change, genetic engineering and sustainable development.

Science centres and museums are great resources for teaching and learning. They provide learners with a unique context to think about science and technology outside the formal school environment. Hence they have a valuable application in the school curriculum to facilitate learning and develop learners' understanding of scientific concepts (Cullen, 2005). Due to the wealth and breadth of images available at the science centres and museums they have become ideal resources for scientific learning (Barry, 1998).

Aderson *et al* (2002), from his analysis of learners' recollections of their field trip experience, identifies that in science centres and museums lessons have contributed to learner's memorable moments of the visits. The education officers who presented the lessons were part of the memories. While it can be argued that the educators' time with the learners is short lived, there is evidence that the interactions are memorable (Tran, 2002). Tran (2006) also reports similar observations among full-time school teachers in their study of museum educators. The findings of the study show that the design of the lesson and nature of the teaching was memorable to the teachers.

According to Mosabala (2014), there is no doubt that a visit to a science museum contributes to the learners' knowledge, attitude and believes. On his research on the visits to science museums in South Africa, he argues that teachers and learners often have different reasons for visiting science museums. Most of the reasons alluded to are edutainment, links to the curriculum, interactive activities, and career

guidance. He further argues that to some of the schools a visit to science museums is a tradition of the school, as they visit such centres every year. This confirms Griffin's (1998) findings that there are many different reasons why teachers and learners visit science museums.

Learners of school age spend about two-thirds of their life outside of formal schooling. The experience of learners from out-of-school learning is critical to learners' knowledge, understanding, beliefs, attitudes and motivations to learn (Braund and Reiss, 2005). They further argue that going on science trips or excursions is rated the most enjoyable way of learning by learners. The science and the way in which it is communicated is often seen as exciting, challenging and uplifting. The approach and context of teaching science at the science centres and museums should be seen more as complementary to science teachings at schools rather than seen as competition.

Science centres and museum science education has many potential advantages, as argued by Ramey-Gassert (1997). She argues that these centres can nurture curiosity, improve motivation and attitudes and can also engage learners through participation and collaboration. According to Taylor (2012), science teaching claims to make efforts to enhance collaborative practices when learners are doing activities, by instructing learners to be in groups. However, at a closer look much of the group's nature of the work remains individual because learners usually work towards individual goals, whereas when learners are collaborating their actions are adjusted in order to achieve shared goals. Further to these, learners may partake in certain roles within the group to attain shared learning goals and generally there is a sense of shared responsibilities. Communication is a key element for cooperation and collaboration to happen (Brown, 1992). Education officers and teachers play a role of engaging learners by using object or puzzle phenomena (Ramey-Gassert, 1997).

Ramey-Gassert (1997) elaborates on the benefits of using science centres and museum settings to prepare pre-service teachers to teach science. He concludes that, compared to traditional classroom science teaching, science centre learning

environments improved learners' attitude toward science and provided pre-service teachers with unique insights into the learners' ways of understanding and learning about the natural world. Teachers' knowledge of science centre curricula and resources can be crucial for successful teaching.

Some researchers hold a different view on the role of Science centres and museums. According to Rennie and McClafferty (2016: 55), "science centres are edutainment institutions where entertainment dimension is more successful than education". Guisasa *et al* (2004) argue that fun is a planned part of a visit to a science centre or museum and entertainment dimension is more successful than the educational side. Science centres and Museums are criticised for being playgrounds where visitors are being entertained rather than educated (Harington, 2001). The implication of this argument is that if fun is more emphasised in science centres and museum the learners may learn to pursue fun rather than learning.

## 2.3. Instructional strategies in science education

Teaching is regarded as a process of helping learners to find information, understand it, organise it and apply it, as argued by Killen (2015). Teaching is also conceptualised as the act of aiding individuals who lack knowledge, skills and understanding by those who have them (Fenstermacher, 1986). Different instructional strategies are ways that can be used to help learners achieve the process of learning. "Improved teaching will lead to improved learning" (Pfeiffer, 2011: 14). Pfeiffer (2011) argues that an education officer is the critical ingredient for quality learning to take place. The education officer creates the learning environment for the learners. Pfeiffer (2011) further argues that it is generally accepted that learners' attitude, behaviour, happiness and achievement is reinforced by the behaviour and attitude of the education officer. The responsibility of the education officer is to deepen the scientific understanding and learning experience of the learner through good and proper instructional strategies.

Killen (2015) argues that teaching can be described as either teacher-centred or learner-centred. A teacher-centred approach is mostly referred to as direct

instruction. He argues that in this kind of teaching the teacher has direct control over what is taught and how the information must be presented to the learners, whereas a learner-centred approach refers to discovery learning or inquiry learning. In this type of teaching approach emphasis is on the role of the learner in the learning process.

If a teacher wants quality learning to occur, education officers together with teachers must deliberately teach in ways that will enable and encourage learners to engage in intellectual activities that can promote quality learning (Killen, 2015). One of the most important functions of the education officer, according to Killen (2015), is to help learners to filter knowledge and understanding from the large amount of information they come across when studying any subject. He further argues that helping learners to convert information which is in a form of text, pictures and sound into knowledge and understanding requires careful consideration of the nature of what is to be learned on the premise that education officers should use pedagogical practices that are deliberately designed to help learners acquire the correct knowledge and skills required.

Pedagogies derived from constructivist theory view an educators' role character as that of facilitating learners' investigations and explorations. Learners should not be seen as empty vessels waiting to be filled with knowledge. "Teachers are guilty of transmission if they do more than stimulating students' reflection and problem solving" (Cobb, 1994: 4). Constructivists' perspective views teaching and learning as a process of knowledge construction. "Teaching should be organised as a cognitive apprenticeship, where knowledge and skill learning are integrated in the learners' social and functional context" (Erduran and Aleixandre, 2007: 20). According to Torff (2003), education officers who are constructivist in their style view learning as centred in the development knowledge and skills of the learner, while those who are transmitters are focused on the delivery of the curriculum and on the efficiency of information flow to the learner.

One of the current standards in instructional strategies is the view that inquiry should be the central strategy of the science instruction. The use of hands-on and inquiry

based approaches develops critical thinking and problem solving skills and makes teaching and learning meaningful (Susan *et al*, 2010). This ideology is based on the presumption that inquiry is the way to help learners develop a sophisticated understanding of the nature of science and their scientific epistemologies (Sandaval, 2005). It is very important to understand these two concepts, namely inquiry and epistemology. In its simplest form, Sandaval (2005) defines inquiry as a process of asking questions to generate knowledge and epistemology as the branch of philosophy concerned with the study of knowledge. The most important epistemological notion that needs to be understood by both the educator and the learners is that scientific knowledge is constructed by people and creativity plays an important role in the development of scientific knowledge. Science knowledge is socially contracted and thus requires cooperation, collaboration and competition (McComas, 1998).

According to Ash and Wells (2006) dialogic inquiry should be the fundamental practice for science education in both formal and non-formal practice contexts. They argue that in both contexts, social interactions can promote collaborative knowledge building. They further argue that the way in which the educators respond to learners' contributions directs the development of any discussion. Therefore, it is important for education officers to strategically balance their authoritative talk with dialogue to keep learners actively engaged in building knowledge. Through dialogue effective education officers are able to calibrate their instructions according to their learners' responses in a sequence of teacher-learner interactions and thereby meet a range of learners' needs in their teaching environment (McGhie-Richmond *at el,* 2007). Thus according to 'constructivist Pedagogy' (Brophy, 2004), effective education officers are presumed not to transmit knowledge, but to co-construct it with their learners through dialogical interaction. Education officers who assist their learners to construct knowledge are more effective than those who transmit it. (Brophy, 2004). Structure inquiry encourages learners to ask questions, to investigate, to discover and to create answers for themselves, rather than waiting for someone else to provide answers (Killen, 2015).

According to Zhai and Dillon (2014), questioning in science education is one of the most used techniques in teaching science. It has a variety of purposes which includes keeping learners active and attentive, stimulating curiosity and encourage them in seeking understanding. Chin (2004) argues that educators in a traditional science classroom tend to ask closed questions with predetermined short answers to evaluate what learners know. He argues that closed questions empowers the educator's control in the classroom discourse and consequently fails to get learners to take more responsibility for their thinking whereas open-ended questions are more likely to open up classroom discourse by inviting learners into the conversation. Education officers who ask open-ended questions and acknowledge learners' contributions are more likely to make their meaning clear. Open ended questions can elicit what learners think, encourage learners to elaborate on their thinking and help them learn to construct conceptual knowledge (Zhai and Dillon, 2014).

In the teaching of science, teaching materials and instructional strategies should be tailored to the abilities and aptitudes of the learners (Hofstein and Rosenfield, 1996). They argue that learning institutions should create learning environments which allow learners to interact physically and intellectually with instructional materials through hands-on experimentation and reflection. Education officers at science centres and museums should make efforts to provide materials and instructions that give reality to scientific concepts (Ramey-Gassert, 1997). It is the responsibility of the education officers to use a variety of instructional strategies and learning materials to increase the impact and effectiveness of their teaching (Hofstein and Rosenfield, 1996). For example, in their studies Hofstein and Rosenfield (1996) found that the use of independent projects as one of the instructional strategies can motivate learners to learn science. They argue that independent projects are one of the instructional strategies that can be used to motivate learners to learn science independently.

Science education reform documents call for science to be taught in a manner that learners learn best, by conducting hands-on experiments and engaging in

investigations by using simple everyday materials (Ramey-Gassert, 1997). She argues that this kind of teaching keeps the learners' natural curiosity and sense of wonder alive and it allows learners to wonder as well as to generate and ponder self-perpetuating questions. One of the principles covering good teachings suggested by Adams and Gupta (2017) is to establish the relevance of what is taught through using real life examples and relating materials to everyday application, drawing cases from current news issues, giving local examples and relating science theories to practice. Thus, it is possible to establish relevance when learners are able to see how science subjects are related (Adams and Gupta, 2017).

Context-based approach is one of the adopted instructional strategies in science education, whereby the context and application of science are used as a starting point for the development of scientific ideas. Context-based approach is easily defined as the use of everyday context to teach scientific principles (Bennett *at el*, 2006). They argue that context-based approach advocates for scientific literacy which is about knowledge, understanding and skills that young people need in order to think and act appropriately on scientific matters that affect their lives and the lives of others. The hope is that context used to develop scientific ideas will motivate learners, make them more positive about science and help them to see the importance of what they are learning (Bennett *at el*, 2006).

## 2.4. Knowledge required by education officers to teach science at science centre and museums

Planning and teaching science is a highly complex cognitive activity in which education officers must apply knowledge from multiple domains (Shulman, 1986). "Educators with differentiated and integrated knowledge will have greater ability than those whose knowledge is limited and fragmented" (Magnusson *at el*, 1999: 95). Effective science education officers know how to best design and guide learning experiences under particular conditions and constraints to help diverse groups of learners develop scientific knowledge and an understanding of scientific concepts (Magnusson *at el,* 1999).

Teaching science in science centres and museum settings is complex and involves a specialised skills and knowledge base. Education officers and trained volunteers in these environments undertake a diverse range of tasks and they have varied responsibilities such as developing, coordinating and implementing programmes for school groups, families, teachers and the general public (Tran and King, 2007). Education officers and trained volunteers engage with a wide range of ages and expertise (Bailey, 2006). Crooke (2006) argues that education officers and volunteers also create and nurture relationships with various community groups in order to attract visitors.

According to Tran (2006), Education officers at science centres and museums are also conscious of, and attentive to, the learner's prior knowledge, abilities and interests, and thus are able to adapt their generic pre-planned lessons to individual school groups at their centres. The primary goal of their lessons is to promote interest in science education so that learners, parents and teachers are encouraged to pursue science by experiencing learning in a casual and non-judgemental setting and also to encourage these visitors to come back to the centres. Education officers can ensure greater consistency in the quality of their pedagogical actions, confidence and decision making (Tran and King, 2007).

Tran and King (2007) identify six components of knowledge which distinguishes science centre and museum educators from school teachers. These are context, choice and motivation, objects, content, theories of learning and talk. The concept of diversity is considered to inspire each of these components.

*Context:* The design of the building in conjunction with the arrangement of the exhibits and the area where lessons are conducted inside or outside the building is often inspiring and memorable (Tran and King, 2007). The nature of the interactions between the learners and the education officers in that setting defines the social context. These centres are also shared spaces reflecting the community of the surrounding environment in which they are located (Brown, 1992). According to Crooke (2006), the community context refers to the local, regional, national and international level at which the science centre operates, which includes its agenda

and financial resources as well as how the public visits the centre. When interacting with visitors, education officers should acknowledge that there are many ways in which the context of the centre may have an impact on the individuals (Brown, 1992).

*Choice and motivation:* Science centres and museums are free choice learning environments (Tran and King, 2007). Learners have a freedom to choose what to learn and when to learn. In this way a learner's intrinsic motivation is fostered (Brown, 1992). Tran and King (2007) argue that although education officers may design the lesson, the layout of the space, decision on how exhibits are displayed and the absence of any externally imposed curriculum means that visitors may use the centre in their own way and at their own pace and that they are driven by their own intrinsic motivation to learn. In this regard it is important that the education officers are confident in amending their interactions in order to follow and build upon the interests of the visitors.

*Objects:* "Science centres and museums are repositories for objects, which are displayed for their authenticity, immediacy, interactivity, and cultural capital" (Tran and King, 2007. 140). They suggest that objects offer a degree of information unavailable in the textbook and at schools as well as the opportunity to experience a sense of scale. They argue that the size of the object and its connection to real events and people makes it truly memorable and enhances the experience of the centre. This argument is supported by Conn's (1998) "object-based epistemology" where he argues that physical objects are regarded as the source of public knowledge because they offer scientific proof visually. Objects specifically selected for audience handling offers additional memorable experiences to the learners, experiences that cannot be found in other settings (Tran and King, 2007). They argue that the opportunity to engage with these unique and authentic objects distinguishes these centres from other social environments and it is one of the main reasons why learners visit science centres and museums. Education officers can use the knowledge they have of these objects to best suit their understanding of the

visitors' needs. The understanding of the nature of these objects is linked with content knowledge.

*Content:* There is a strong body of knowledge from research to suggest that education officers with deeper knowledge of the subject matter use higher levels of operations and insights in their teaching compared to their counterparts with limited knowledge of the subject (Tran and king, 2007: Eshack, 2007: and Even, 1993). Tran and King (2007) argue that when education officers know the domain of the content and know how they know such information and why they believe it to be true as well as understand its significance to the discipline of science and to the broader society, which enables education officers to be flexible to the visiting learners' interests and choices and thus enhance visitors experience.

Hein (1998) argues that an extensive knowledge in content is neither required nor possible and that the role of education officers in these centres is to facilitate learners' own interpretation of the objects, whereas Tran and King (2007) argue that content knowledge enables the education officers to indicate salient features, history, and the significance of the exhibits which may otherwise have gone unnoticed.

*Theories of learning:* Visitors at science centres and museums are of different ages, social groupings, economic status, cultural identities and experiences (Tran and King, 2007). They argue that education officers need to embed their practice in theoretical models of learning to provide maximum support for such a wide range of visitors.

According to Hirsch and Silverman (2000) there are two theoretical perspectives that dominate teaching and learning in science centres and museums, namely constructivism and socio-cultural theory. The constructivist perspective offers education officers an understanding that learning is an active process of engaging and manipulating objects and experiences in order to construct a mental picture of the world (Piaget, 1983) as cited by Tran and King (2007). As suggested by Hein (1998), visitors at science centres and museums learn by constructing their own

understanding according to constructivist theory. From the socio-cultural perspective learning occurs through discourse within social interactions (Vygotsky, 1978) as cited by Tran and King (2007). At science centres and museums education officers help learners to shape their thinking through social activities using materials and symbols invented by its culture (Tran and King, 2007).

*Talk:* "Unlike in schools, where the written word is emphasised, the social learning context of museums favours the spoken word" (Tran and King, 2007. 142). They argue that education officers at science centres and museums relay mostly on talk-based interactions to connect the learners with the objects, content and context. The kind of talk may comprise of verbal and non-verbal interactions during casual conversations that happen between education officers and an individual or small group of learners regarding an exhibit. Tran (2002) argues that talk also refers to the occasions when an education officer communicates with a large number of learners during an organised programme such as a demonstration, class or lecture. For science centres and museum educators, their knowledge of talk may involve knowing how to speak about exhibits to learners of different ages, abilities and interests at the same time and only for a short time (Tran, 2007).

## 2.5. Conceptual Framework

The conceptual framework of this study is built from the work of Lee Shulman (1986), where he proposes the three categories of knowledge in teaching. Namely: Content Knowledge, curricular knowledge and pedagogical knowledge. This conceptual framework is underpinned by social constructivist theory which views teaching and learning as a process of knowledge construction (Cobb, 1994). According to Erduran and Jimenez-Aleixandre (2007), teaching within the social constructivism theory should be organised in such a way that knowledge and skills learning are integrated into the learners' social and functional context. The conceptual framework is built to assist in the exploration of the teaching practices of education officers at science centres and museums. In order to understand content knowledge, knowledge of materials and instructional strategies of education officers at a science

centre these categories of knowledge, proposed by Shulman (1986), are explored in detail. Content knowledge in this context refers to the subject matter knowledge, pedagogic knowledge refers to teaching methods and curricular knowledge refers to the knowledge of resources plus exhibits used in the science centre. The instructional strategies also play an important role in understanding the teaching practices of education officers in teaching at the science centre. Instructional strategies in this context refer to ways or techniques used by education officers to assist learners in learning science.

### 2.5.1. Content Knowledge

According to Shulman (1986), content knowledge represents teacher's understanding of the subject matter taught. "It is the amount and organisation of knowledge per se in the mind of the teacher" (Shulman, 1986.9). This argument is supported by Tran and King (2007), where they state that content knowledge refers to an understanding of the structure of the subject matter and its epistemology. Epistemology is a branch of philosophy concerned with the study of knowledge (Sandaval, 2005) According to Shulman (1986) the education officer needs to not only understand that something is so, the education officer must further understand why it is so, thus the emphasis is on a deeper understanding of the subject matter taught. Shulman (1986) argues that education officers must not only be able to define the accepted truth to the learners, they must also be able to explain why it is worth knowing and how it is related to other subjects. Education officers' content knowledge affects their instructional practice and the achievement of their learners (Shulman, 1986). According to Mudau (2013), the education officer uses his or her knowledge to decide on the instructional strategy when presenting a lesson. In this study content knowledge means the education officers' understanding of the content subject matter of the science centre. This includes the content knowledge of different lessons presented to the school groups. According to Tran and King (2007), in a science centre context knowing the domain of the content, the information and why we believe it to be true as well as understanding its significant to the science

discipline enables education officers to be flexible to the visiting learners and thus enhance visiting learners' science centre experience.

### 2.5.2. Curricular Knowledge (Resource knowledge)

Shulman (1986) describes curricular knowledge as knowledge of the programme and corresponding materials available to teach a particular section of content. This is the knowledge that an education officer uses to draw forth tools of teaching that help to present a particular section of content (Shulman, 1986). These include printed and published resources and exhibits used by education officers and learners during the lesson (Remillards, 2005). Curricular knowledge is represented by the programmes that are designed for the teaching of a particular subject (Shulman, 1986). It is the knowledge of the materials and resources that are used to support teaching. These resources and materials can be used by both the Education officer and the learners during teaching and learning interaction (Tran and King, 2007). In this study the focus will be on the resources which are the main part of curricular knowledge at the science centre. These resources comprise of the exhibits, lesson plans, collections of specimens and other bio-facts materials used to illustrate scientific principles (Tran and King, 2007). Lesson plans are important resources because they stipulate the aims and objectives, together with a complete outline of how the lesson should unfold and how other resources such as exhibits and bio-facts should be used to enhance teaching and learning.

### 2.5.3. Pedagogical Knowledge

Pedagogical knowledge is "the method of presenting and formulating the subject that make it comprehensible to others" (Shulman, 1986. 9). He argues that this will include an understanding of what makes the learning of a specific topic easy or difficult to teach or understand. In this study pedagogic knowledge refers to the teaching methods used by education officers when presenting their lesson. According to Killen (2005) the teaching method used by education officers is either

teacher-centred or learner-centred. Torff (2003) argues that education officers who are constructivist in their style view learning as centred in the development knowledge and skills of the learner, while those who are transmitters are focused on the delivery of the curriculum and on the efficiency of information flow to the learner.

### 2.5.4. Instructional strategies

Instructional strategies are ways or techniques used by education officers to help learners to contract knowledge and acquire the relevant skills (Fenstermacher, 1986). Inquiry and hands-on techniques are fundamental strategies used in science education to help learners learn best (Rennie and McCaffetery 2007). According to Hofstein and Rosenfield (1996), in the teaching of science instructional strategies should be tailored to the abilities and aptitudes of the learners.

In this study the categories of knowledge that underline the teaching practices of education officers at science centres and museums can be summarised as follows: Science centre content knowledge, science centre materials knowledge and science centre Pedagogical knowledge. These categories of knowledge should represent the fundamental framework on which teaching in science centres and museums should be based. Instructional strategies function together with this knowledge in the teaching practices of education officers at a science centre environment.

The education officers' knowledge in a science centre environment can be summarised on figure 1.2. below:

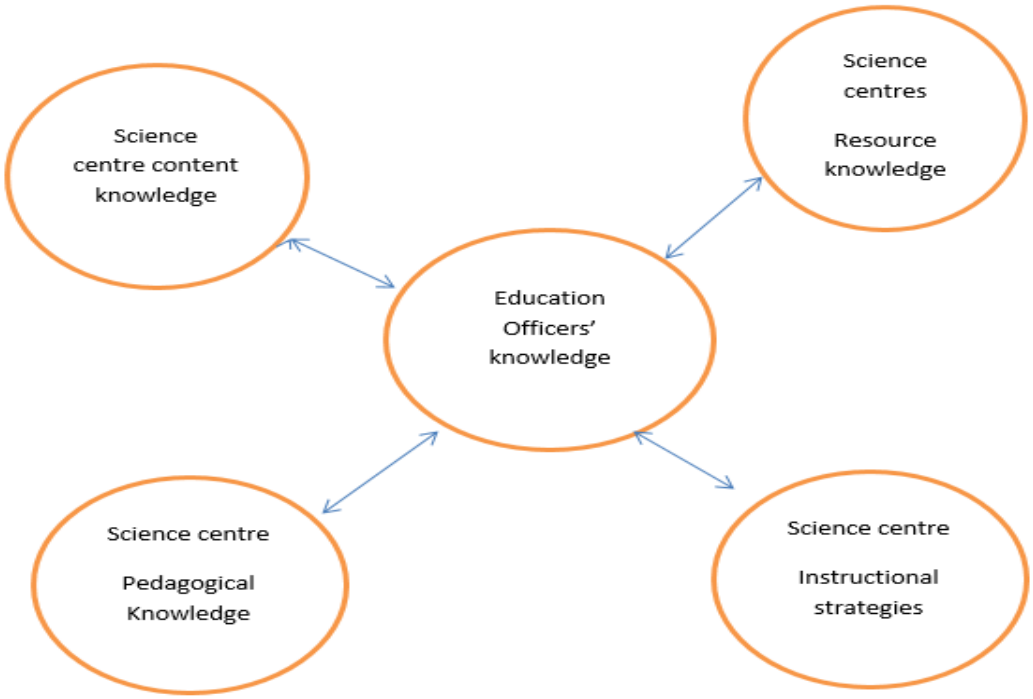


**Figure 2.2. Education officers' knowledge.**

# CHAPTER 3
# RESEARCH METHODOLOGY

## 3.1. Introduction

In this chapter, the researcher will discuss in detail the research methodology which includes the research design, the nature and the context of the research, techniques and tools that were used for data collection and the pilot study tools. The ethical implications of the study together with rigour have been discussed. This study was informed by Hatch's definition of a participant observation case study of qualitative research, which places the researcher in a social setting (Hatch, 2002). The study examines the nature of education officers' teaching practice at science centres and museums. The investigation focuses on the knowledge and instructional strategies used by education officers to teach science at science centres.

## 3.2. Qualitative case study approach

It is imperative to indicate that this study is qualitative in nature. The most basic definition of qualitative research according to Braun and Clarke (2013) is that it uses words as data; it seeks to understand and interpret more local meaning by using data gathered in a context to produce general understanding. Braun and Clarke (2013, 21) also argue that "qualitative research is exploratory, open-ended and produce in-depth, rich and detailed data from which to make claims". Doing qualitative research means that you understand that it is a craft which is marked by the challenges of doing original research where the researcher can also bring his or her own belief system as a motivating force for defining and conducting research (Yin, 2016).

The researcher chose this methodology because it connected well with the purpose and the research question of this study. This is about the knowledge and instructional strategies used by education officers at science centres in teaching science. As alluded by Richards and Morse (2013: 24). "The researcher actively creates the link between the purpose and the method to be used". The best way of understanding how learners are taught science at a science centre is to implement

this methodology which has helped the researcher to interview, observe and interact with the education officers.

### 3.3. The nature of the research

Exploring the teaching practices of education officers at the science centre is experimental by its very nature. Brauna and Clark (2013) argue that experimental qualitative research is driven by the desire to know peoples' own perspectives and meaning in order to prioritise them in reporting the findings. In this case, the education officers at the centre were the main focus of the researcher, their practices and experiences were crucial in order to explore the knowledge and instructional strategies at the science centre.

This study has explored the knowledge and instructional strategies used to teach science at the science centre in Pretoria, it is therefore a descriptive case study. According to Liamputtong (2013) a case study research has particular boundaries, it is bound by time and place, and these boundaries are explicit through the description of the location, culture or institution. The study has attempted to describe the instructional strategies and knowledge employed by education officers at a science centre located in Pretoria. Liamputtong (2013) argues that case study research is employed to obtain knowledge of contextual phenomena about an organisation or institution. It is generally accepted as an intensive, detailed and in-depth study or an investigation of a single unit. In this case the study focuses on the teaching practices of education officers at the science centre in Pretoria; it looked in detail on how the centre communicates science to the school groups on a daily basis. According to Braun and Clarke (2013) case study is valuable for the discovery of new processes and behaviours and is useful for responding to how and why questions about a particular set of events. Other researchers such as Richards and Morse (2013) and Yin (2016) argue that case study has the inability to generalise further than the case.

Exploring the teaching practices of education officers at a science centre involves conversing with people in their everyday activities in order to collect reliable data,

as alluded to by Yin (2016). The development of a “double-consciousness”, as argued by Braun and Clarke (2013: 9), where the researcher has to listen intently and critically reflect on what is said by the education officers at the science centre in order to produce much richer and complex data, is vital.

## 3.4. Research context

The science centre in Pretoria was identified for this study based on its accessibility to the researcher, a larger number of learners that visit the centre and the education services it provides. Within the country (South Africa) there are science centres in all nine provinces, where some of the provinces have more than one science centre. Gauteng Province, where this science centre is situated, has more than one science centre. All of these science centres are supported financially by the Department of Science and Technology (DST) through the South African Agency for Science and Technology Advancement (SAASTA), which is a business unit of the National Research Foundation (NRF).

Exploring the teaching practices of education officers is vital because one of the core functions of the science centre in Pretoria is “Science education support”, which is informed by the strategic framework of the DST. One of the pillars of this strategic framework is “popularising science, technology and innovation as attractive, relevant and accessible in order to enhance scientific literacy and arouse interest in science careers” (DST, 2014:49). The aim of this study was to identify the nature of the education officers’ content, pedagogic and resource knowledge and their instructional strategies in teaching science at a science centre.

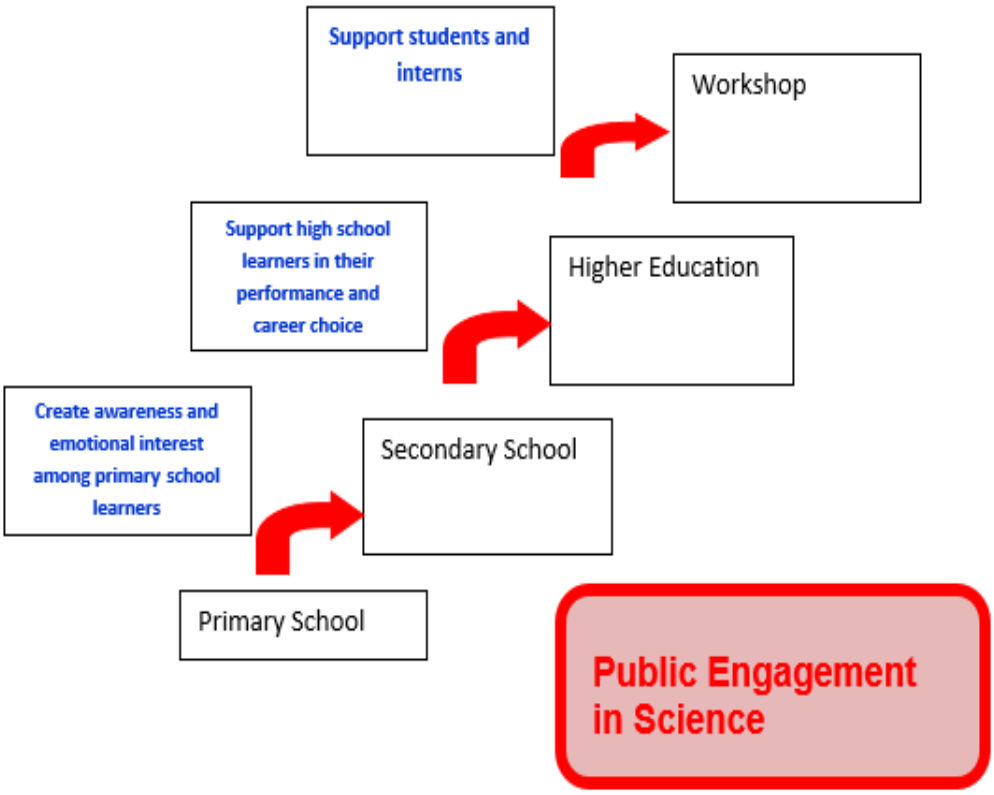


Figure 3.1. Science education support at the science centre

The key concept in the science centre's strategic plan is the science centre Academy, a framework integrating and coordinating the organisation's human capital development initiatives. Its delivery is based on six programmes, three of which relate to the science centre's responsibility regarding science engagement where education support is one of them.

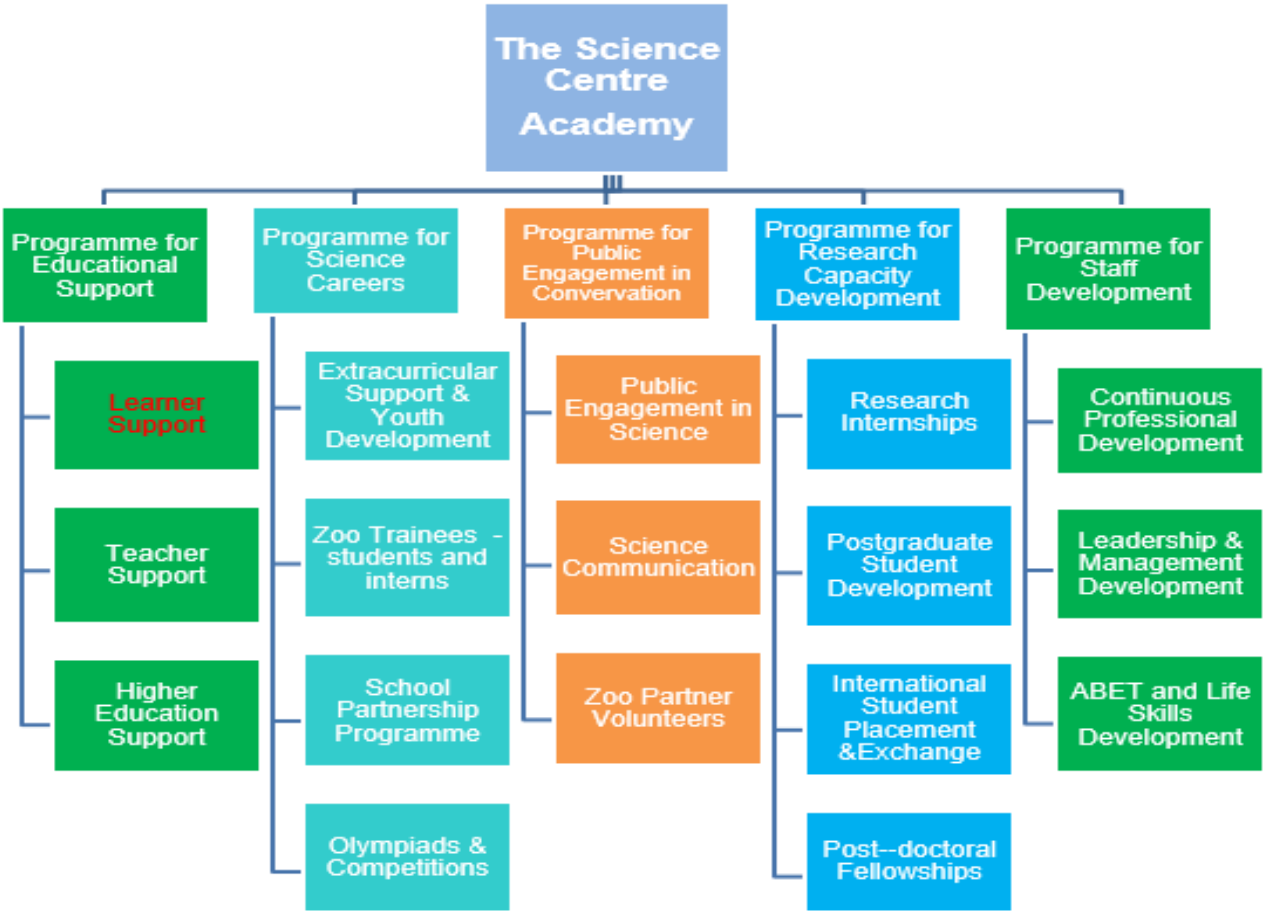


Figure 3.2. Science centre Academy

The science centre offers education lessons to school groups. Schools are encouraged to book for a lesson prior to their visit to the centre. Lists of lessons with short descriptions are advertised to the schools through the centre's website and newsletters. Upon arrival to the centre schools are directed or taken to different stations where lessons are presented. Education officers present these lessons to school groups on a daily bases.

The lessons are presented to school groups visiting the centre from Mondays to Fridays. Schools are encouraged to book for these lessons, but many schools arrive unannounced. Lessons for learners in the Foundation and Intermediate Phases are conducted at different stations scattered throughout the centre. Teachers are thus encouraged to guide learners through the centre, making use of the educational lessons at the stations. These lessons are relatively short and interactive.

| | Phase | Theme | Length |
|---|---|---|---|
| 1 | Foundation | Don't Litter | 15 – 20 min |
| 2 | Foundation | National Symbols | 15 – 20 min |
| 3 | Foundation | The Majestic Elephant | 15 – 20 min |
| 4 | Intermediate | Discovering Reptiles | 20 min |
| 5 | Intermediate & Senior | The Microscopic World | 20 min |
| 6 | Senior | Micro-Zooming | 30 min |
| 7 | Senior/FET | Vultures | 30 min |
| 7 | FET | Understanding Biodiversity | 60 min |
| 8 | FET | The Application of Genetics | 60 min |

Table 3.1. List of lessons presented daily to the schools.

All the lessons are designed by permanent qualified education officers at the centre. Some of the lessons have been there for many years but they are all revised every year and new lessons are also developed. The lessons are aligned to the National Curriculum statement (NCS) with the help of education officials and teachers from the Department of Basic Education (DoBE). For each lesson there is a lesson plan which describes the content to be taught and the activities to be used during the lesson. The lesson plan is used as a guide by education officers and also as a means to ensure consistency of the content taught to all the school groups.

Educational lessons for learners take cognisance of Bloom's three domains of learning, namely the cognitive, psychomotor and affective. Lessons for younger learners, i.e. the Foundation Phase, lay emphasis on the affective in order to create awareness and emotional interest in animals and the environment, where the cognitive. To a larger extent, but also the psychomotor domains play important roles in lessons for older learners where skills and future careers are important. The purpose of these interactions is not to replace classroom learning, but rather to add to this by broadening the learners' exposure and widening its value.

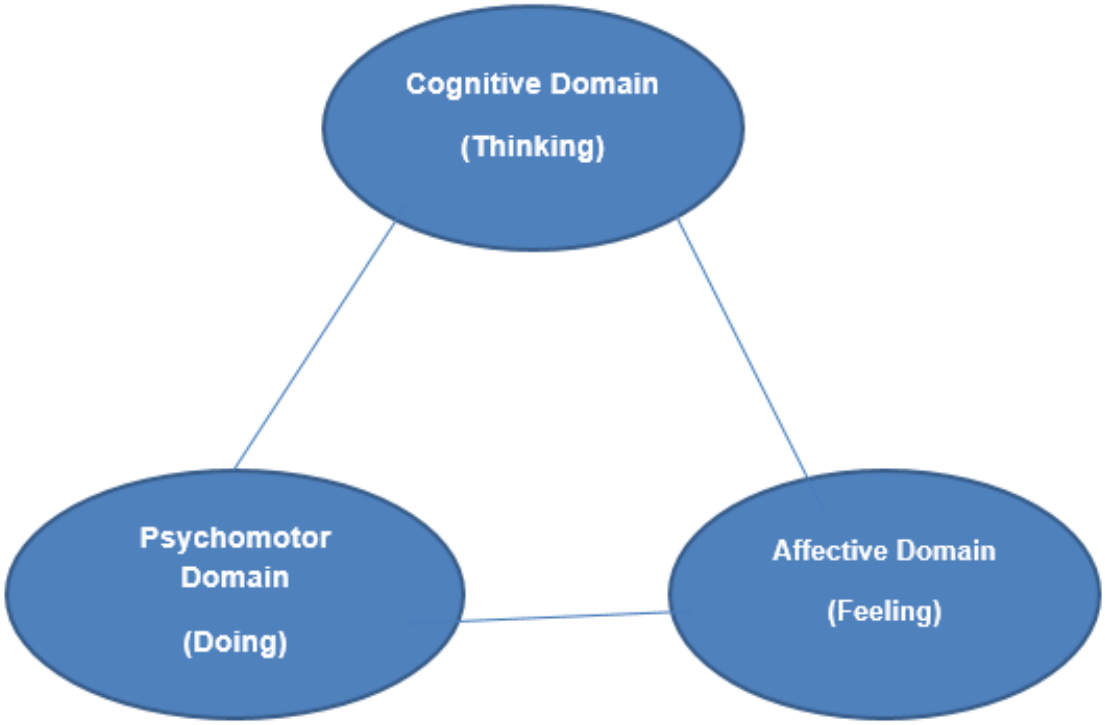


**Figure 3.3. Bloom's Domains of learning**

## 3.5. Sampling

According to Richards and Morse (2013), sampling is key to good qualitative inquiry; it helps to understand the dilemmas of qualitative validity. Three education officers from a list of seven were selected for this investigation. A purposeful sampling method was used to select the three participants. Purposeful sampling involves the selection of participants because of their characteristics, which are those who are willing to reflect on the phenomena of interest and they are willing to participate (Richards and Morse, 2013).

The science centre has three permanent education officers plus interns who present the lessons to the school groups. Interns are recruited annually by the science centre to teach school groups. All interns at the science centre have a formal

qualification, either in the form of a National Diploma, a Degree or post-graduate qualification in Natural Sciences. Interns are trained by the permanent education officers to present the lessons. In this study both permanent staff and interns are regarded as education officers because they are all involved in presenting lessons to the school groups.

Three participants/education officers from the group were sampled based on the following criteria: They have a relevant Natural Science qualification, they have experience or interest in science education, they have successfully completed the training provided by the science centre and they have interest in participating in this study.

## 3.6. Data collection techniques

The research question determines the nature of the research context and the researcher must select and indicate the type of participants as well as the form of data obtained (Richards and Morse, 2013). For this research the following techniques have been used to collect data, namely; interviews, observations and document analysis. This is called triangulation method, where multiple data sources are used to produce a greater depth and breadth of understanding. This method corroborates findings and builds a more holistic picture of the phenomenon (Billups, 2014).

Richards and Morse (2013) warn against the word “collect” as if the data is there ready to be picked like oranges. They argue that in qualitative research, data is “made”. Making data is a collaborative and on-going process in which data is interactively negotiated by the researcher and participants. Making data is a complex process in which raw data has to be refined to increase validity.

### 3.6.1 Interviews

There are different types of interviews. According to Opie (2004), interviews can either be structured, unstructured or semi-structured. The structured interviews have a predetermined agenda which is controlled by the interviewer and have no

flexibility; the unstructured interviews have an unpredictable direction and are very flexible in nature, they are open-ended whereas semi-structured interviews are less controlled, they are more flexible and they are not completely determined by the interviewer.

Semi-structured interviews were used for this study and given to the three sampled education officers to generate data on how they present lessons to the learners. The interviews had to be audio recorded and transcribed in preparation for analysis. Semi-structured interview is an appropriate approach when the researcher knows enough about the study topic in order to frame the needed discussions in advance (Richards and Morse, 2013).

There are two types of one-on-one semi-structured interviews utilised for this study. Each education officer was interviewed before the lesson observation and after the observation. The semi-structured interviews conducted prior to observation were used to ascertain the preparedness of the education officers to present the lesson. The post observation semi-structured interviews were conducted immediately after the lesson observation. These post observation interviews were used to assist education officers to reflect on their lesson presentation. The interviews lasted for 20 minutes depending on the education officer's willingness to explain more on the question asked. The questions used by the researcher were open-ended to allow education officers to talk more about their instructional strategies and experiences in teaching learners at the science centre

According to Brophy (2004), it is usually best to start with questions that an interviewee can answer easily and proceed to more difficult or sensitive topics if the researcher wants to get the best results from the interview. He also argues that it is vital for the interviewer to understand the respondents' meaning than to relay on assumptions.

### 3.6.2. Observations

According to Richards and Morse (2013), observing in qualitative research is the most natural of all the ways of making data because it enables the researcher to

learn more and discover what is going on by watching and listening. Good and Brophy (2004) argue that research using observational techniques yields important information that has practical implications on understanding and improving the teaching practices.

The researcher observed and recorded the lessons. Audio recording helped the researcher to retain as much data as possible and allowed the researcher to revisit and review the audio recorded (Richards and Morse, 2013). The distinctive feature of observation is that it offers the researcher an opportunity to gather live data from naturally occurring social situations, where the researcher was able to enter and understand the situation which was being described (Creswell, 2009).

The researcher has observed at least two lessons per participant from the list of lessons provided on figure 3.1. The lessons to be observed were selected on the basis of the response by the education officers on the questionnaire. Lessons that are popular and education officers feel free and confident to present were used for the study. These observations helped to understand how education officers teach science at the science centre and also answer the critical question of which instructional strategies are used to teach science at the science centre.

## 3.7. Pilot study

All of the data collection tools were given to the supervisor for verification and input to ensure validity. The word validity means “well founded and applicable, sound and to the point; against which no objection can fairly be brought” (Richard and Morse, 2013: 95). Validity is important to ensure that the outcomes of the study were appropriate and fully justifiable and properly based on the data (Richards and Morse, 2013).

The study was piloted first with one education officer as a participant. All three of the data collection tools were administered in the pilot study. After the input from the supervisor on the data collection tools, the researcher piloted the study where data had been collected from a participant who had presented lessons to the learners.

The data has been analysed and discussed with the supervisor before the main study took place.

## 3.8. Data analysis

After the data was collected the researcher organised the data in a more meaningful way. Through the analysis process the researcher turned the large volume of data into clear, understandable and trustworthy information (Liamputtong, 2013). Through reading and re-reading, the researcher was able to make sense of the data he has generated.

The researcher organised the data by using coding and identifying themes from the coding and by searching for theme connections, then prepared it for analysis (Creswell, 2009). The researcher has read through all of the data in order to gain a general sense of the information on how teaching is conducted at the centre and reflect on the overall meaning of the data.

Data analysis conducted based on the ethnography approach. According to Richards and Morse (2013) in ethnography the segments of data may be considered as pieces of a puzzle that fit together to give a complete, holistic and rich description of the cultural perspective on the research problem. In this case, it is the nature of the content, pedagogic and resource knowledge and instructional strategies used by education officers at the science centre.

## 3.9. Ethics

Ethical considerations are important in all research endeavours that involve human subjects. These take a heightened significance in qualitative research designs where a researcher works very closely with participants (Roller and Lavrakas, 2015). In this study the researcher worked very closely with participants to explore the teaching practices of education officers at the science centre. The rights of participants were respected at all times. Participants have been fully informed about the purpose of the study and their rights to confidentiality and anonymity.

The ethics guideline of the University of South Africa and that of the science centre was used to guide this research. Permission was requested from the relevant authorities, such as the permission from the science centre, permission from the university and permission from the participants for this research. All letters for permission were discussed and finalised with the assistance of the supervisor.

### 3.10. Ensuring rigour.

Rigour is more concerned with the trustworthiness of the research process and its findings. In qualitative research, the researchers consider that dependability, credibility, transferability and confirmability as trustworthiness criteria to ensure the rigour of qualitative findings (Anney, 2014).

To ensure credibility triangulation method was used to collect data from the participants. Data was obtained through semi-structured interviews, observations of lesson presentations and document analysis of lesson plans developed by the science centre to help understand the teaching practices of the education officers. In ensuring honesty, each participant was given an opportunity to refuse to participate in the project so as to ensure that the data collection sessions involved only those who were genuinely willing to take part and were prepared to offer data freely. Participants were encouraged to be honest without fear of losing credibility from the science centre management and they were told of their rights to withdraw at any time should they feel like they are no longer interested. The researcher was open to scrutiny by colleagues and other peer researchers, this was done by discussing the questions and observation schedules with peer researchers.

Data was collected objectively using audio-tapes and pictures captured with a camera to support the authenticity of data. Audio-tape was used to record the interviews of the researcher and the participants. It was also used to record the lesson presentations. The researcher allowed the participants to listen to their recorded interviews for any corrections or clarifications. Lesson observations were

done several times to allow participants to be comfortable to present at the presence of the research.

For transferability the results of a qualitative study must be understood in the context of the characteristics of that particular organisation (Shenton, 2004). This study is in the context of a science centre environment where different groups of learners visit to learn more about Natural Science. Education officers have the responsibility of presenting lessons to these groups using the science centre's exhibits to enhance learning.

## 3.11. Summary

In this chapter the researcher has discussed in detail the research methodology used in the study. Case study qualitative approach was selected because it links well with the purpose of the study and it has helped the researcher to answer the research questions. The nature of the research and the research context are outlined in detail in this chapter in order to give a better understanding of the study. Data techniques used were explored in detail together with the data analysis strategies. Finally the researcher explained the ethical clearance procedures and their importance in conducting this study and rigour was also discussed.

# CHAPTER 4
# DATA PRESENTATIONS, DISCUSSIONS AND FINDINGS

## 4.1. Introduction

In this chapter the researcher presents, discusses and reports on the findings from the three cases of education officer A, B and C in order to have a better understanding of their teaching practices at the science centre. Each case is presented separately in order to get an individual in-depth view of their content knowledge, pedagogical knowledge and their knowledge of the science centre resources in teaching science. This data is used to answer the research question, namely; what is the nature of education officers' teaching practices at the science centre?

## 4.2. Case 1: Education officer A.

### 4.2.1. Data presentation

#### A. Biography of Education officer A

Education officer A is a qualified conservator with a national diploma in nature conservation from Tshwane University of Technology. She majored in ecology, plants and animals studies, her other elective modules are environmental education and science communication. She has also completed one month training on lesson presentations and communication skills at the science centre. The one month training covers topic such as the role of the science centre in science education, different teaching methodologies, communication skills and science centre teaching and learning resources.

#### B. Content knowledge of education officer A

The researcher asked education officer A what lesson she likes to teach at the science centre and why? Education officer A responded by saying:

> "R*eptile, because learners don't know them, they just know that there are creepy and crawlies. They*

*don't know. So we giving them the fun part of it yet add the knowledge. I feel like this way they will break, you know, that stereotypic whatever. They will just forget about what they know and now they will apply science to it. Ok so these animals are like this. They will get a better understanding of reptiles"*

When introducing her lesson, education officer A said the following to the learners:

*"I am going to teach you about reptiles. Ok, who can tell me what is a reptile? What kind of an animal is it? How does it look like? Explain to me what kind of an animal is a reptile. You can say anything".*

Few learners responded to some of her questions even though they were all asked at once. The education officer went on to say that most of the reptiles have dry scales and are cold-blooded. She emphasised her point by saying "their skins are very dry". She demonstrated by scratching the mounted reptile placed on her table. She said "If I scratch my skin you won't hear that sound. So they are cold blooded and they also have dry scales".

When asked what is the meaning of cold-blooded by the researcher, during post interview, she said "these are animals, mainly reptiles, that bask in the sun when is cold to get the heat from the sun"

She went further to give more information on reptiles to the learners by saying the following statements:

"*So we have three types of reptiles, we have the first one which is Crocodiles and Alligators. Crocodile's mouth is shaped like a V shape. Can you see how it is shaped? (Illustrating with the mounted crocodile on the table) However, that of an Alligator is shaped*

*like a U shape. You will see by the mouth that this one is not a crocodile it is an alligator".*

When explaining the second category of reptiles she said. "There is a second group called Testudines." She used a shell of a tortoise to demonstrate how tortoises look like. She also explained that tortoises use a shell for protection against predators.

She explained the third group by saying "The last group we call it Squamata where there are lizards and snake". She used the mounted Chameleon as an example in this grouping. She mentioned that a chameleon is known for changing its colour. She said that a chameleon changes colour for protection.

*"It changes colour for protection. When it does not want other animals to see it and also when it wants food. Say there was a grasshopper and the chameleon wants to eat it, it has to change to the colour of its environment so that the grasshopper will not be able to see it".*

Education officer A continued teaching learners about reptiles and said “In the group of snakes, we have snakes with venom and those without venom. We don’t say a snake has poison we called it venom”. She also mentioned other snakes such as Anacondas, saying an Anaconda can swallow a small person not a big person like her because she has broader shoulders. She said Anacondas are able to swallow small animals such as goats and sheep.

She explained to the learners that when they see a snake at home they must not run away nor try to kill it but they must call an elder person to help with removing the snake from the house.

When giving tips on how to treat a person spited on the eyes by a venomous snake she said they must first wash the eyes with water or urine if there is no water, before taking the person to the hospital.

She also mentioned that snakes have an important role to play in the ecosystem.

Learners seemed surprised to hear that. She asked learners what will happen if there are many rats in their homes. Learners responded saying rats will eat their clothes and cause diseases. She concluded the discussion on snakes by saying:

> *“Snakes control the population of rats, they eat rats*
> *and they come to our homes looking for rats”.*

**C. Pedagogic knowledge plus instructional strategies of education officer A**

Education officer A does not have a formal qualification in teaching. When asked about her experience and qualification in education she said “Some of us we do not have the background on teaching, in terms of how to actually get the message and how can we grasp the children’s attention”.

When asked by the researcher on the points to consider before presenting a lesson education officer A said that she always looks at the grade and what the learners already know before she can present the content of her lesson. She said these help her to lay out her presentation properly.

**Education officer A**:

> "*you can't be presenting a lesson the same way for the grade threes the same that you would be presenting it to the grade sevens. So to know the kids' age, their level of understanding and mainly the teaching method to use. You could ask the teachers language they use and they will tell you ok, they use this, they use English. So I feel like that's the most important thing, then that's when you can actually lay out your presentation properly."*

Education officer A was asked about the difficulties she encountered when presenting the lesson on reptiles. She said that grabbing the learners' attention is a problem because learners are scared of reptiles. She always has to be sweet and soft to the learners to get their attention.

When asked what she does when learners ask questions showing that they don't understand what they are being taught, she said she uses comparisons or scenarios to explain the content of the lesson to the learners. She said "I feel like when teaching reptiles you have to use like scenarios that kids are able to relate with. It's not just you telling them all those scientific names about reptiles and everything but you have to relate it to them". She also mentioned that she avoids being too scientific in her presentations, she will try to simplify scientific content for the learners.

The researcher asked her about the teaching methods she uses to present her lessons. She said:

*"I prefer to actually go hands-on. I don't just give information to kids. I want them to actually be able to touch whatever that I am using but in doing so I make sure that there is order, there has to be order because kids can't be like… I make sure ok I give them what they have to know yet they become hands-on during the lesson"*

She repeated the concept of hand-on many times to emphasise that learners must touch and feel the models she is using to teach about reptiles.

Education officer A introduced her lesson by asking learners questions. Some of the learners responded to some of her questions. This is how she introduced her lesson:

**Education officer A:** I am ma'am **……..**. I am going to teach you about reptiles. Ok, who can tell me what is a reptile? What kind of an animal is it? How does it look like? Explain to me what kind of an animal is a reptile. You can say anything. (She asked the questions with authority, showing that she is in charge of everything around her)

**Learner 2**: Crocodile.

**Education officer A**: Crocodile… another one…

**Learner 3**: Lion.

**Education officer A**: Lion on the reptiles? Another one? Ok

**Learner 4**: Lizard.

After the introduction she explained the different groups of reptiles to the learners by saying, “So we have three types of reptiles, we have the first one which is Crocodiles and Alligators. Crocodile’s mouth is shaped like a V shape. Can you see how it is shaped? However that of an Alligator is shaped like a U shape. You will see by the mouth that this one is not a crocodile it is an alligator”.

She then used her question and answer method to explain the second group of reptiles. She said the following:

> *“Who can tell me where can you find a tortoise? Where does it live? Where do you see it often? You find turtle in salt water, Terrapin in water that does not have salt. What about tortoise?”*

When explaining the last group, she used question and answer method. She said:

> “*The last group that I love with all my heart is snakes. Who loves snakes in here? They are loved by the young ones. Is it the older ones who throw stones at snakes neh? You pour paraffin on them? You set them on fire? What do you do when you see a snake?”*

**Learner**: I run.

**Education officer A**: You run?

**Other Learners**: we kill it.

**Education officer A**: You see. What do you kill it with?

**Other Learners**: With rocks.

**D. Resource Knowledge of education officer A**

The researcher asked the education officer what is her view on the use of exhibits to teach science at the science centre? She responded by saying:

> "*For me it's very important more than anything, because even I at school I was given the theory part but the most interesting was, for me doing practicals. Because that's when I got to see whatever I was reading in a book or was writing about in a test. So kids coming here and actually feeling and touching the crocodile skin, it enhances their imagination and you get to be closer to the animal, understand it more than just the information that they have"*

Education officer A said that exhibits help to answer many questions that learners have because learners get to see the real objects and how it looks like, something that is difficult for an Education officer at school to explain to the learners.

When asked whether she follows a lesson plan when presenting the lesson to the learners the education officer said that it is important to have a structured lesson plan and to cover all aspects on the lesson plan but again she prefers to be flexible and answer other questions which do not form part of the content of the lesson plan.

The education officer mentioned that the exhibits help her to be hands-on in her lesson presentation.

When asked what she would like to improve on in her lesson she said: "I would like to improve the teaching material because some of the things are not as clear but I like my teaching resources"

The education officer used her exhibits to explain and show learners different types of reptiles. She used a mounted crocodile to explain how crocodiles look; she used a tortoise shell to explain the body covering of tortoises and used a mounted chameleon to explain how chameleons look. She also had a stuffed snake; some of the learners were scared to look at the snake in her hands. They even asked if the snake was alive. She assured them that the snake was real but not alive. Some learners touched the stuffed snake; some were too scared to come closer to the snake.

4.2.2.Discussions and findings

**A. Content knowledge of education officer A**

There is a strong body of knowledge from research to suggest that education officers with deeper knowledge of the subject matter use higher levels of operations and insight in their teaching compared to their counterparts with limited knowledge of the subject (Tran and king, 2007: Eshack, 2007: Rennie and McCaffetery, 2007 and Even, 1993).

Education officer A with a qualification in nature conservation was expected to know more about reptiles because they are part of the ecology modules that she specialised with. According to Friedrichsen *et al* (2009), professional development programs provide opportunities to acquire content knowledge of the subject matter.

During her lesson presentation she said that there are three groups of reptiles and gave examples for each grouping. She mentioned that the three groups of reptiles are Crocodiles and Alligators, *Testudines* and *squamata.* She used a crocodile as an example from the first group where she compared a crocodile with an alligator. In the second group she discussed the tortoise and explained how it differs from terrapins and turtles in terms of their adaptations. In the third group she mentioned squamata and discussed chameleons and snakes as examples.

Her content Knowledge of reptiles from her discussions was limited and open for questioning. In terms of groupings of reptile we have *Crocodilia* as a group, in which

we find crocodiles and alligators as examples. Not what she said to the learners that the first group is crocodiles and alligators. It is important to mention that the name of the group is called *Crocodilia.* It can also be argued that there are four groups of reptile instead of three. The last group she did not mention is *Sphenodontia* where we have tuataras which are only found in New Zealand. It would have been proper for her to have mentioned the fourth group, even if she didn't want to discuss it in detail. Her discussion on the first three groups was adequate. She managed to discuss reptiles and their adaptations in their environment in details. The confusion was on the first group of *Crocodilia* where she used examples to represent the group, which was wrong and may have confused the learners.

Furthermore, her content knowledge of "cold-blooded animals" was confusing. In her presentations she said the following:

> ***Education officer A****: …. most of the time it is said that reptiles are cold-blooded animals. What do we mean when we say an animal is cold-blooded?*
>
> ***Learner 1****: it is dangerous.*
>
> ***Education officer A****: it is dangerous. Another one says what?* ***[Pause]*** *Ok let me give you an example. When we people feel cold what do we do so that we can keep warm?*
>
> ***Learner 1****: we stand next to the fire.*
>
> ***Learner 3****: We wear jerseys.*
>
> ***Learner 4****: We use a heater.*
>
> ***Education officer A****: We keep warm by a heater; we drink coffee because we want to keep warm right? But who has seen a snake having a cup of tea or coffee? You have not seen it neh?*

***All Learners**: No (**laughs**).*

***Education officer A**: Ok. **(All laugh).** What does another one say? Haven't you seen a lizard warming itself on the sun lying on top of a rock?*

***All LEARNERS**: We have seen.*

***Education officer A**: Yes. Most of the reptiles bask on the sun meaning they keep warm by sitting on the sun.*

In this discussion she did not explain the meaning of "cold-blooded". It was clear from the discussions that learners didn't know the meaning of cold-blooded. Ideally, she should have brought in the scientific concept of "regulating body temperature". Learners were very interested and connected to her talk of using a heater and wearing a jersey when is cold. She managed to bring context in the discussion but the meaning of cold-blooded did not come out clearly. According to Tran and King (2007), education officers at science centres and museums rely mostly on talk-based interactions to connect the learners with the objects, content and context. The kind of talk may comprise of verbal and non-verbal interactions during conversations that happen between the education officer and the learners.

Education officer A missed the opportunity to explain the meaning of cold-blooded to the learners during this talk-based interaction. When asked by the researcher during the post interview she said cold-blooded animals are those animals that bask on the sun when it is cold. Her explanation of cold-blooded is not correct.

The education officer gave an important conservation message to the learners explaining that they must not kill snakes because they play an important role of controlling the population of rats in the ecosystem. Science centres and museums can provide a link between theoretical aspects of science and issues which affect our homes, communities and the world around us. They can help to develop understanding, attitudes and values, and lead to a more enlightened, committed and

actionable population in areas such as citizenship, climate change, genetic engineering and sustainable development (Braker, 2008).

Mosabala (2014) argues that in a South African context schools visit science centres and museums to learn about science which is relevant to the school curriculum in order to reinforce and expand the classroom curriculum. In this instance, the learners were learning about reptiles which is part of the Life and Living Knowledge strand of the curriculum (CAPS Natural Science and Technology Grade 4-6 DBE, 2011). According to CAPS Natural science and Technology Grade 4-6 DBE (2011), the main aim is to build a framework of knowledge for learners by helping them to make connections between the ideas and concepts in their minds. The content knowledge displayed by the education officer was relevant to teach learners about reptile and their adaptation in the environment.

According to Torff (2003), in a constructivist theory, learning is most effective when new knowledge is used by individuals to construct meaning for themselves. In this instance, knowledge of reptiles from education officer A should help learners to construct meaning for themselves. Learners should be able to see the links between what they learnt at the science centre and what they are learning at school. Her discussion on the groups of reptile and their adaptation was relevant to the curriculum as stated in CAPS Natural Science and Technology Grade 4-6 DBE (2011) under the Life and Living Knowledge strand which talks about living and non-living matter and has examples such as animals and plants under living matter and water and rocks under non-living mater.

**B. Pedagogic knowledge plus instructional strategies of education officer A**

Teaching can be described as either teacher-centred or learner-centred (Killen, 2015). Teacher-centred approach is mostly referred to as a direct teaching method where the education officer is in control of the teaching and learning process whereas learner-centred is referred to as discovery or inquiry learning, where the learner is at the centre of the whole process (Killen, 2015).

Education officer A introduced her lesson by asking learners questions. Her questions were: “who can tell me what is a reptile? What kind of an animal is it? How does it look like? Explain to me what kind of an animal is a reptile”. She asked these four questions at once and expected answers from her learners.

This was not a discussion but a questioning method where the education officer was showing her authority on the subject matter. According to Zhai and Dillon (2014) questioning and dialogic inquiry in science education is one of the most used techniques in teaching science. If used correctly, it can keep learners attentive and stimulate their curiosity. To advance the collaborative discussion, the education officer should not act as a sole source of knowledge but should support the learners to express their contributions. Education officer A’s questioning did not encourage learners to express their contributions. Her questioning required learners to recall information. Zhia and Dillon (2014) argue that the education officer must strategically balance their authoritative talk with dialogue so as to keep learners actively engaged in knowledge building.

In a teacher-centred approach, closed questions are asked with predetermined short answers to evaluate what learners know whereas in a learner-centred approach open-ended questions are more likely to open classroom discourse by inviting learners into the conversation (Chin, 2004). It is very clear that education officer A’s questioning was not inviting to the learners. She asked all these questions to evaluate what learners already know about reptiles. She asked these questions with authority and expected learners to reproduce all of the facts they know about reptiles.

She continued her lesson by bombarding learners with information on three categories of reptiles. Learners were seated passively trying to digest concepts such as *Testudine* and *Squamata*. Her teaching was more of a teacher-centred approach and she used a lecturing method to give information to the learners. This kind of teaching limits the opportunity for learners to think and generate new information (Erduran and Jimenez-Aleixandre, 2007).

When education officer A was asked about the teaching method she used to teach reptiles, she said “I prefer to actually go hands-on, I don’t just give information to kids…” Science centres and museums can provide hands-on, exploratory science learning in a non-evaluative and relaxed context (Ramey-Gassert, 1997). The use of hands-on and inquiry based learning develops critical thinking and problem solving skills and makes teaching more meaningful (Susan *et al*, 2010). Science education reform documents call for science to be taught in a manner that learners learn best, by conducting hands-on and engaging activities. This kind of teaching keeps the learners’ natural curiosity and sense of wonder alive and it allows learners to wonder as well as to generate and ponder self-perpetuating questions (Ramey-Gassert, 1997). Education Officer A had one activity at the end of the lesson where she allowed learners to be hands-on by touching and feeling her exhibits. It would have been much productive if she had different activities of touch and feel throughout the lesson.

The education officer explained how a crocodile looks like comparing it to an alligator. She showed learners a model of a crocodile after her explanation. She could have done it better by allowing learners to explore and discover the model and identify its body parts and how they are adapted to their environment instead of the education officer just explaining all of the information. While showing them the model she allowed them to touch and feel the texture. She was very protective of her model, other learners never got the opportunity to touch and feel it. From the interview she insisted on her touch and feel method which did not work well for this lesson because she was too protective of her models and bio-facts. She could have allowed learners to touch and feel other exhibits such as the tortoise shell and the chameleon.

Education officer A alluded to the point that she used scenarios and comparisons when she realises that learners do not understand what she is talking about. This became clear when she introduced the concepts of cold-blooded. She compared reptiles with what humans do when they feel cold, though her message of cold-blooded was not clearly explained. She managed to give a scenario and comparison

in her lesson. Benett *at el* (2006) call this kind of teaching a context based approach. They define context based approach as the use of everyday context to teach scientific principle. Context based approach is one of the adopted instructional strategies in science education, where context and application of science are used as a starting point for the development of scientific ideas. Education officer A started talking about wearing a jersey to keep warm which reptiles cannot do to illustrate the concept. Unfortunately the meaning of “cold-blooded” did not come out clearly. If done correctly a context based approach can be used to develop scientific ideas, make learners more positive about science and help them see the importance of what they are learning (Bennett *at el*, 2006).

Teaching is regarded as a process of helping learners to find information, to understand, organise and apply it, as argued by Killen (2015). In this lesson it was completely different. Learners were given facts and concepts about reptiles to memorise. These facts and concepts included the three groups of reptiles, cold-blooded, venom and anti-venom and many more.

The primary goal of the lessons at the science centre, such as this lesson on reptiles, is to promote interest in science education so that learners and teachers are encouraged to pursue science by experiencing learning in a casual and non-judgemental setting and also to encourage the visitors to come back to the centres.

**C. Resource Knowledge of education officer A**

Resource knowledge is the knowledge that an education officer has about the teaching materials used to enhance learning at the science centre. These include the exhibits, lesson plans, specimens, buildings and galleries at the centre (Coon, 1989). The opportunity to engage with these unique and authentic objects distinguishes science centres and museums from other social environments and it is one of the main reasons why learners visit science centres and museums (Tran and King, 2007).

Education officer A confirmed that resources are the main attraction at the science centre. She indicated that learners were so fascinated to see her models and a living

alligator. While presenting her lesson she used a model of a crocodile to explain the different mouth shapes of crocodiles and alligators. Learners enjoyed the touch and feel activity. When asked about the importance of resources in her lesson she said “Kids coming here and actually feeling and touching the crocodile skin, it enhances their imagination and you get to be closer to the animal, understand it more than just the information that they have”. This confirms Tran and king’s (2007) argument that Science centres and museums are repositories for objects, which are displayed for their authenticity and interactivity and that objects offer a degree of information unavailable in the textbook and at schools, and the opportunity to experience a sense of scale. The size of the object and its connection to real events and people makes it to be truly memorable and enhances the experience of the centre.

Education officer A has shown knowledge of her resources by always referring to the exhibits when illustrating her points. When discussing crocodiles she always referred to her model, she also used the tortoise shell to explain *Testudine* and used the chameleon to explain the *Squamata* group. This could have been done better by allowing learners to explore those exhibits rather than using one exhibit for the touch and feel activity.

Lesson plans are also important resources for science centres because they outline the objectives and how the lesson should unfold. Education officer A indicated that she does use a lesson plan but she was flexible when learners ask question outside of the framework. Education officer A did not cover all aspects as stipulated on the lesson plan and she did not do all of the activities on the lesson plan. On the lesson plan there is the fourth group of reptiles that she didn’t mention. There is an activity of sorting reptiles according to their grouping using pictures. She did not do that activity with the learners. Though the lesson was interesting, it was not fully implemented according to the lesson plan. She waited time on the introduction.

Summing up the general findings from education officer A is that she has shown adequate content knowledge of reptiles, though her content knowledge needs some polishing to be more accurate and reliable. Schools visit the science centre to cover subject matter that cannot be covered effectively in the classroom (Tran, 2006).

When the subject matter is not accurate it may create misconceptions. Learners will not see the links between what they learn at school and what they have learnt in a science centre (Rennie and McClafferty, 2007). It is important for the learners to see the links between scientific knowledge acquired both at school and from a science centre (Tran and King 2007).

Her pedagogic knowledge was ineffective; she used a traditional method of teaching where the education officer was the source of all information. The science centre's aim is to stimulate learners' interest in science. Her method of teaching failed to stimulate the learners. She failed to provide the opportunity for active science because of her traditional passive lecturing method (Ramey-Gassert, 1997. Inquiry should be the central strategy of science teaching (Sandaval, 2005). Learners should be kept active and attentive to stimulate curiosity in the process of scientific knowledge contraction. Unfortunately it did not happen in this lesson due to a lack of pedagogic knowledge and instructional strategies

However, she was able to use most of her resources productively even though not all of her learners had an opportunity to be hands-on. With her rare and unique specimens and artefacts, she was able to capture the learners' attention. Exhibits provide opportunities for learners to see and handle specimens; therefore it helps to raise the level of scientific literacy amongst learners (Killen, 2015). Her implementation of the lesson plan needs attention since she failed to cover all of the activities stipulated in the lesson plan. Lessons used by the science centre are developed to support the needs of the school curriculum because many schools visit the science centre for its link with the curriculum as alluded to by Mosabala (2014). If the lesson plans are not used properly there will be a gap between the science education at school level and the education given at the science centre.

## 4.3. Case 2. Education officer B

4.3.1. Data presentation

### A. Bibliography of education officer B

Education officer B is in possession of a National diploma in nature conservation which she obtained from Tshwane University of Technology. She majored in ecology, plants and animals studies, her other elective modules are environmental education and science communication. She also holds a B-tech in nature conservation, where she majored with coastal and marine management and fresh water management. She is a qualified conservator.

When asked about her knowledge and experience in science education, education officer B indicated that she once taught environmental education at one of the environmental centres in Gauteng for a period of one year. She has also completed one month training on lesson presentations and communication skills at the science centre. The one month training covers topics such as the role of the science centre in science education, different teaching methodologies, communication skills and science centre teaching and learning resources.

### B. Content knowledge of education officer B.

The researcher asked education officer B what lesson she likes to teach at the science centre and why? Education officer B responded by saying:

> *"I like teaching learners about national symbols mainly because this is the first lesson I was introduced to when I arrive at this science centre, but now I'm getting interested in Vultures because of their importance in nature and their ability to fly, I mean how they fly. So my lesson this time is vultures."*

When presenting the lesson, education officer B said the following about vultures:

*"It eats dead animals, meaning that it's a scavenger. So when we say 'scavenger' it means that it does not actively hunt for food or for prey. It waits for your lions, your leopards, your cheetahs to make the kill and then it only gets to the scene when the animals are dead."*

She further described the importance of vultures in the environment and what enables them to eat rotten food by saying the following:

*"And then we also said they clean the environment. That is true because if we were to find dead animals all over South Africa, then there will be too much or high disease transmission. Because those dead animals also contain diseases that are harmful to human or also to other animals. So the digestive system of a vulture enables it to digest the bacteria from those dead animals, ok?"*

Learners were informed about the causes of the vulture's vulnerability. Education officer B said.

*"They are vulnerable. They are endangered because people kill them to do traditional medicine. One thing we need to remember is that 80% of South Africans depend on traditional medicines. They do not have access to right or expensive medical treatment. Ok. And then, they also vulnerable because some of the farmers have started a new practice where, if they find an animal dead, they will just bury it in the ground meaning that there would be shortage of food for the vultures...".*

Education officer B differentiated between the two groups of vultures, the old world vultures and new world ones. This is what she said when differentiating vultures

> *"So in the world we have two groups of vultures. We have new world vultures which occur in South and North America. And then we have old world vultures which occur in Africa, Asia and Europe."*

She described each vulture's characteristics according to the method it uses to find its food. She said that new world vultures rely on smell to track down food, whereas the old world vultures rely on sight.

She continued teaching about their adaptations and said:

> *The talons, we don't call these the feet or the toes we call them the talons. So these talons are tough. They enable them to walk smoothly on the ground while searching for dead animals. And then, this one, the Cape Vulture from the old world it relies on sight or on vision to track down food. Hence, it spends most of the time flying high in the sky. And also the talons they are not as tough as the ones of new world because they spend most of the time flying searching for food up high in the sky."*

Education officer B used her knowledge of the subject matter to give learners information on vultures and how they are adapted to their environment.

She started explaining how vultures fly comparing them to aeroplanes, she said:

> *"So can anyone tell us what does a bird do, any bird, with its wings before it takes off? Before it can fly high in the sky, what does it do with the wings? Even if it's a chicken. Ok. Chicken e fellela gona mo (it*

*ends here) but what does it do with the wings? It opens the……"*

***Learners:*** *"The wings."*

***Education officer B:*** *"It opens the wings. It only positions them like this and then it flies?"*

***Learners:*** *"No!"*

***Education officer B:*** *"What does it do?"*

***Learners:*** *(mumbling)*

***Education officer B:*** *"It flaps the wings. The way they flap the wings it differs according to the bird species. So for the chickens, they flap them like this,*

*fast. And then the vultures they flap them like this and then they run for a short distance. So the reason why they flap their wings and also run for a short distance is to gain momentum. It's the same thing that happens with our aeroplanes. Before they can take off from OR Tambo airport, they first need to be on the runway for a certain distance and then that's when they can take off, ok. So also with our choppers or our helicopters before they could actually take off….for now though, they don't need to run on the runway, but they first need to spin their wings to gain momentum."*

She went on and explained the forces that act on a flying object, using the picture of a Vulture as reference. She said the following:

**Education officer B:** ***"****Ok. So we are all aware that for any flying object there are four forces which are involved. Right? Have you guys been taught forces?"*

**Learners:** "Yes."

**Education officer B:**

*"Remember I talked about the warm wind thermal or the warm air temperature from dark surfaces? So what happens is that when that vulture goes down from the cliff to get that warm air temperature, it goes there to make the body warm and also to gain lift. So that warm wind thermal helps the vulture to apply a lift force. So if you had to define a lift force in simple terms, it's a force that adds right angle to the direction of motion. So basically in simple terms, it's a force that pulls an object upwards. So we know that if you had to throw your phone up in the sky, you are giving the lift force more advantage. But eventually it will go down. And it will be pulled by the weight force or the gravitational force. So moving onto our 2 horizontal forces, we have a thrust force.*

*A thrust force is a force that propels a flying object towards the direction of motion. So basically it's a force that pulls a flying object forward neh? So if we had to go to our vulture, how does it apply a thrust force? The design of the body, its streamline. When we say streamline, we mean it's pointy here at the front (pointing at the Vulture's head on the picture). And then the surface of the body here it's smooth. There's no kind of disruption or interruption on its body.*

During post interview the researcher asked education officer B to explain her understanding of aerodynamics in relation to flight of vulture and aeroplane she giggles and said

*"Uhmmm, first of all, what I can tell you is that aerodynamics is a concept that deals with the wind and the air and the sky. And also how a flying object is able to resist the pressures. It also involves the design of that flying part of an object to make it fly smoothly in the sky. That's what I understand."*

**B. Pedagogic knowledge plus instructional strategies of education officer B**

Education officer B does not have a formal qualification in teaching. However during the pre-interview, when asked about her experience in teaching science, she indicated that she has a year's experience of teaching environmental education at one of the environmental centres in Gauteng.

The researcher asked the education officer what she would consider before presenting a lesson. In her response she said:

*"Of all, you should check also the language of the students. And then also you should be able to, in*

> *your lesson you should let them engage with you than you actually teaching them. So you should ask them questions or let them come up with answers. And also, I also make sure that after each lesson I ask them if they don't have any questions. So those are the things to consider"*

The researcher asked education officer B what teaching method she used to teach at the science centre, she responded saying:

> *"The method was to… Ok. I told them about the flight of vultures. And then I also showed them some things. I didn't ask questions on things that I felt were too difficult for them. But I also got them to participate. So I demonstrated to them some things but in some they had to come and do that activity to show me their level of understanding."*

Education officer B introduced her lesson by saying "*we are going to talk about vultures."* She told the learners that her lesson will be in a form of a discussion and they must respond to her questions. She also told learners to be free and that they may respond to her questions by using any language, even their home language is allowed.

She went on to give roles by saying

> *"Ok, and then, ummm, please do not hold secret meetings. I should be the only one talking unless you raise your hand. And please do not eat while we having a lesson"*

Education officer B used question and answer method to engage with the learners. Some few questions were posed to learners to find out their background information.

**Education officer B**: Are you guys familiar with the term ‘vortex'?”

**Learners**: “No!”

**Education officer B**: “Le kele labona (have you ever watch a tornado movie) movie ya-tornado?”

**Learners**: (mumbling)

She went on with her lesson and asked learners questions. She asked “Can anyone tell me, what makes vultures interesting or what makes them unique from other birds. Are you guys familiar with vultures?”

After asking questions, education officer B started giving learners information on vultures, how they are adapted to their environment and how they fly. She used her knowledge of aerodynamics to explain the mechanism of flight to the learners.

During the lesson the education officer used analogy where she used the movement of a tornado to explain the vortex created by vultures. When explaining the flight of vultures she said,

*“Tornado e etsa so (it goes like this)… it moves in this motion. So if you guys watched that movie you get to notice that, whatever object is lying around that vortex it gets to be pulled into the centre of that*

> *vortex, of the tornado. So the same thing happens with our vultures. As they are flying in the sky, the vultures form it in this pattern. Its intention is to pull or to drag that vulture backwards*."

The researcher asked education officer B what she did when realising that learners do not understand some of the concepts during lesson presentation. Education officer B said,

> *"First of all, I had to change my language, first of all because most were from schools in the townships. So if you have to be too formal with them some might be ignorant, some might be interested but not understand at all. So I kind of had to adjust my language that I use and also apply examples that they see every day in their lives. So that's the approach I used."*

**Resources knowledge of education officer B**

Education officer B used pictures to show the learners some of the vultures she was talking about: "So here I have a picture of the vulture that you find in the new world which is North and South America. And the name of this vulture is called a Turkey Vulture. And then, on my right hand we have a picture of a vulture which you find in the old world which is Africa, Asia and Europe." She used a picture again to demonstrate the shape of the vulture's wing.

> "So on this picture, if we had to cut the wing like this, the wing of the vulture like this while flying in the sky, this is the kind of shape you would get.

The education officer also had a mounted vulture that she was using as a teaching resource. She referred to the mounted vulture for other illustrations. She used the mounted vulture to explain the type of species, talons and the wings.

A model of an aeroplane was used to demonstrate the mechanism that the vulture uses in order to fly. Education officer B explained the reason she used an aeroplane model. She said. “So the reason why we have an aeroplane is because it is designed similarly to a vulture. And it also uses the same mechanism as a vulture to fly high in the sky.”

The researcher asked the education officer what is her view on the use of exhibits to teach science at the science centre? Education officer B indicated that exhibits are very important because they make the lesson more interesting and they attract learners to the station where the lesson is conducted.

### 4.3.2. Discussion and findings

#### A. Education officers’ content knowledge

Education officer B is a qualified conservator with a national diploma in conservation plus a B.Tech degree in the same field. It is expected from her to have content knowledge on vultures because professional development programmes provide opportunities to acquire content knowledge of the subject matter (Friendriechsen *et al*, 2009). With her qualifications in nature conservation it is expected from her to

share more knowledge on birds such as vultures. Education officer B also indicated that she is interested in vultures and how they fly.

Education officer B explained to the learners that there are two different groups of vulture which are the old world vultures and new world vultures. She has shown her content knowledge of vultures by describing each vulture's characteristic according to the method it uses to find its food. She said that new world vultures rely on smell to track down food, whereas the old world vultures rely on sight to track down food.

Her content knowledge on vultures is adequate. She explained that vultures eat dead animals, which makes them scavengers. She indicated that vultures play an important role in the ecosystem, the role of cleaning the environment by eating the bodies of dead animals.

Education officer B has shown an in-depth content knowledge of the subject matter by applying the principles of flight and forces that act on a flying object, which is part of physics, in Life Sciences. Education officers in a science centre environment must have the ability to apply knowledge from multiple domains (Shulman, 1986). Her content knowledge was remarkable when she switched into the topic of Physics and started explaining the concept of aerodynamics and relating it to how vultures fly.

> **Education officer B:** …*So, that warm wind thermal helps the vulture to apply a lift force. So if you had to define a lift force in simple terms, it's a force that adds right angle to the direction of motion. So basically in simple terms, it's a force that pulls an object upwards. So we know that if you had to throw your phone up in the sky, you are giving the lift force more advantage. But eventually it will go down. And it will be pulled by the weight force or the gravitational force. So moving onto our 2 horizontal forces, we have a thrust force. A thrust force is a force that propels a flying object towards the*

*direction of motion. So basically it's a force that pulls a flying object forward neh? So if we had to go to our vulture, how does it apply a thrust force?*

She used her content knowledge to show the relationship between Life Science and Physics. She used her content knowledge to help learners develop scientific knowledge and an understanding of the scientific concepts (Mugnusson *at el*, 1999). This kind of content knowledge shown by education officer B helped learners to realise the link between the two subjects and the links between what they were learning at the science and what they learnt at school. According to Kember and McNaught (2007), it is possible to establish relevance when learners are able to see how the science subjects are related. Before introducing the concept of forces the education officer and learners had this interaction:

**Education officer B:** ***"****Ok. So we are all aware that for any flying object there are four forces which are involved. Right? Have you guys been taught forces?"*

**Learners:** "Yes."

Education officer B used this conversation to show learners that there is a link between what she was teaching with what they were learning at school. Bencze and Lemelin (2001) argue that education officers in a science centre environment must function in a way as to complement formal education. Science centres and museums are unique science educational environments with the ability to complement the learning that takes place in the formal school environment (Griffith, 1998). Education officers at science centres must provide learners with a unique context to think about science and technology outside of the formal classroom environment, they must have a valuable application in the school curriculum by facilitating and developing learners understanding of scientific concepts (Cullen, 2005).

The link of the subjects is also recognised by the curriculum as stated in CAPS Life Sciences Grade 10-12 DBE (2011), that the knowledge under Diversity, Change and Continuity strand and their topics should not be studied separately or independently but it should be linked with knowledge strands from other learning areas. Education officer B has successfully shown the link of content knowledge between Life Sciences and Physics.

Education officer B's ability to link the two subjects and present the subject matter that is relevant to the curriculum as stated in CAPS Life Sciences Grade 10-12 DBE (2011) confirms Mosabala's (2014) argument that in a South African context, schools visit science centres and museums to learn and reinforce science topics that they learn at school because many high schools are interested to learn this lesson of vultures at the science centre.

Education officer B explained to the learners that vultures are endangered because people kill them for traditional medicine. If this practise is not well regulated vultures will become extinct in the near future. Education officers at science centres and museums can provide a link between theoretical aspects of science and issues which affect our homes, communities and the world around us. They can help to develop understanding, attitudes and values, and lead to a more enlightened, committed and actionable population in areas such as citizenship, conservation and sustainable development (Braker, 2002).

According to Tran and King (2007), content knowledge enables the education officer to indicate those salient features and the significance of the exhibits which may have gone unnoticed. Education officer has been able to do that with her lesson on vultures.

She managed to explain their significance in the environment by explaining that they eat the corpses of animals to clean the environment. She also managed to indicate those salient features of vultures, such as their ability to fly up high and explain the scientific principle of flight to the learners.

**B. Pedagogic Knowledge plus instructional strategies of Education Officer B**

According to Killen (2015), teaching is regarded as the process of helping learners to find information, to understand it, to organise it and to apply it. Learners should not be seen as empty vessels waiting to be filled with knowledge. “Teachers are guilty of transmission if they do more than stimulating students’ reflection and problem solving” (Cobb, 1994: 4).

Education officer B’s way of teaching was that of giving learners information throughout the lesson. When introducing the concept of vultures she said:

> *“So in the world we have two groups of vultures. We have new world vultures which occur in South and North America. And then we have old world vultures which occur in Africa, Asia and Europe.”*

There was no form of interaction with the learners with this information. She continued treating learners like empty vessels waiting to be filled with information (Brophy, 2014) education officer B said,

> “…*The talons, we don’t call these the feet or the toes we call them the talons. So these talons are tough. They enable them to walk smoothly on the ground while searching for dead animals. And then, this one, the Cape Vulture from the old world it relies on sight or on vision to track down food. Hence, it spends most of the time flying high in the sky. And also the talons they are not as tough as the ones of new world because they spend most of the time flying searching for food up high in the sky.”*

Killen (2015) argues that teaching can be described as either teacher-centred or learner-centred. Teacher-centred approach is mostly referred to as direct instruction. In this kind of teaching the education officer has direct control over what is taught and how the information must be presented to the learners, whereas a learner-centred approach refers to discovery learning and inquiry

learning, in this type of teaching approach emphasis is on the role of the learner in the learning process. Education officer B used a teacher-centred approach to teach learners about vultures. All she did was to give learners information on vultures and how they are able to adapt to their environment.

There was no interaction at all with the learners. She was giving a lecture to the learners using her authority on the subject matter. According to Killen (2015), if teachers want quality learning to occur, education officers must deliberately teach in ways that will enable and encourage learners to engage in intellectual activities that can promote quality learning. The responsibility of education officers, according to Killen (2015), is to help learners filter knowledge and understanding from the large amount of information they come across when studying the subject. In education officer B's lesson that did not happen, instead the education officer continued giving learners large amount of information about vultures without helping learners to filter knowledge from this large amount of information.

Guisasola *et al* (2009) argues that in a science centre and museum environment, the teaching of science should have more of a fun environment compared to the seriousness of the classroom environment and be less authoritative. Education officer B was very strict and serious when presenting her lesson. She went on to set up roles for the learners before starting with her presentation. She said the following with an authoritative voice:

> **Education officer B*:*** *Ok, and then, please do not hold secret meetings. I should be the only one talking unless you raise your hand. And please do not eat while we having a lesson, alright?"*

There was no fun in her lesson it was a serious atmosphere. She was the only one allowed to talk. The role of the learners was to listen. Fun is important in learning science at the science centre because learners are able to relate and remember information they learnt in a relaxed environment (Rennie and McClafferty, 2016).

When asked about the teaching method she used to teach about vultures, education officer B said.

> *"I told them about the flight of vultures. And then I also showed them some things. I didn't ask questions on things that I felt were too difficult for them. But I also got them to participate. So I demonstrated to them some things but in some they had to come and do that activity to show me their level of understanding."*

It is clear from her response that she did not have a particular method of teaching. Even the demonstration approach she mentioned never happened. She had a model of an aeroplane that she could have used to illustrate the forces she mentioned to the learners, but she did not do that. She could have engaged her learners with a hands-on activity to explain the forces that act upon a flying object. According to Susan *et al* (2010), the use of hands-on activities develops critical thinking and problem solving skills and makes teaching and learning meaningful. Watermeyer (2012) argues that interactive lessons coupled with exhibits are credited for being hands-on, this method of teaching is pedagogically superior to traditional ways of transmitting knowledge.

**C. Resource knowledge of education officer B**

When asked to state her view on the use of exhibits to teach science at the science centre, education officer B indicated that exhibits are very important because they make the lesson more interesting and attract learners to the station where the lesson is conducted. According to Cullen (2005), science centres and museums are greater resources for teaching and learning because they provide learners with a unique context to think about science and technology outside of the formal school environment. Due to the images available at these centres they become ideal resources for scientific learning (Barry, 2010).

The education officer had little interaction with her exhibits. She concentrated much on giving learners information and forgot about the exhibits that could have assisted her to illustrate the concept of flight. Tran and King (2007) argue that exhibits are important in science centres and museums because they distinguish these centres from other social environments. School groups visits science centres and museums mainly because of their exhibits.

Education office B had a mounted vulture and an aeroplane model to assist her in the presentation. Both exhibits were rarely used. She only referred to the aeroplane when discussing how vultures fly. All she said was

> *"So the reason why we have an aeroplane is because it is designed similarly to a vulture. And it also uses the same mechanism as a vulture to fly high in the sky."*

She could have used the aeroplane to show learners those similarities between the vulture and an aeroplane and illustrate how those features work. Education officers should use their knowledge of the exhibits and link it to their content knowledge to illustrate scientific concepts (Tran and King, 2007).

According to the lesson plan on vultures which is linked to the knowledge strand of Diversity, Change and Continuity as stated in CAPS Life Sciences Grade 10-12 DBE (2011), the education officer should illustrate how vultures fly using both the mounted vulture and the aeroplane model. Education officer B did not do that activity.

Summing up the general findings from education officer B, her content knowledge on vultures was vast. She managed to explain different groups of vultures and how they are adapted to their environment. It was very interesting to listen to her knowledge of flight including the forces that act on a flying object. The education officer used her content knowledge to show the relevance of science centres to the teaching in the classroom (Tran and King, 2007). She was also able to link Life Science knowledge of vultures with Physics knowledge of aerodynamics. According

to Kember and McNaught (2007), it is possible to establish relevance when learners are able to see how the science subjects are related.

Her pedagogic knowledge was unproductive; it was more of a transmitter of knowledge than that of helping learners to contract knowledge. According to Killen (2015), education officers should use pedagogical practices that are deliberately designed to help learners acquire the correct knowledge and skills required. Pfeiffer (2011) argues that the responsibility of the education officer is to deepen the scientific understanding and learning experience of the learners through good and proper strategies. She failed to keep learners active and interested throughout the lesson. Her instructional strategies were poor. The primary goal of these lessons is to promote interest in science education so that learners can be encouraged to pursue science by experiencing learning in a casual and interesting way (Tran and King, 2007).

Education officer B had all of the required resources at her disposal but she could not use them effectively to enhance learning in this lesson about vultures. According to Conn (1998), physical objects are regarded as the source of public knowledge because they offer scientific proof visually. Opportunity to engage with these unique resources enhances learning (Tran and King, 2007).

## 4.4. Case 3. Education Officer C

### 4.4.1. Data presentation

#### A. Biography of education officer C

Education officer C has a Bachelor of Science Degree in Life Sciences from the University Of South Africa (UNISA). His major subjects are Biochemistry and Microbiology and his elective modules are animal and plant diversity, medical plants and environmental awareness. He indicated that his two major subjects included practical work in a laboratory. He has also completed one month training on lesson presentations and communication skills at the science centre. The one month training covers topics such as the role of the science centre in science education,

different teaching methodologies, communication skills and science centre teaching and learning resources.

**B. Content knowledge of education officer C**

The researcher asked education officer C what is the lesson that he prefers to teach at the science centre and why? Education officer C responded by saying:

> *"Microscope lesson, I think it's too much practical and then I think the kids or learners would enjoy doing it, and then also I think it would be much….. it will be good for them to learn about it, as to why do we have microscope in such facilities because I don't think learners do understand that or do know that we have a research centre here, so I think it will be something very much good for them know."*

Education officer C introduced his lesson by asking learners questions. He asked them if they know what a microscope is. Learners said "yes". He then asked them if they have used a microscope before, they responded and said "No". He asked them what a microscope is. Learners mumbled. Education officer said:

> *"A microscope is an optical instrument that is used to view things that you cannot see with your naked eye."*

When explaining the main difference between the two microscopes on his table, education officer C said that the first one on his right is a simple compound microscope and the one on the left is a digital stereo microscope. On the simple compound microscope you use slides whereas you don't need a slide on the digital stereo microscope.

Education officer C asked the learners to identify the parts of a microscope. Learners started identifying and said:

**Learners:** “Eye piece.”

**Education officer C:** “Eye piece. What is it for?”

**Learners:** (mumbling)

**Education officer C:** “You put your eye on the eye piece so that you are able to see through, akere? And then this part?”

**Learners:** “The arm.”

**Education officer C:** “The arm, what do you think is the function of the arm?”

**Learners:** “The handle”

**Education officer C:** “So it acts as a handle. So these connect the ID and the body tubes to the rest of the components of the microscope, labona?”

**Learners:** “Yes.”

**Education officer C:** “And then we have these three things, what do we call them?”

**Learners:** “Objective lenses.”

**Education officer C:** “Yes. These are the objective lenses. What do you think it is? Think! Your came number 2 for the Life Sciences competition”

**Learners:** “Revolving nose cheeks.”

**Education officer C:** “Yes. What do we use a revolving nose cheeks for? And thank you to Mr Google ko morao. What’s the function of the revolving nose cheeks?

**Learner:** “So that it can change the objective lenses.”

The discussion continued and the education officer assisted the learners to identify all of the other components of the compound microscope. He did not ask learners to identify parts of the digital stereo microscope.

Education officer C showed learners different slides and explained to the learners the differences between the two slides and how they are used. He said.

> *"These are slides, akere? So normally you have your slides and you can tell. This one, it has a mountain specimen on it. This specimen is permanent here. It's a flower of a maize. So it's permanent here it won't move away. So we have this which doesn't have anything but then now we will put a specimen on top of it.*

Education officer C gave instructions to the learners on how to prepare their own slides. He explained that they have to remove a thin layer of an onion and place it slowly on a slide using a tool from the dissecting kit. Learners must place it in such a way that it does not form bubbles, when done they must clip it onto the microscope, they must adjust the lenses and start observing how it looks like.

During the interview the researcher asked education officer C the purpose of the lenses on the microscope. Education officer C responded and said:

> *"They are for focusing, so as you know they have to put their eye on the eye piece, so they can see through, and then they use those lenses. We've got 3 lenses, one is short, and then the medium one and the last one is the longest one. They also differ in a manner in which they magnify so I give them a microscope, I show them how to use the different lenses, so they put an object on the stage and then they using this one lens and if they cannot see anything or if they are unable to see anything then they change it and they use another one, until they get a nice picture."*

Education officer C concluded his lesson by telling learners about different careers they can choose which are related to the microscope lesson. He said.

> *Ok. Guys before you go. Did you know that there are many careers you can choose in science that are related to the microscopes? You can be a microbiologist, a lab technician, a geneticist or a forensic scientist; there are many, many careers for you guys.*

**C. Pedagogic knowledge plus instructional strategies of education officer C**

Education officer C does not have any formal qualifications in teaching, when asked about his experience in science education he indicated that he was involved in an environmental awareness project at the university where they would visit schools and teach them about the environment and how to take care of it.

The researcher asked education officer C what he would consider before presenting a lesson. The education officer said:

> *"I think it is to introduce yourself and also to introduce the lesson and then to get to know the primary language of the learners as well as uhm you must know as the presenter the content of what you teaching about"*

When asked about the teaching methodology that he uses when teaching learners about microscopes he said:

> *"Okay, so with this one because it is a practical lesson, it has to be practical but then as I continue with the lesson I have to go back and check if they do understand everything, so I keep asking questions, that way I get to track If they are understanding."*

The researcher asked education officer C what he does to make the lesson of microscopes interesting to the learners. The education officer said.

> *It's getting them to be interactive, so I won't do much of talking, so it will be a doing activity so we going to experiment together, so I won't talk a lot.*

Education officer C introduced his lesson by asking learners questions, learners also responded to the questions. The conversation was:

> **Education officer C:** "OK. Are you all doing Life Sciences?"
> **Learners:** "Yes!"
> **Education officer C:** "Ok. Do you guys know a microscope?
> **Learners:** "Yes!"
> **Education officer C:** "Have you seen one before?"
> **Learners:** "Yes!"
> **Education officer C:** "Have you used it before?"
> **Learners:** "No!"
> **Education officer C:** "But then you learnt about it koskolong?"
> **Learners:** "Yes!"
> **Education officer C:** "What is a microscope?"
> **Learners:** (mumbling)

**Education officer C:** “First thing, there’s no wrong answer. We’re here to learn. And then I will not be doing the talking alone, we have to talk together. Akere?”
**Learners:** “Yes!”

**D. Resources knowledge used by education officer C**

Education officer C used the two different microscopes to teach learners about microscopes. Other resources he used were pictures of different microscopes, a dissecting kit, cloves, onions and slides. The researcher asked education officer C about his view on the use of exhibits to teach science at the science centre. He responded by saying:

> *“Yes it is it important because it gets learners to fall in love, to develop love for science, and as well as to be practical because when you do something practically so, then you do not just forget easily, so it is very good.”*

When asked whether he follows the lesson plan when presenting the lesson, education officer said he does but not everything on the lesson plan. He emphasised that he allows learners to ask questions and discuss concepts related to the questions even if is not part of the lesson plan, but he tries not to move away completely from the lesson plan.

During the lesson presentation, education officer C used the microscope to help learners identify different components of the microscope. He allowed learners to touch the instrument and to suggest the name of the parts and also to state its functions. The education officer used pictures to show learners other microscopes that he did not have at the station. He also used the same pictures to discuss the different components of the microscope with the learners.

The education officer gave learners the compound microscope and other resources to help them perform the experiment. He first demonstrated to the learners how to remove a thin layer of an onion using tools from the dissecting kit. He then demonstrated on how to place a slide on a microscope. He adjusted, and allowed learners to see how his slide looked and encouraged them to do similar or better slides than his.

4.4.2 Discussion and findings

**A. Content knowledge of education officer C**

Education officer C's qualifications place him in a better position to teach learners how to use microscopes because of the subjects and practical work he completed for his qualification. According to Friendriechsen *et al* (2009), professional development programmes provide opportunities to acquire content knowledge of the subject matter. His qualification includes practical work of using microscopes in a laboratory setting.

The lesson of microscopes, as stated in CAPS Life Sciences Grade 10-12 DBE (2011) is under the knowledge strand of Life at molecular, cellular and tissue level. It is a sub-topic under Cells, the unit of life. One of the specific aims of this knowledge strand is doing science or practical work and investigations. As stated in CAPS Life Sciences Grade 10-12 DBE (2011), one of the reasons for doing Life Science is to expose learners to the scope of biological studies by stimulating their interest and creating awareness of different scientific fields. Therefore science centres and museums can play a significant role in inculcating positive attitudes towards science among all learners (Cullen, 2005). According to Cullen (2005), science centres and museums have a valuable application to school curricular to facilitate learning and develop learners' understanding of scientific concepts.

When asked about the lesson he prefers teaching at the science centre, education officer C said that he enjoys teaching learners about microscopes because it is a practical lesson where learners have to work on an experiment using microscopes. According to Bailey (2006), teaching science that requires certain practical activities

in a science centre setting is complex and involves specialised skills and an adequate knowledge base. Working with instruments such as a microscope requires a skill that can be perfected through experience and knowledge.

Education officer C asked the learners what a microscope is, expecting them to give him a scientific explanation of a microscope. Learners mumbled. Education officer C then explained to the learners that a microscope is an optical instrument that is used to view things that you cannot see with your naked eye. His explanation was fair and understandable and gave a hint as to what a microscope is.

Learners did not respond to his explanation. It was clear that learners did not understand some of the words of his explanation. Education officer C could have broken down his explanation by explaining the meaning of optical instrument or asked the learners if they understand the phrase “optical instrument”. According to Pfeiffer (2011), it is the responsibility of the education officer to deepen the scientific understanding of the learners.

Education office C explained to the learners the difference between the two microscopes placed on his table. He said that the first one is a compound microscope and it uses slides and the second one is a stereo microscope which does not use slides. His explanation was not bad, however he could have explained what is used on the stereo microscope instead of slides. He concentrated on the compound microscope and said very little about the stereo microscope. Ideally he should have explained to the learners that on a stereo microscope you place a specimen on a Petri dish and that you are able to see an object/specimen in three dimensions. It is important for the education officers to be able to explain those silent features that cannot be easily noticed (Tran and King, 2007).

When discussing the components of a microscope education officer C asked learners to identify and explain each of the components. Learners were able to identify most of the parts and explain their functions. When coming to the objective lenses their conversation went as such:

**Education officer C:** *"And then we have these three things, what do we call them?"*
**Learners:** *"Objective lenses."*
**Education officer C***:* *"Yes. These are the objective lenses. What do you think it is? Think! Your came number 2 for the life sciences competition"*
***Learners:*** *"Revolving nose cheeks."*
**Education officer C:** *"Yes. What do we use a revolving nose cheeks for? And thank you to Mr Google ko morao. What's the function of the revolving nose cheeks?*
**Learner***:* *"So that it can change the objective lenses."*

Education officer C did not explain the main function of objective lenses in detail. He said that they are used for magnification. He could have also explained how to calculate magnification using the numbers written on those lenses for learners to understand the meaning of magnification.

When concluding the lesson education officer C told learners about different careers they can do related to the lesson. Education officer C can be commended for such a talk because the primary goal of the lessons at science centres and museums is to promote an interest in science education so that learners are encouraged to pursue science by experiencing learning in a casual and non-judgemental setting (Tran and King, 2007).

**B. Pedagogical Knowledge plus instructional strategies of education officer C**

Education officer C does not have a teaching qualification. He only has one year of experience teaching environmental education at community level and other schools. When asked about what to consider before presenting a lesson, his response was

not satisfactory. He mentioned things like introducing himself, introducing the learners and knowing the primary language of the learners.

Education officer C started his lesson by asking learners different questions such as do you know what a microscope is? Have you used it before? He asked them to understand their prior knowledge on microscopes. Education officers at science centres and museums are also conscious of the learners' prior knowledge so that they can be able to adapt their pre-planned lessons to individual school groups at the centre (Tran, 2006). The education officers used these questions to gauge the learners' prior knowledge on microscope before he would continue with his lesson.

When asked about the teaching method he used, he said that because it is a practical lesson he also used practical methods and asked questions to check if they understood him or not. From this discussion and how the lesson was presented it is clear that the education officer did not have any methodology in mind. According to Killen (2015), education officers should use pedagogical practices that are deliberately designed to help learners to acquire the correct knowledge and skills required. Education officer C used question and answer method. Questioning is proper in science education if used correctly (Zhai and Dillon, 2014).

In this instance it was not used properly. Most of the questions he asked were closed questions. He wanted learners to remember the names of the components of the microscope and their functions.

His teaching method was teacher-centred. According to Killen (2015) in a teacher-centred approach the education officer has direct control over what is taught and how the information must be presented. This was evident with education officer C when he was discussing the components of a microscope, information was flowing according to his knowledge and components of the microscope were discussed according to the systems he used to name them.

When asked what he does to make the lesson interesting he said that he gets the learners to be interactive and he does not always talk. From the observation, what

he did was contrary to what he said. He was always talking, giving instructions to the learners throughout the experiment and reprimanding those who were exploring with his exhibits. Learners were only allowed to touch the microscope when they were placing a slide. The lesson required learners to be hand on. According to Susan *et al* (2010) the use of hands-on and inquiry based learning develops critical thinking and problem solving skills and makes teaching and learning more meaningful.

Education officer C can be commended for encouraging collaboration in his lesson. He grouped the learners into smaller groups and gave them the apparatus to perform an experiment of extracting cells in groups. According to Taylor (2012), science education should make efforts to enhance collaboration practices when learners are doing activities by instructing them to work in groups. Ramey-Gassert (1997) argues that science centres can nurture curiosity, improve motivation and attitude and can also engage learners through participation and collaboration.

**C. Resource knowledge of education officer C**

Education officer C used the two different microscopes to teach learners on how to use a microscope. He helped learners to identify different components of the compound microscope by giving learners an opportunity to touch those components on the microscope. Tran and King (2007) argue that the opportunity to engage with these unique and authentic objects distinguishes science centres and museums from other social environments and they confirm that engaging with these objects is one of the main reasons for school groups to visit these centres. Education officer C was able to use his knowledge of these resources to enhance learning amongst the learners. Learners were fascinated to touch and work on the microscope and to use other equipment such as dissecting kit to prepare their own slides for observation under a microscope.

Education officer C did not use the resources fully to interact with the learners and to make the lesson interesting. Learners were glued to the microscopes during the presentation, waiting for that moment when they could start working with them.

Education officer C asked learners if they had ever used the microscopes. Learners responded immediately saying “No”. It was clear that some of the learners were seeing real microscopes for the first time. These real objects offer a degree of information which is not available in the textbook and the opportunity to experience a sense of scale (Tran and King, 2007).

Education officer C helped the learners to extract cells from an onion to observe under a microscope using other resources on his table. Learners enjoyed using these resources and the experience of performing an experiment. Barker (2008) argues that a visit to a science centre or museum is often a lasting impression to the learners because it promotes a deeper understanding of the experimental and analytical approaches that underpin science and the way in which the world around us works. It is also confirmed by Cullen (2005) that science centres and museums are greater resources for teaching and learning because they provide learners with a unique context to think about science outside the classroom. Conn (1998) argues that objects specifically selected for audience handling offer additional memorable experiences to the learners.

When asked whether he follows the lesson plan to the letter when presenting, education officer C indicated that he uses the lesson plan as a guide but also discusses other related topics when learners ask questions. This approach became problematic to education officer C, as he did not complete all of the activities stipulated in the lesson plan because of discussing other issues related to microscopes which are not part of the lesson plan. According to Tran and King (2007), although education officers may design the lesson plan, the absence of an externally imposed curriculum will mean that the learners may use the science centre in their own way and discuss what they are most interested in because learners will be driven by their own intrinsic motivation to learn. In this instance learners became interested in how the digital camera works on the stereo microscope, which was not part of this lesson. They spent much of their time trying to figure out how the stereo microscope works.

Tran and King (2007) argue that it is important that the education officers at science centres and museums are confident in amending their interactions in order to follow and build upon the interest of the learners.

Summing up the general findings for education officer C is that his content knowledge on microscopes is adequate. He has been able to present microscopes and their functions to the learners. He managed to assist learners with the knowledge required to perform an experiment of extracting cells from an onion. He used his knowledge of microscopes to assist learners with concepts required by the school curriculum in an interactive manner. According to Mosabala (2014) most of the reasons for schools to visit these centres are for edutainment, links to the curriculum, interactive activities and career guidance. Education officer C used his knowledge to cover most of the reason for school groups to visit the science centre. However education officer C can improve upon his content knowledge by discussing other microscopes such as the digital stereo microscope.

Education officer C's pedagogic knowledge was lacking. He used a traditional way of teaching where he was the sources of all information. His method of teaching was teacher-centred characterised by direct instructions. He used closed questioning method which directed learners on what to say and how to say it (Pfeiffer, 2011). Education officer C was focusing on the flow of information to the learners rather than assisting then to construct knowledge (Erduran and Aleixandre, 2007). According to Killen (2015), teaching should be a process of helping learners to find information and to understand, organise and apply it.

Education officer C used his knowledge or resources adequately to help learners understand microscopes and their functions. He could have done it better by allowing learners to be more hands-on. The use of hands-on activities develops critical thinking and problem solving skills and makes teaching and learning more meaningful (Susan *et al*, 2010). Education officer C did not give learners enough opportunity to work with the microscopes. According to Hofstein and Rosenfield (1996), education officers should create a learning environment which allows learners to interact physically and intellectually with the resources through hands-

on experimentation and reflection. Education officer C failed to take his lesson to that level.

## 4.5. Conclusion

In this chapter the researcher has presented the data and analysis of the practices of the three education officers in teaching science at the science centre. The focus was on the content knowledge, pedagogic knowledge plus instructional strategies and resource knowledge they use to teach science at the science centre. The knowledge of each education officer helped the researcher to arrive at the findings for each case.

# CHAPTER 5
# SUMMARY OF FINDINGS AND RECOMMENDATIONS

## 5.1. Introduction

This chapter presents summary of the findings guided by the research questions and objectives of the study. The chapter also presents the contributions of the study, its shortcomings and recommendations. Further possible research will be suggested and lastly the conclusion of the study is given.

### 5.2.1. Summary of the findings

The findings in this study are used to attempt to answer the research question using the Education Officer Knowledge model and the instructional strategies. The model comprises of the content knowledge, pedagogical knowledge, resource knowledge and instructional strategies of the education officer. The research question to be answered is:

What is the nature of education officers' teaching practices at the science centre?

And the sub-questions are:

- What is the nature of education officers' content knowledge in teaching science at the science centre?
- What is the nature of education officers' pedagogic knowledge in teaching science at the science centre?
- What is the nature of education officers' resource knowledge in teaching science at the science centre?
- What instructional strategies are used by the education officers to teach science at the science centre?

### 5.2.2. Content, pedagogic and resource knowledge of the education officers at the science centre.

The teaching of science in a science centre environment is complex and it involves a specialised set of skills and knowledge for it to be successful (Tran and King,

2007). They argue that content knowledge, knowledge of teaching methodologies and the knowledge of the exhibits at the science centre are vital in teaching science. These types of knowledge were demonstrated by the participating education officers during the interviews with the researcher and when they were presenting lessons to the learners.

The study revealed that the education officers have adequate content knowledge to teach different science lessons at the science centre. However in some cases the content knowledge needs some polishing. It is important for education officers to have sufficient content knowledge at the science centre. Bencze and Lemelin (2001) argue that science centres position themselves in a society's collective knowledge and they function in a way as to complement the learning that take place in a school environment.

This is supported by Mosabala (2014) in his research where he found that South African schools visit science centres because of its content knowledge that links to the curriculum. It is also noted that the education officers need to improve upon their content knowledge in order to remain relevant.

The pedagogic knowledge of the education officers was ineffective. Killen (2015) argues that teaching can be described as either teacher-centred or learner-centred. The education officers used a teacher-centred pedagogy. The education officers had a direct control over what is taught and how the information should be presented. Learners were not given time to explore any other knowledge except the one prescribed by the education officers. It has been observed from the lessons that learners were learning passively and were seated at the station with the education officer being active and moving around giving instruction to the learners. In one of the lessons the education officer gave rules and instructed learners never to talk, if they want to talk they must first raise their hands. The education officer said that he is the only one allowed to talk and present the lesson.

The resource knowledge of the education officers was inadequate. They had all of the resources required to make their lessons interesting but they failed to use their

exhibits to enhance learning. Hofstein and Rosenfield (1996) argue that education officers should create a learning environment which allows learners to interact physically and intellectually with the resources through hands-on experimentation and reflection. The education officers were very protective of their resources and as such did not allow learners to handle the exhibits. It is also noted that on the practical lesson of microscopes the resource knowledge was not bad. There is evidence of the education officer using microscopes to enhance learning by allowing learners to explore these objects. It is confirmed by Tran and King (2007) that objects selected for learners to handle offer memorable experiences to the learners, this experience cannot be found in a textbook.

In a science centre and museum environment physical objects are regarded as the source of public knowledge because they offer scientific proof (Conn, 1998). Most of the school groups visit the science centre to explore the exhibits. It is revealed in this study that education officers could not expose that scientific proof to the learners because of their inefficiency to use the exhibits as outlined in the lesson plans.

### 5.2.3. **Instructional strategies used by education officers at the science centre**

The responsibility of the education officer at science centres and museums is to deepen the scientific understanding and learning experience of the learner through good and proper strategies (Pfeiffer, 2011). The use of lecturing method by education officers in their lessons is evident in this study. Education officers used one-way methods of communicating whereby learners were listening passively and only allowed to talk when asked a question. Learners were told to take a seat and listen with no interruption. The learners' role was to respond to the questions asked by the education officers. Learners were bombarded with more information and never given a chance to question. Cobb (1994) warns against this strategy and says that an education officers' role should be that of facilitating learners' investigations and exploration in a science centre environment. Learners should not be seen as empty vessels waiting to be filled with knowledge. Cobb (1994) argues that education officers are guilty of transmission if they do more than stimulating learners' interest and problem solving in science.

It was also observed in this study that education officers were using a show-and-tell strategy to teach science at the science centre. Education officers used their exhibits to show learners how their exhibits look and told the learners what those exhibits are. The role of the learners was to listen. Learners were asked if they know those exhibits, where did they see them. Education officers, when asked during interviews said that they prefer to be hands-on but when observed they were using a show-and-tell strategy. There was little or no interaction with the exhibits. Cobb (1994) argues that the use of hands-on and inquiry strategies develop critical thinking and problem solving skills. The education officers failed to be hands-on in their lesson presentations, instead using a show-and-tell strategy.

Education officers also used questioning as part of their instructional strategy. Most of the questions asked by the education officers required a direct answer. It has been observed that education officers used a closed question strategy during their lesson presentation. Learners were asked questions that required them to remember what they have learnt at school, not questions that required them to apply their mind. Closed questions empower the education officer whereas open questions stimulate curiosity and keeps learners active (Zhai and Dillo, 2014). Learners were passive during the presentations.

## 5.3. Main contribution of the study: the nature of education officers' teaching practices at the science centre

Previous research on schools visiting science centres and museums has focused mainly on learners' learning experiences. This study focused on the practices of education officers employed by the science centre to interact with the learners. The study focused on the content, pedagogic, resource knowledge and instructional strategies of the education officers used to present lessons to the visiting learners. The three participants have qualifications in science, either a National Diploma of a Junior Degree in the field of science with at least one year's experience of interacting with school groups, but none have a formal qualification in teaching. The study found that the participants have adequate content knowledge, however they used a teacher-centred methodology and they were transmitting knowledge to the learners.

They used a show-and-tell instructional strategy in their lessons which is highly discouraged in science education (Zhai and Dillo, 2014). This has shown that content knowledge alone cannot make a person a good education officer. One month's training on teaching methodology and instructional strategies cannot be enough to train presenters in science education. One year of experience without a proper teaching qualification is also not enough for science education. The study has also revealed that content knowledge, pedagogic knowledge, resource knowledge and instructional strategies can influence the teaching of science in a science centre environment.

These findings can be useful to the science centre and other centres who rely on other professionals who are not necessarily qualified educators to teach learners science. These findings can be used by the science centres to rethink their recruitment and training processes at the centres. To the education officers at the science centre this finding should encourage self-introspection on how science education can be presented to the visiting learners best. To the science community and the department of science and technology (DST) the findings should encourage debate on the best practises to teach science in a science centre environment. For the department of education (DBE) these findings inspire a need to consider the role of science centres when developing the curriculum.

## 5.4. Limitations of the study

Participants in this study were observed teaching two lessons of their choice, only three participants volunteered to be part of the study. It would have been interesting to observe other participants in the centre or to include other science centres in this study. However this science centre was chosen because it receives the highest number of school learners per annum in the area and the practice of having other professionals teaching learners science who are not necessarily qualified science teachers is common in science centres. The accessibility of this science centre and its location made the study possible. The researcher was able to look at each case separately as well as in conjunction with each other and in detail. Participants were interviewed and observed on the lessons of their choice.

A lager sample and longer observation would have given a better insight into the practices of education officers when teaching science at the science centre. The findings are accepted to be unique in this science centre in Pretoria and they cannot be used to generalise the practices of education officers at other science centres, but they can be used as a lesson on bad practices to be avoided by education officers when presenting a science lesson to the learners.

## 5.5. Recommendation

The recommendations are based on the findings of the study. Although the findings in this study cannot be used to generalise, it is recommended that:

- Graduates who join the science centre should be extensively trained on their responsibilities at the science centre. An intensive training course should be conducted on lesson presentations at the centre.
- It has been found in this study that content knowledge alone is not enough for teaching science at the science centre, other knowledge such as resource knowledge, pedagogic knowledge and instructional strategies cannot be ignored for successful teaching. The science centre should look at their recruitment strategies and search for professional educators.
- Education officers should improve on their instructional strategies at the science centre. They should engage learners with hands-on activities. Lecturing and show-and-tell methods should be limited or discouraged for science to be interesting and productive at the science centre.
- Since resources/exhibits are core in teaching science at a science centre, education officers should know their exhibits very well and they must be trained to use those exhibits successfully.
- Education officers should work together with school-based teachers and the Department of Education by attending workshops where the school curriculum is discussed. This will assist education officers with understanding new developments in science education.

## 5.6. Further research

This study has been successful in establishing the content, pedagogic and resource knowledge as well as instructional strategies used by education officers to teach science at the science centre, however further research in the following related topics can be conducted.

- The effect of teaching science by other science graduates who are not qualified teachers at science centres.
- The role of science centres in science education.
- The use of exhibits in science centres to enhance science teaching.
- Bridging the gap between the teaching of science in the classroom and science centres.

## 5.7. Conclusion

The final chapter discussed the summary of the findings, the main contribution of the study, limitations and further study in the teaching of science in science centres and museums.

The teaching of science is indeed the responsibility of all stake holders including science centres and museums. For science to be taught in a meaningful way and be interesting to the learners the education officers' content, pedagogic and resource knowledge and instructional strategies must be taken into serious consideration.

## REFERENCES


Adams, J. D. and Gupta, P. (2017). Informal science institutions and learning to teach: *An examination of identity, agency and affordances*. Journal of research in science education. 54(1) 121-138

Ainley, J. (2007). Improving science learning. Research developments. 16(5). 5-16.

Anderson, D., Piscitelli, B., Weier, K., Everett, M., & Tayler, C. (2002). Children's museum experiences: Identifying powerful mediators of learning. *Curator, 45*(3), 213-231.

Anney, V.N. (2014). Ensuring the quality of the findings of qualitative research: Looking at trustworthiness criteria. Journal of Emerging Trends in Educational Research and Policy Studies. 5(2): 272-281

Bailey, E. B. (2006). Researching museum educators' perceptions of their roles, identity, and practice: *Journal of Museum Education* 31(3): 175-198.

Braker, D.R. (2008). Discourse in inquiry science classroom: Reference manual. University of Nebraska. Lincoln.

Barry, A (1998) 'On Interactivity: Consumers, Citizens and Culture'. *The Politics of Display: Museums, Science, Culture.* London, Routledge. 98–117.

Bencze, J. L. and Lemelin, N. (2001). Doing science at a science centre: Enabling independent knowledge construction in the context of schools' museum visits. Museum management and curatorship. 2(19). 141-157.

Bennett, J., Hogarth, S. and Lubben, F. (2006). Bringing science to life*: A synthesis of the research evidence on the effects of context-based and STS approaches to science*. Department of educational studies. University of York. York.

Billups, F. (2014). The quest for rigor in qualitative studies*: strategies for institutional researchers*. NERA research.

Braun, V. and Clarke, V. (2013). Successful qualitative Research: *a practical guide for beginners.* Sage publications. London.

Braund, M. and Reiss, M. (2005). The call of the outdoors. Times supplement. 10-35.

Brian L. Gerber, Anne M.L. Cavallo & Edmund A. Marek (2001) Relationships among informal learning environments, teaching procedures and scientific reasoning ability, International Journal of Science Education, 23:5, 535-549.

Brophy, J. (2004). Social constructivist teaching. *Affordances and constraints.* Symposium conducted at the Annual Meeting of the American Educational Research Association, San Diego, California.

Brown, A.L. (1992). Design experiments: Theoretical methodological challenges in creating complex interventions in classroom setting. *Journal of the learning science,* 2(2). 90-170

Cobb, P. (1994). An Exchange: *Constructivism in Mathematics and Science education*. Education research 23(7) 4-26.

Conn, S. (1998). Museums and the American intellectual life, Chicago: Chicago University Press. 1876-1926

Creswell, J. W. (2009). Research design: *Qualitative, quantitative and mixed methods approaches (2nd)*. SAGE. London.

Crooke, E. (2006). Museums and community. In A companion to museum studies. Macdonald. Oxford: Blackwell Publishing.

Chin, C. (2004). Museum experience: A resource for science teacher education. *International Journal of Science and Mathematics Education, 2*, 63-90.

Cullen, M. (2005). Enhancing multiple intelligence through museum visit. The Journal of the science teachers' association, *43(3), 27-28.*

Department of Education, (2002). National curriculum statement. Pretoria. Government Printing Works.

Department of Education. (2011). National Curriculum Statement Grade 7-9 Natural Science. Pretoria: Government Printing Works.

Department of Science and Technology, (2014). DST Strategic plan. Pretoria: Department of Science and Technology

Erduran, S. and Jimenez-Aleixandre, M.P. (2007). Argumentation in science education: *Perspectives from classroom-Based research*. Spriner Publications, Spain.

Eshach, H. (2007). Bridging in-school and out of- school: *Formal, non-formal and informal education:* Journal of science education and technology, 16(2), 153-295

Even, R. (1993). Subject-matter knowledge and Pedagogical content knowledge: Prospective secondary teachers and the function concepts. *Journal for Research in Mathematics Education*. 24(2) 90-118.

Fenstermacher, G.D (1986). Philosophy of research on teaching: Three aspects. *Hand book of research on teaching,* 3, 37-65. New York. Macmillan.

Fortner, R.W. (1997). Model of affective learning for non-formal science facilities. Journal of research in science teaching, 34(8), 805-818.

Fraser, B.J. (1998). Science learning environments: Assessment, effects and determinants. In B.J. Fraser & K.G. Tobin (Eds.), International handbook of science education (pp. 527-564).

Friedrichsen, P. J., Abell, S. K., Pareja, E. M., Brown, P. L., Lankford, D. M., & Volkmann, M. J. (2009). Does teaching experience matter? Examining biology teachers' prior

knowledge for teaching in an alternative certification program. *Journal of Research in Science Teaching*, *46*, 357-383.

Gerber, B. L., Cavallo, A. M., & Marek, E. A. (2001). Relationships among informal learning environments, teaching procedures and scientific reasoning ability. *International Journal of Science Education, 23*(5), 535-549.

Geveke, H. C., Steenbeek, H. W., Doornenbal, J. M. and Van Geert, L. C. (2017). Attractor state in teaching and learning processes*: A study of out- of school science education*. Front psychology, 8, 299

Gilbert, J. (1995). Learning in museums: *Objects, models and text*. Journal of education in museums, 16, 19-38.

Griffin, J. (1998). School-Museum integrated learning experience in science: *A learning journey.* PhD science education, University of Technology, Sydney.

Harington, D.G. (2001). The development and validation of a learning environment instrument for CSIRO science education centres. PhD science education. Curtin university of Technology.

Hatch, J.A. (2002). Doing qualitative research in education settings. State University of New York press

Hein, G. E. (1998). Learning in the museum. London: Routledge.

Hirsch, J.S. and Silverman, L.H. (2000). Transforming practice: *selection from the journal of museum education.* Routledge. New York.

Hofstein, A. and Rosenfeld, s. (1996). Bridging the Gap between Formal and Informal Science Learning. The weizman institute of science, Rehovot, Israel, 28, 87-112

Killen, R. (2015). Instructional strategies for quality teaching and learning. Juta. Cape Town.

Liamputtong, P. (2013). Qualitative Research Methods. (4th ed). Oxford University Press. Australia.

McComas, W. F. (1998). The role and characteristics of the nature of science in science education. Kluwer academic publishers. New York.

McGhie-Richmond, D. (2007). Developing effective instructional strategies for teaching in inclusive classroom. Exceptionality Education Canada (17) 1, 27-52.

Magnusson, S., Krajcik, J. and Borko, H. (1999). In: J. Gess-Newsome and N.G. Lederman, eds. Nature, sources and development of pedagogical content knowledge.*Examining pedagogical content knowledge: the construct and its implications for science education.*Dordrecht: Kluwer Academic Publishers, 95-132.

Mosabala, M.S. (2014). Understanding teachers' and their learners' perception about Museums visits in South Africa: Mediterranean Journal of social science, 5(4). MCSER publishing: Rome. Italy

Mudau, A.V. 2013c. Using the Classroom Practice Diagnostic Framework (CPDF) to Investigate Teaching Difficulties of a Physics Topic*. Mediterranean Journal of Social Sciences*, 4(3), 637-646.

Mushaikwa, N. 2014. Investigating Pre-service Natural Science Teachers' Perceptions of Earth in Space through Special Modelling and Argumentation. Unpublished Masters Dissertation, University of the Western Cape, Cape Town.

Opie, C. (2004). *Doing Educational Research - A Guide to First Time Researchers*. London: Sage Publications.

Pfeiffer, L.G. (2011). A comparison of the preferred learning styles of year 5, year 7 and year 9 students in science using the science laboratory environment inventory and a cooperative learning unit of work based on multiple intelligences. PhD of science education. Curtin University. New Zealand.

Piaget, J. (1983). Piaget's theory. In P. H. Mussen & W. Kessen (Eds.), *Handbook of child psychology: History, theory, and methods,* 703-732.

Ramey-Gassert, L. (Mar., 1997). "Learning Science beyond the Classroom". The Elementary School Journal 97, no. (4) 433-450.

Remillards, J.T (2005) Examining key concepts in research on teachers use of Mathematics curricula. University of Pennsylvania. Review of education research summer. 75 (2). 211-246.

Rennie, L.J. & McClafferty, T.P. (2007). Objects and learning: Understanding young children's interaction with science exhibits. New York: Erlbaum. 191–213.

Rennie, A. J. and McClefferty, T. P. (2016). Science centres and science learning. studies in Science Education, 27, 53-98.

Richard, L and Morse, J.M. (2013). Readme first for a user's guide to*: Qualitative Methods.* (3rd ed). Sage publication. London.

Roller, M.R. and Lavrakas, P.J. (2015). Applied Qualitative Research Design: *A total qualitative framework approach.* The Guilford press. New York.

Sandoval, W. A. (2005). Understanding students' practical epistemologies and their influence of learning through inquiry. University of California, Los Angeles.

Shenton, A. (2004). Strategies for ensuring trustworthiness in qualitative research projects. Education for information. 22(3). 63-75.

Shulman, L.S. (1986). Those who understand: A concept of teacher knowledge. American Educator, 10(1). 10-75.

Susan, M. S. Rennie, L.J & Gilbert, J,K (2010), The roles of the formal and informal sectors in the provision of effective science education, Studies in Science Education, 46(1), 1-44

Torff, B. (2003). Developmental changes on teachers' use of higher order thinking and content knowledge. Journal of Educational Psychology, 95, 563-569.

Tran, L. U. (2002). The roles and goals of educators teaching science in non-formal settings. Master's thesis, North Carolina State University, Raleigh.

Tran, L. U. (2006). Teaching science in museums: The pedagogy and goals of museum educators. Centre for Informal Learning and Schools, King's College. London.

Tran & King. (2007). The Professionalization of Museum Educators: The Case in Science Museums, Museum Management and Curatorship, 22(2), 131-149.

Vygotsky, L.S. (1978). Mind in society. The development of higher psychological process. Cambridge, MA: Harvard University Press.

Watermeyer, R. (2012). A conceptualisation of the post-museum as pedagogical space. Journal of Science communication.

Yin, R. K. (2016). Qualitative Research from start to finish. (2nd ed). The Guilford press. New York.

Zhai, J and Dillon, J. (2014). Communicating science to students: Investigating professional botanic garden educators' talk during guided school visit. Journal of research in science teaching, 51(4), 407- 429.

## APPENDICES
## APPENDIX A: OBSERVATION SCHEDULE

**Part one: General information**

<table>
<tr><td colspan="2">Observation Dates: 02/05/2018 – 05/05/2018</td><td colspan="2">Researcher’s name: Bilankulu Hasani Justice</td></tr>
<tr><td colspan="2">Science centre in Pretoria</td><td colspan="2">Names of Education Officers(pseudonym):<br><br>Education Officer A, B & C</td></tr>
<tr><td>Grades: 5, 6 & 7</td><td>Learners : 35 per lesson</td><td>Subject: NS</td><td>Lessons for observation:<br>• The power of microscope<br>• Discovering reptiles<br>• Understanding Biodiversity</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Aim(s):<br>• To understand how microscopes work<br>• To explore the world of reptiles<br>• To understand South African Biodiversity</td></tr>
<tr><td>Scheduled time</td><td>Start time: 10h00</td><td>Time ended: 10h45</td><td>Duration: 45min</td></tr>
</table>

**Part two: Teaching practises**

| **Statement** | **Researcher’s comment** | **Observer’s comment** |
|---|---|---|
| 1. Evidence of the lesson preparation. To check the aim and objective to be attained. | | |

| | | |
|---|---|---|
| 2. The strengths of the education officer in presenting the lesson. | | |
| 3. The objectives of the lesson attained. | | |
| 4. The use of teaching aids in the lesson. | | |
| 5. The teaching method(s) used? | | |
| 6. The preparedness of the education officers to present the lesson | | |
| 7. The involvement of learners in the lesson | | |
| 8. The lesson is learner-centered or teacher centered. | | |
| 9. The area where the lesson is conducted, is it conducive for teaching and learning? | | |
| 10. Facilitating and monitoring of the lesson activities. | | |
| 11. The pedagogical strategies of the education officers | | |
| 12. The use of the facility (science centre) as a teaching resource | | |
| 13. The education officers understanding of the subject matter | | |
| 14. The challenges of the education officers | | |
| 15. The relevance of the lesson to the scientific activities of the center | | |

## APPENDIX B:
## INTERVIEW SCHEDULE
## SEMI STRUCTURED INTERVIEW SCHEDULE.

**Phase 1: Pre- observation.**

1. Please state your science qualifications and your major subjects.
2. Do you have any training or experience in science education/ presentation of lessons?
3. Have you received any training on teaching/presenting of lesson at the science center?
4. The training you received at the science center, did it add any value to your teaching/ presentation skills? Please explain.
5. What is your view on the science education at the science center?
6. In your view, what are the important points to consider before you can present a lesson?
7. Which lesson do prefer to teach/ present and why?
8. What is your view on the use of interactive exhibits in teaching science at the science center?
9. Do you think that is necessary to teach/present lessons to the school groups at the science centre? Please explain.
10. What can you do to arouse learners' interest in science when teaching/presenting a lesson?

**Phase 2: Post- observation.**

11. Did you enjoy teaching/ presenting a science lesson?
12. What is the most part you enjoyed when teaching/ presenting a lesson?
13. What did you find difficult when teaching/ presenting a lesson?
14. When learners asked you questions and you didn't know the answer what did you do?
15. If you realize that learners didn't understand what you were teaching/ presenting, what did you do?

16. Do you always follow the lesson plan when teaching/ presenting a lesson?
17. How do you make science to be more interesting to the learners in your presentation?
18. Which teaching method do you prefer in teaching/ presenting a lesson?
19. What would you like to improve in your lesson presentation?
20. Did you achieve your goals in this lesson?

**APPENDIX C:**
**LETTER TO THE EDUCATION OFFICER**
**PARTICIPANT INFORMATION SHEET**

Date 26 March 2019

Title: The exploration of the teaching practices of education officers at a science centre in Pretoria, Gauteng province

**DEAR PROSPECTIVE PARTICIPANT**

My name is Hasani Justice Bilankulu and I am doing research under the supervision of A V Mudau, a professor in the Department of science towards a M Ed at the University of South Africa. We are inviting you to participate in a study entitled Exploring the teaching practises of the education officers at a science centres in Pretoria, Gauteng province.

This study is expected to collect important information that could help the centre and other science centres when developing their lessons, to consider the need of the school curriculum. The study should inform education officers at other science centres on the practises of others in presenting science topics to reinforce and expand the classroom curriculum. It should also assist the policy developers to look at the contributions of science centre and museum when developing the school curriculum

**WHY AM I BEING INVITED TO PARTICIPATE?**

You are invited because your involvement and the interest you have shown in science education at the science centre.

I obtained your contact details from our first meeting we held at the science centre where I briefed you about the study. Please note that three participants have been selected for this study

**WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?**

Describe the participant's actual role in the study.

The study involves *audio-taping, questionnaires, semi-structured interviews*. You will be observed when presenting a lesson. You will be interviewed on how you present the lesson. The first interview will be done before you present your lesson and the second interview will be done after the lesson. Each interview will last for 15 minutes.

**CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?**

Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent adult form. You are free to withdraw at any time and without giving a reason. All the information given in the study will remain anonymous.

**WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?**

This study is expected to benefit both the participants and the science centre on instructional strategies in science education by reviewing the practices of education officers at the centre. It will also assist the science community with better way of teaching science at science centre.

**ARE THERE ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?**

Since the research involves the day to day task of the participants there is no negative consequences for participating in this research project.

**WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?**

You have the right to insist that your name will not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, will know about your involvement in this research **OR** Your name will not be recorded anywhere and no one will be able to connect you to the answers you give .Your answers will be given a code number or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

Your answers may be reviewed by people responsible for making sure that research is done properly, including the transcriber, external coder, and members of the Research Ethics Review Committee. Otherwise, records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.
All the information gathered in this study will remain anonymous and cannot be traced to your name

> *While every effort will be made by the researcher to ensure that you will not be connected to the information that you share during the focus group, I cannot guarantee that other participants in the focus group will treat information confidentially. I shall, however, encourage all participants to do so. For this reason I advise you not to disclose personally sensitive information in the focus group.*

**HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?**

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet *at the science centre* for future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics

Review and approval if applicable. After such a time *hard copies will be shredded and electronic copies will be permanently deleted from the hard drive of the computer through the use of a relevant software programme)*.

**WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?**

No payment will be given to any participant

**HAS THE STUDY RECEIVED ETHICS APPROVAL**

This study has received written approval from the Research Ethics Review Committee of Unisa science education Department. A copy of the approval letter can be obtained from the researcher if you so wish.

**HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?**

If you would like to be informed of the final research findings, please contact Hasani Justice Bilankulu on 061 077 5343 or email justice@nzg.ac.za

Should you have concerns about the way in which the research has been conducted, you may contact Professor A V Mudau at mudauv@unusa.ac.za.

Thank you for taking time to read this information sheet and for participating in this study.

Thank you.

_____

Hasani Justice Bilankulu

## APPENDIX D:
## LETTER TO THE SCIENCE CENTRE MANAGER

**Request for permission to conduct research at the Science centre**

**Title of the research:**
**An exploration of the teaching practices of education officers at a science centres in Pretoria, Gauteng province.**

Date 26/March 2018

Mr. Ulrich Oberprieler

Conservation Education & Public engagement in science

Tel: 012 328 3265. Ulrich@nzg.ac.za

Dear Mr. Oberpprier,

I, Hasani Justice Bilankulu am doing research under supervision of A.V Mudau, a professor in the Department of science and mathematics education towards a M Ed degree at the University of South Africa. We are inviting you to participate in a study entitled exploring the teaching practices of the education officers at the science centre in Pretoria: Gauteng province.

The aim of the study is to investigate the teaching of science at the science centre.

Your department has been selected because is the one responsible for education support at your institution.

The study will entails observing and interviewing education officer at the centre.

This study should help the centre to improve their teaching/facilitation strategies to address their strategic goals. It should also help other science centres to learn good practices and improve on their instructional strategies.

There is no risk involved in this study

There will be no reimbursement or any incentives for participation in the research.

Feedback procedure will be discussed with the participants at the end of the study before the paper is published.

Yours sincerely
Justice Bilankulu

Education Officer

# APPENDIX: E:
# APPROVAL LETTER FROM THE SCIENCE CENTRE

SANBI
Biodiversity for Life
South African National Biodiversity Institute

NZG/RES/P18/08

**25 April 2018**

**Justice Bilankulu**

**University of South Africa (UNISA)**

**OUTCOME OF SUBMITTED RESEARCH PROPOSAL**

This letter serves to inform you that your submitted research proposal titled "Exploring the teaching practises of the education officers at a science centre in Pretoria: Gauteng Province" was **approved** by the SANBI Research Ethics and Scientific Committee (RESC).

**The following provisos should be taken into consideration:**

1. Inform the RESC of completion or termination (with reason) of your research at the NZG.
2. Submission of an annual progress report in November of each year. Failure to submit a progress report may result in approval to be withdrawn.
3. Submission of a written request for an extension or for any changes within the research project.
4. The following must be used and/or stated in the acknowledgement of the NZG after the completion of the research project:
   - All scientific publications and abstracts (please include PDF documents of all publications) presented at conferences must be submitted with progress reports annually.
   - The NZG Biobank for providing the samples.
   - The NZG for contributing as a research platform.
5. Submission of a final report in December of each year.

**IMPORTANT:** It is your responsibility to ensure compliance to Section 20 of the Animal Diseases Act 1984 (Act 35 of 84) that applies to "investigation, experiment or research". A copy of your section 20 permit must be sent to this office before research can commence.

The research proposal has been registered on the database as P18/08. Please use this project number in all future correspondence.

Thank you for making use of the NZG as a research platform.

## APPENDIX F
## PRE-INTERVIEW FOR EDUCATION OFFICER A

**Researcher**: Ok. Do you mind if I call you Education Officer A?

**Education Officer A**: No problem

**Researche**r: is that fine to be called Education Officer A

**Education Officer A**: yes

**Researcher**: ok good. Alright, this is just a semi structured interview

**Education Officer A**: Yes sir.

**Researche**r: just going to ask you some few questions. Please respond to the best of your knowledge.

**Education Officer A**: ok

**Researcher**: Ok. The first question, can you please state your science qualification if you have any and what are the major subjects?

**Education Officer A**: ok. My science qualification is national diploma in nature conservation.

**Researche**r: yah.

**Education Officer A:** and my major subjects is ecology, it is plants and animal studies, yah, and conservation communication.

**Researcher**: ok. Where did you study?

**Education Officer A**: Tshwane University of technology

**Researcher**: Tshwane alright, TUT.

**Education Officer A**: Yes.

**Researcher**: Ok, do you have any training or experience in science education?

**Education Officer A**: it was, it was part of, my conservation communication because it was part of EE, we had an EE chapter.

**Researcher**: Mmm

**Education Officer A**: Yes, so I guess that's where we were taught a bit about how to communicate. Yah. But not thoroughly like proper training, yah but I feel like that's where we got a bit of knowledge of communicating science.

**Researcher**: But apart from the one that you got while you were studying have you ever attended any training?

**Education Officer A**: nothing, nothing. (Laughs)

**Researcher**: Nothing? As far as presentations are concerned?

**All laugh**

**Education Officer A**: yes, I have nothing (Laughs)

**Researcher**: Ok, ok. Alright, here at this science centre, have you ever received any form of training in terms of teaching or presentation?

**Education Officer A**: Yes, I was given a bit.

**Researcher**: A bit neh?

**Education Officer A**: Yes, and I, I feel like even if I was given training, I gotten… like to be better when I'm doing it myself because, you…, I am getting training but yet, ok I am getting the knowledge but when I'm doing it that's when I feel like yah I can add other things to my…yah the training that I got but yah certain training. **(Laughs)**

**Researcher**: But the training that you got would you say it was useful or what? Was it useful in terms of, of teaching, in terms of presenting at this education lesson, the one that you got at, at the science centre?

**Education Officer A**: Yah, it, it was a bit useful.

**Researcher**: A bit useful?

**Education Officer A**: Yeah

**Researche**r: Ok. Ohh. So would you say it added some value in your…?

**Education Officer A**: Yes, definitely. It did.

**Researcher**: it did neh? Mmm

**Education Officer A**: it did.

**Researcher**: Can you explain a bit, how, why do you think it has added something?

**Education Officer A**: Because you know, the thing about teaching and like since we are a science centre, we, some of us we do not have the background on…, in terms of teaching how to actually get the message and how can we grasp the children's attention like we didn't know such.

**Researcher**: Ok. (**Clears throat**) What's your view on the science education at this science centre specifically? What's your view looking generally at science education at this centre? What's your view?

**Education Officer A**: I feel like there's a, there's a lot, not, there is, yah a lot to be done.

**Researcher**: There's a lot to be done?

**Education Officer A**: Yes.

**Researcher**: Ok.

**Education Officer A**: Because we are so privileged that we have so many animals and everything.

**Researcher**: Mmmm

**Education Officer A**: Like there is, yah, there's so many things going on but I feel like it's just, we giving small info

**Researcher**: Mmm, mmm.

**Education Officer A**: of what we are and what we, what we represent as a science centre. So I feel like there a lot that needs to be explored.

**Researcher**: Ok, Ok. So in your view what are the important points to consider before you can present a lesson?

**Education Officer A**: Ok. First, because in my, according to my experience,

**Researcher**: Mmm

**Education Officer A**: before I can give a lesson to the kids I look at the grade. It's important to know their grade

**Researcher**: Mmm

**Education Officer A**: you can't be presenting a lesson the same way for the grade threes the same that you would be presenting it to the grade sevens. So to know the kids age, the level of understanding and yah and mainly the teaching method

that the teachers use because you could ask the teachers what mode of language do they use and they would tell you ok they use this, they use English. So I feel like that's the most important thing, then that's when you can actually lay out your presentation properly.

**Researcher**: Mmmm

**Education Officer A**: Yah

**Researcher**: Looking at the lessons that are being offered at this science centre, which one would you prefer to, to present?

**Education Officer A**: The reptiles.

**Researcher**: Reptiles, why?

**Education Officer A**: Yes. Yoh, reptiles are fascinating. Animals for me… and I feel like there is a lot that kids don't know

**Researcher**: Mmm

**Education Officer A**: they don't know, they just know yah the're creepy and crawlies. They don't know. So us giving them the fun part of it but yet add the knowledge to. I feel like this way they will break, you know, that stereotypic whatever. They will just forget about what they know and now they will apply science to it. Ok so these animals are like this. They will get a better understanding of what they are. Yah. So that's reptiles.

**Researcher**: Tell me, what's your view of the use of interactive exhibits like resources in… in teaching science at a science centre?

**Education Officer A**: for me it's very important more than anything. For me… because even myself at school I was given the theory part but the most interesting was, for me doing practicals. Because that's when I got to see whatever I was reading in a book or was writing about in a test. So kids coming here and actually feeling and touching the crocodile skin, it enhances their imagination and you get to be closer to the animal, understand it more than just the information that they have. So it's very important, yah. For me, yah, it's very important.

**Researcher**: Tell me, do you think it is necessary to teach or to present the lesson to the school groups at the science centre? Do you think is necessary, the schools that are coming in here? Do you think it's important to teach them?

**Education Officer A**: It's very important because kids might come in here to see lions and everything but they are young minds. They need to be groomed, you know.

They need to get that information not just about leisure. They need to get these lessons for them to understand. Because hopefully they might be the future environmentalist that join us in the field. So they need to know that.

**Researcher**: Ok. What can you do to arouse learner's interest in science at this science centre when presenting a lesson? What are the things that you do or what do you think one can do most especially to you as a presenter to arouse the leaner's interest in science?

**Education Officer A**: For me it's just fixing my …….. If I as an Education Officer am aligned with what I am doing, the attitude is correct and also the material that I am using, I feel like that's what gives me more confidence because I know that this is not what they get at school so I am giving them something different and something that they will never forget hopefully. So it's my material and my confidence and attitude as a teacher. Just bringing them more materials because what I have experienced is that these kids they would come with questions, they come with questions but certain things you can't just explain them without them actually seeing whatever that you say to them. So they have sort of made me to want to research more and look for more other material to actually add to what I have so that it can make it easier for me when I talk about this, they actually see it. Because what we also do is that we take them to the alligators so that they can see whatever we were talking about. If we were telling them about the difference between a crocodile and an alligator they have to see that. So it's material, material all the way.

**Researcher**: Ok. Do you think a group size of learners, whether it's a large group or a small group, does it have any impact on your presentation to you as an individual, as a teacher or as a presenter, does the group size, a number of learners have any impact on how you present your lesson?

**Education Officer A**: Ahh I can say yes and no, because it depends on the venue. Yes, so if my venue cannot accommodate all of the kids then it's going to be a problem but even if it's a large group then still I can be able to accommodate them then its fine because I feel like it's just going to cause … kids when they are all there, there won't be any focus. So there has to be a conducive environment for everyone.

**Researcher**: Ok.

**Education Officer A**: Yah.

**Researcher**: Alright. Thank you so much ehh, I said I will call you Education Officer A.

**Education Officer A**: Education Officer A. (Laughs).

**Researcher**: yah, thank you so much Education Officer A for the information that you just gave me. Like I said in our meeting this is between me and you. The information ends here. And if you feel like I have asked some unfair questions to you please you need to tell me that this question was really unfair, and if you feel like maybe there are some other questions that you didn't answer well you can tell me. Is there any question maybe that you would like to ask or anything that you want to say?

**Education Officer A**: ahh, not for now. But I will ask maybe later on.

**Researcher**: Ok.

**Education Officer A**: Yeah.

**Researcher**: Thank you so much neh.

**Education Officer A**: Thank you.

**Post interview**

**Researcher**: (Clears throat). Ok Education Officer A thank you very much for the wonderful presentation. I just want to ask you some few questions based on the lesson that you were presenting. And they are just very few, I hope you will bear with me they won't take much time. We will finish very soon. The first question that I would like to know from you, tell me what did you enjoy most about presenting this science lesson?

**Education Officer A**: Yooo. What's so interesting about this lesson is that kids are not very often exposed to such especially the reptile lesson so it's…, it's like me introducing a new sight of reptiles, them seeing them and yah getting to actually touch some of the things that I use during the lessons, yah, that's mostly exciting.

**Researcher**: Ok. Is there anything that you find to be difficult when you are presenting the lesson?

**Education Officer A**: Yes because often the kids are frightened, yah, so it takes a lot convincing for me to actually, you know, grab the, the child's attention and everything so I have to really be sweet and soft and everything so that they may not be frightened as much, yah, about reptiles.

**Researcher**: With the content of the lesson and the information that you were presenting was there anything that you find it to be difficult on your side?

**Education Officer A**: No. It wasn't difficult because I had to present it in my own way although the content… because I can't be too scientific when I present my presentation so I have to at least try to accommodate the kids and understand the age groups there so it wasn't a lot, yah it wasn't difficult. Yah.

**Researcher**: When learners ask you questions and you didn't have an answer for that question how did you respond to that?

**Education Officer A**: Yooo. Ahhh. I would often say I am not sure but I would tell them referring to something maybe that I am a bit sure about but I would tell them you know what, I am not sure but then you can take a look at that maybe google because now there is a use of technology but I won't dismiss the question or… I would just use a similar comparison to, yah, to what they asked me. So yah, at least they should get a better understanding of yah, what they are trying to know, want to know actually.

**Researcher**: If you realise that you didn't understand some of the concepts that you were teaching how do you deal with that? You find out that there is something that wants to explain and you don't understand it that much, how do you deal with that?

**Education Officer A**: At that moment or before the lesson?

**Researcher**: Let's say at the moment of the lesson was there anything that you feel you didn't understand much **(Education Officer A clears throat)** and if any, how did you respond?

**Education Officer A**: If…In particular because if I were to explain probably a certain part of that reptile especially the snakes if I'm not sure of how it really functions I'm not going to try to, try to go deep into it. I would just generalise it knowing ok, this is what it does but then I'm not going to specify ok, this one does this in particular and everything. So I'm not gonna go too much into it because I will just try like, it's like opening a can of worms, people want to know more, ok, how does it work and it is just, yah, not good at all.

**Researcher**: When presenting this lessons do you always follow the lesson plan? And looking at the lesson that you presented today, were you following the lesson plan as it is or?

**Education Officer A**: I would say yes and no because you must have a structured lesson plan. Yes you must cover all the aspects but sometimes there are things where they just arise and you would see that kids would want to know certain things which were not part of the, the lesson plan. Then that's when then I sort of go out of

it then try to make things to be relevant to, yah, just use examples that are relevant to them at the moment, so yah. It's both yes and no. Yah.

**Researcher**: What, what teaching method would you prefer or you using to present this lesson?

**Education Officer A**: I prefer to actually to go hands -on. Ehh I don't just give information to kids. I want them to actually be able to touch whatever that I am using but in doing so I make sure that there is order, there has to be order because kids can't be like…, like confused or whatever not focused during the presentations. I make sure ok I give them what they have to know yet they become hands on during the lesson. So that's what I use mostly.

**Researcher**: So on this lesson what is it that you would like to improve?

**Education Officer A**: I would like to improve the teaching material because, yah, some of the things they are not as clear but I would like… yah that's the... like my teaching resources, I would like to improve them and yah. Yah I guess that's what I have to improve at the moment.

**Researcher**: Ok what do you think, have you achieved your goals in this lesson?

**Education Officer A**: Yah I think I do, I do because especially when it comes to… if I were to use snakes for example. Like we are trying to tell… make these kids aware that you know killing snakes it's not good even if, you know, you might be frightened of it because there is a culture there where kids if there's a snake coming into their houses they have to kill it or something. So I am hoping that ehh yah, like I'm really achieving like trying to be make these kids to be convinced not to kill these snakes. So yah, some of them are saying yah I'm convinced…

**Researcher**: Ok. Thank you very much Education Officer A. Is there anything that you would like to tell me about the teaching of reptiles? Anything that you feel that I have to know?

**Education Officer A**: Ok. I feel like when teaching reptiles you have to use uhmm like scenarios that kids are able to relate with. It's not just you telling them all those scientific names about reptiles and everything but you have to relate it to, like them as human beings and for them to understand the difference between reptiles and humans is that we have a different way of adapting and also reptiles have another way of adapting so what I often do is like if I ever want to explain how they, they adapt in terms of the temperature and everything, I would use us as humans, we have to wear jerseys and drink coffee and everything but they rely more on the environment. So such things they make the kids to be able to understand, ok this is

what makes reptiles different, this is… so it's like using whatever that's happening at the moment, something that's relevant. So I feel like that is more useful when teaching such a lesson. You are not just giving information it's like using examples that kids are able to relate with.

**Researcher**: Ok.

**Education Officer A**: So yah…

**Researcher**: Alright. Thank you very much.

**Education Officer A**: Thank you.

## APPENDIX G
## EDUCATION OFFICER A OBSERVATION

**Education Officer A**: Good morning.

**All learners**: Good morning.

**Education Officer A**: How are you?

**Learners**: we are good

**Education Officer A**: I am good as well. I am mam' **Letlhaka**. I am going to teach you about reptiles. Ok, who can tell me what is a reptile? What kind of an animal is it? How does it look like? Explain to me what kind of an animal is a reptile. You can say anything. You can rise your hands, don't be afraid.

**Learner 1**: ……..

**All learners**: **(**laugh**)**

**Education Officer A**: don't laugh. Or snake right? Ok, another one? How do they walk? Let us talk.

**Teacher 1**: Yes. Keeping quite will not help.

**Education Officer A**: You want to finish here and go to national symbols right?

**Learners**: Yes.

**Teacher 1**: And speaking does not mean you are able, you just try and speak what you think it is.

**Education Officer A**: Yes. That's it. Nobody is wrong. I don't beat learners. Yes…

**Learner 2**: Crocodile

**Education Officer A**: Crocodile… another one…

**Learner 3**: Lion.

**Education Officer A**: Lion on the reptiles? Another one? Ok

**Learner 4**: Lizard

**Education Officer A**: Lizard neh. Ok, most of the time it is said that reptiles are cold blooded animals. What do we mean when we say an animal is cold blooded?

**Learner 1**: it is dangerous.

**Education Officer A**: it is dangerous. Another one says what? **[Pause]** Ok let me give you an example. When we people feel cold what do we do so that we can keep warm?

**Learner 1**: we stand next to the fire.

**Education Officer A**: We stand by the fire. Another one?

**Learner 3**: We wear jerseys.

**Education Officer A**: we wear a jersey. Another one?

**Learner 4**: We use a heater.

**Education Officer A**: We keep warm by a heater, we drink coffee because we want to keep warm right? But who has seen a snake having a cup of tea or coffee? You have not seen it neh?

**All Learners**: No (**laughs**).

**Education Officer A**: Have you seen one? Have you seen a crocodile folding its feet wearing a jersey? Have you seen it? You have not seen it neh?

**All Learners**: No (**Laughs**)

**Education Officer A**: So what do they do to keep warm? How do reptiles keep warm?

**Learner 3**: They stay inside a cave.

**Education Officer A**: They stay inside a cave. What does another one say?

**Learner 5**: Inside their enclosure.

**Education Officer A**: Ok. **(All laugh).** What does another one say? Haven't you seen a lizard warming itself on the sun laying on top of a rock?

**All Learners**: We have seen.

**Education Officer A**: Yes. Most of the reptiles bask on the sun meaning they keep warm by sitting on the sun.

**Education Officer A**: I also want to make an example, who knows this animal? What is its name?

**Learner 6**: Crocodile

**Education Officer A**: it is Crocodile neh. So when I do this what do you hear?

**Learner 6**: Sound.

**Education Officer A**: Sound, what kind of a sound?

**Learner 3**: it is rough

**Education Officer A**: its rough neh, it's dry. Do you hear that?

**All Learners**: Yes

**Education Officer A**: So, many reptiles have dry scales neh. So their skin is very dry. Their skin is not like that of a human. If I scratch my skin you won't hear that sound. So they are cold blooded and they also have dry scales. Let us all say that…

**All Learners**: They are cold blooded and they have dry scales.

**Education Officer A**: Yes, dry scales right.

**Education Officer A**: So we have three types of reptiles, we have the first one which is crocodiles and alligators. Who knows an alligator? Do you know what kind of an animal it is? It almost looks like a crocodile, often times when people see an alligator they say it's a crocodile. But what is the difference between them? I will show you when we are done here. They are just outside. Crocodile's mouth is shaped like a V shape. Can you see how it is shaped? However that of an alligator is shaped like a U shape. You will see by the mouth that this one is not a crocodile it is an alligator. And there is a second one called testudines. I want you to tell me first which animal houses itself in this shell? Who is it for?

**Learner 7**: Tortoise.

**Education Officer A**: It is for tortoise neh. So why do tortoise have this? What do you call this housing?

**Learner 7**: Shell.

**Education Officer A**: It is a shell neh. So why do they have a shell at the back?

**Learner 3**: So they can be protected.

**Education Officer A**: Yes, they want to be protected from what?

**Learner 3**: when they see a person they hide inside.

**Education Officer A**: Yes, it is for protection against predators. So that other animals will not eat it. And there is also a cousin of tortoise. Often people say that it is a tortoise but it is not a tortoise. We have a turtle neh. Who knows a turtle? Do you know it?

**Learner 8**: Yes.

**Education Officer A**: Where does it live mostly?

**Learner 5**: In water.

**Education Officer A**: In what kind of water?

**Learner 7**: Green water.

**Education Officer A**: Green water? But how is the water? Is it like the water that you are used to?

**All Learners**: No

**Education Officer A**: how is it? Look at the water at the back, in the picture. Where is this water found?

**Few Learners**: Sea water.

**Education Officer A**: Sea water neh, it is salt water, you get turtles. Then there is a small one called terrapin. What do you call it?

**All Learners**: Terrapin.

**Education Officer A**: Terrapin neh. In which type of water does it live in? If it's not salt water how is it?

**Few Learners**: it is clean.

**Education Officer A**: It does not have salt neh. So which water does not have salt?

**Learner 1**: it is rain water.

**Education Officer A**: it is rain water. But often where do you get the water? In rivers and dams right?

**All Learners**: Yes.

**Education Officer A**: that is where you find them most. And who can tell me where can you find a tortoise? Where does it live? Where do you see it often? You find turtle in salt water, terrapin in water that does not have salt. What about tortoise?

**Learner 3**: In the bushes.

**Education Officer A**: Ok. On the land. It does not live in the water right?

**All Learners**: Yes.

**Education Officer A**: Then the last group we call it schoamata. Where there are lizards and snakes neh. Ok so who can tell me what is this?

**Learner 3**: It is a chameleon.

**Education Officer A**: Chameleon neh. So what is it known for?

**Few Learners**: For changing colours.

**Education Officer A**: For changing colour neh. So when it changes colour does it mean it likes fashion or what? Why does it change colours?

**Learner 6**: For protection.

**Education Officer A**: For protection neh. When it does not want other animals to see it and also when it wants food. Say there was a grasshopper and the chameleon wants to eat it, it has to change to the colour of its environment so that the grasshopper will not be able to see it.
Ahh, the last group that I love with all my heart is snakes. Who loves snakes in here? No one?? No ways! They are loved by the young ones. Is it the older ones who throw stones at snakes? You pour paraffin on them? You set them on fire? What do you do when you see a snake?

**Learner 9**: I run.

**Education Officer A**: You run?

**Other Learners**: we kill it.

**Education Officer A**: You see. What do you kill it with?

**Other Learners**: With rocks.

**Education Officer A**: Ok. In the group of snakes, we have snakes with venom and those without venom. We don't say a snake has poison we called it venom. What is it called?

**All Learners**: Venom.

**Education Officer A**: Yes, we don't say a snake has poison it has venom. Those that don't have venom, who knows this snake? Don't you watch movies?

**Learners**: We do.

**Education Officer A**: what is this snake?

**Learner 3**: Anaconda.

**Education Officer A**: Yes but we don't say 'underconda' right, it is ana-conda. What do we say?

**All Learners**: Anaconda.

**Education Officer A**: Anaconda neh. So on the movie they say it eats people. Is it true?

**Some Learners**: No.

**Other Learners**: Yes.

**Education Officer A**: Who says it is not true? Others what do you say or you don't know if it is true or not?

**All Learners**: **[All laugh]**

**Teacher 1**: I am afraid of snakes with all my heart.

**[All laugh]**

**Education Officer A**: Sorry teacher. Ok. So anaconda cannot swallow a person like me, can you see how broad are my shoulders, I am big. However it can a swallow a small child because they are still small. And it can also swallow a goat because its shoulders are straight. Yes. So when it is about to swallow that goat what will it do first?

**Learner 6**: It wraps you.

**Education Officer A**: It wraps you around first neh, then what does it do?

**Learner 6**: it breaks your bones.

**Education Officer A**: It breaks your bones and you suffocate. Then what does it do?

**Learner 6**: Then it eats you.

**Education Officer A**: Yes. This one does not have venom. Then there are ones which have venom like this one (demonstrates with a picture). It is puff adder neh.

This one insert its fangs in the flesh and releases venom but there are other ones that look like this (demonstrates with a picture). Who knows this snake?

**Most Learners**: Cobra.

**Education Officer A**: It is cobra neh. It is called Mozambiquean spitting cobra neh. Where does this one insert venom?

**Learner 4**: It spits it.

**Education Officer A**: Where?

**Learner 4**: On the eyes.

**Education Officer A**: On the eyes neh. So let us say it is standing three meters away from me it can spit its venom on my eyes, if I am not wearing my reading glasses then it will enter my eyes. So what must one use to remove the venom from the eyes? What must you remove it with? If you don't remove you will go blind. So then what must you remove it with?

**Learner 1**: You go to the doctor.

**Education Officer A**: Ok. Before you got to the doctor? You know we take time before going to the doctor. So before you go to the doctor what must you remove it with?
With water neh. Clean water, you don't add anything just clean water. Then you can see a doctor.

**Learner 1**: Yes.

**Education Officer A**: Let us say you are at the mountain, you are playing then a snake spit its venom on your eyes and there is no water, there is no river nearby. What must you use? There is no water? Urine.

(All laugh)

**Education Officer A**: You must use urine. Immediately when you pass urine you must use it to wash your eyes then you will go to the hospital. Say you don't have urine and your friend nearby has it, you will have to use your friend's urine to wash your eyes. Who can do that? You have to do it.

**(All Laugh)**

**Education Officer A**: Ok. The last one, I want show you what you must do when you see a snake inside the house. What will you do? Let's say you are from playing, then when you get inside the house you see a snake, what must you do?

**Learner 8**: I will hit it with a rock.

**Education Officer A**: You will do what? Hit it with a rock? What will another one do?

**Learner 4**: I will call my parents.

**Education Officer A**: Ok. Before you call them, you know what you must do? The moment you see it you go back while looking at it otherwise it might go under the bed then you will have to turn every furnisher in the house to find the snake. So you must look at it to make sure it doesn't go anywhere. When you are a bit far from it then you will call a parent and then a parent will call the people who work at SPCA who will come and collect it. Don't pour patrol or paraffin and throw stones at it please, don't kill the snakes. What do they help with?

**Few Learners**: They eat rats.

**Education Officer A**: Yes. They help with eating rats. When there are too many rats what is going to happen?

**Few Learners**: They are going to eat clothes.

**Education Officer A**: You will find your school jersey with holes because it was eaten by rats or your lunch box eaten by rats. It is not nice neh. So snakes help with eating rats neh. Ok thank you. Who has a question then you will go to national symbols? You can ask anything you want to know about snakes. You will go out with a line and you will touch, whoever is not scared if you are not scared don't touch, you will touch the crocodile skin, the shell of a tortoise then go out. As you go out you will see alligators.

## APPENDIX H:
## TYPOLOGY: EDUCATION OFFICER A

Coding for Education officer A

| | Descriptions | Comments (codes) |
|---|---|---|
| 1 | **Researcher**: Ok, ehm. Do you mind if I call | |
| 2 | you Education officer A? | |
| 3 | **Education officer A**: No problem | |
| 4 | **Researche**r: is that fine to be called | |
| 5 | Education officer A | |
| 6 | **Education officer A**: yes | |
| 7 | **Researcher**: ok good. Alright ehm, this is | |
| 8 | just a semi structured interview | |
| 9 | **Researche**r: just going to ask you some few | |
| 10 | questions. Ahh Please respond to the best of | |
| 11 | your knowledge. | |
| 12 | **Researcher**: Ok. The first question, can you | |
| 13 | please state your science qualification if you | |
| 14 | have any and what are the major subjects? | |
| 15 | **Education officer A**: ok. My science | |
| 16 | qualification is national diploma in nature | |
| 17 | conservation. | |
| 18 | **Education officer A:** and my major subjects | |
| 19 | is ecology, it is plants and animal studies, | |
| 20 | yah, and conservation communication. | |
| 21 | **Researcher**: Ahh ok. Where did you study? | |
| 22 | **Education officer A**: Tshwane University of | |
| 23 | technology | |
| 24 | **Researcher**: Tshwane alright, TUT. | |
| 25 | | |

| | | |
|---|---|---|
| 26<br>27<br>28 | **Researcher**: Ok, ok. Uhm **(clears throat)** do you have any training or experience in science education | |
| 29<br>30<br>31<br>32 | **Education officer A**: it was, it was part of, uhh my conservation communication because it was part of EE, we had an EE chapter. | |
| 33 | **Researcher**: Mmm | |
| 34<br>35<br>36<br>37<br>38<br>39 | **Education officer A**: Yes, so I guess that's where we were taught a bit about how to communicate. Yah. But not thoroughly like proper training, yah but I feel like that's where we got a bit of knowledge of communicating science. | |
| 40<br>41<br>42 | **Researcher**: But apart from the one that you got while you were studying have you ever attended any training? | |
| 43<br>44 | **Education officer A**: nothing, nothing. (Laughs) | |
| 45<br>46 | **Researcher**: Nothing? As far as presentations are concerned? | |
| 47<br>48 | **Education officer A**: yes, I have nothing (Laughs) | |
| 49<br>50<br>51<br>52 | **Researcher**: Ok, ok. Alright, here at this science centre, have you ever received any form of training in terms of teaching or presentation? | |
| 53 | **Education officer A**: Yes, I was given a bit. | |
| 54 | **Researcher**: A bit neh? | |
| 55<br>56 | **Education officer A**: Yes, and I, I feel like even if I was given training, I gotten… like to | |

| | | |
|---|---|---|
| 57 | be better when I'm doing it myself because, | |
| 58 | you…, I am getting training but yet, ok I am | |
| 59 | getting the knowledge but when I'm doing it | |
| 60 | that's when I feel like yah I can add other | |
| 61 | things to my…yah the training that I got but | Pedagogical |
| 62 | yah certain training. **(Laughs)** | knowledge, making the |
| 63 | **Researcher**: But the training that you got | message clear to the |
| 64 | would you say it was useful or what? Was it | learners |
| 65 | useful in terms of, of teaching, in terms of | |
| 66 | presenting at this education lesson, the one | |
| 67 | that you got at, at the science centre? | |
| 68 | **Education officer A**: Yah, it, it was a bit | |
| 69 | useful. | |
| 70 | **Researche**r: Ok. Ohh ok, ok. So would you | |
| 71 | say it added some value in your…? | |
| 72 | **Education officer A**: Yes, definitely. It did. | |
| 73 | **Researcher**: Can you explain a bit, how, | |
| 74 | why do you think it has added something? | |
| 75 | **Education officer A**: Because you know, | |
| 76 | the thing about teaching and like since we | |
| 78 | are a science centre, we, some of us we do | |
| 79 | not have the background on teaching, in | |
| 80 | terms of how to actually get the message | |
| 81 | and how can we grasp the children's | |
| 82 | attention. | |
| 83 | **Researcher**: Mmmm. Ok. (**Clears throat**) | Pedagogical |
| 84 | What's your view on the science education | knowledge, moving |
| 85 | at this science centre specifically? What's | from known to |
| 86 | your view looking generally at science | unknown-prior |
| 87 | education at this centre? What's your view? | knowledge |
| 88 | | |

| | | |
|---|---|---|
| 89<br>90<br>91<br>92<br>93<br>94<br>95<br>96<br>97<br>98<br>99<br>100<br>101<br>102<br>103<br>104<br>105<br>106<br>107<br>108<br>109<br>110<br>112<br>113<br>114<br>115<br>116<br>117<br>118<br>119<br>120 | **Education officer A**: I feel like there's a, there's a lot, not, there is, yah a lot to be done. Because we are so privileged that we have so many animals and everything.<br>**Education officer A**: Like there is, yah, there's so many things going on but I feel like it's just, we giving small info of what we are and what we, what we represent as a science centre. So I feel like there a lot that needs to be explored.<br>**Researcher**: Ok, Ok. So in your view what are the ehh important points to consider before you can present a lesson?<br>**Education officer A**: Ok. First, because in my, according to my experience,<br>**Researcher**: Mmm<br>**Education officer A**: before I can give a lesson to the kids I look at the grade. It's important to know their grade and what they already know<br>**Researcher**: ok<br>**Education officer A**: you can't be presenting a lesson the same way for the grade threes the same that you would be presenting it to the grade sevens. So to know the kids age, the level of understanding and yah and mainly the teaching method that the teachers use because you could ask the teachers what mode of language do they use and they would tell you ok they use this, they use English. So I feel like that's the most | Content knowledge, subject matter information to the learners |

| | | |
|---|---|---|
| 121 | important thing, then that's when you can | Knowledge of the |
| 122 | actually lay out your presentation properly. | exhibits/resources used |
| 123 | **Researcher**: Mmmm | in teaching |
| 124 | **Education officer A**: Yah | |
| 125 | **Researcher**: Looking at the lessons that are | |
| 126 | being offered at this science centre, which | |
| 127 | one would you prefer to, to present? | |
| 128 | **Education officer A**: The reptiles. | |
| 129 | **Researcher**: Reptiles, why? | |
| 130 | **Education officer A**: Yes. Yoh, reptiles are | |
| 131 | fascinating. Animals for me… and I feel like | |
| 132 | there is a lot that kids don't know | |
| 133 | **Researcher**: Mmm | |
| 134 | **Education officer A**: they don't know, they | |
| 135 | just know yah the're creepy and crawlies. | |
| 136 | They don't know. So us giving them the fun | |
| 137 | part of it but yet add the knowledge to. I feel | |
| 138 | like this way they will break, you know, that | |
| 139 | stereotypic whatever. They will just forget | |
| 140 | about what they know and now they will | |
| 141 | apply science to it. Ok so these animals are | Content knowledge, |
| 142 | like this. They will get a better understanding | importance of subject |
| 143 | of what they are. Yah. So that's reptiles. | matter knowledge |
| 144 | **Researcher**: What's your view of the use of | |
| 145 | interactive e exhibits like resources in… in | |
| 146 | teaching science at a science centre? | |
| 147 | **Education officer A**: for me it's very | |
| 148 | important more than anything. For me… | |
| 149 | because even myself at school I was given | |
| 150 | the theory part but the most interesting was, | |
| 151 | for me doing practicals. Because that's when | |

| | | |
|---|---|---|
| 152 | I got to see whatever I was reading in a book | |
| 153 | or was writing about in a test. So kids coming | |
| 154 | here and actually feeling and touching the | |
| 155 | crocodile skin, it enhances their imagination | |
| 156 | and you get to be closer to the animal, | |
| 157 | understand it more than just the information | |
| 158 | that they have. So it's very important, yah. | Importance of |
| 159 | For me, yah, it's very important. | resources (resource |
| 160 | **Researcher**: Tell me, do you think it is | knowledge) |
| 161 | necessary to teach or to present ehh the | |
| 162 | lesson to the school groups at the science | |
| 163 | centre? Do you think is necessary, the | |
| 164 | schools that are coming in here? Do you | |
| 165 | think it's important to teach them? | |
| 166 | **Education officer A**: It's very important | |
| 167 | because kids might come in here to see lions | |
| 168 | and everything but they are young minds. | |
| 169 | They need to be groomed, you know. They | Resource/exhibits |
| 170 | need to get that information not just about | knowledge, showing |
| 171 | leisure. They need to get these lessons for | learners the exhibits |
| 172 | them to understand. Because hopefully they | |
| 173 | might be the future environmentalist that join | |
| 174 | us in the field. So they need to know that. | |
| 175 | **Researcher**: Ok. What can you do to arouse learner's interest in science at this science centre when presenting a lesson? What are the things that you do or what do you think | |
| 176 | one can do most especially to you as a | |
| 177 | presenter to arouse the leaner's interest in | |
| 178 | science? | |
| 179 | | |

| | | |
|---|---|---|
| 180 | **Education officer A**: For me it's just fixing | |
| 181 | my …….. If I as a Education officer Am | |
| 182 | aligned with what I am doing, the attitude is | |
| 183 | correct and also the material that I am using, | |
| 184 | I feel like that's what gives me more | |
| 185 | confidence because I know that this is not | |
| 186 | what they get at school so I am giving them | |
| 187 | something different and something that they | |
| 188 | will never forget hopefully. So it's my material | |
| 189 | and my exhibits and attitude as a teacher. | |
| 190 | Just bringing more materials because what I | |
| 191 | have experienced is that these kids they | |
| 192 | would come with questions, they come with | |
| 193 | questions but certain things you can't just | |
| 194 | explain them without them actually seeing | |
| 195 | whatever that you say to them. So they have | |
| 196 | sort of made me to want to research more | |
| 197 | and look for more other material to actually | |
| 198 | add to what I have so that it can make it | |
| 199 | easier for me when I talk about this, they | |
| 200 | actually see it. Because what we also do is | |
| 201 | that we take them to the alligators so that | |
| 202 | they can see whatever we were talking | |
| 203 | about. If we were telling them about the | |
| 204 | difference between a crocodile and an | |
| 205 | alligator they have to see that. So it's | |
| 206 | material, material all the way. | |
| 207 | **Researcher**: Ok. Do you think a group size | |
| 208 | of learners, whether it's a large group or a | |
| 209 | small group, does it have any impact on your | |
| 210 | presentation to you as an individual, as a | |

| | | |
|---|---|---|
| 211 | teacher or as a presenter, does the group | The use of exhibits in |
| 213 | size, a number of learners have any impact | teaching about reptiles |
| 214 | on how you present your lesson? | – resource knowledge |
| 215 | **Education officer A**: Ahh I can say yes and | |
| 216 | no, because it depends on the venue. Yes, | |
| 217 | so if my venue cannot accommodate all of | |
| 218 | the kids then it's going to be a problem but | |
| 219 | even if it's a large group then still I can be | |
| 220 | able to accommodate them then its fine | |
| 221 | because I feel like it's just going to cause … | |
| 222 | kids when they are all there, there won't be | **Getting the attention** |
| 223 | any focus. So there has to be a conducive | **of the learners,** |
| 224 | environment for everyone. | **pedagogical** |
| 225 | **Researcher**: yah, thank you so much | **knowledge** |
| 226 | Education officer A for the information that | |
| 227 | you just gave me. Like I said in our meeting | |
| 228 | this is between me and you. The information | |
| 229 | ends here. And if you feel like I have asked | |
| 230 | some unfair questions to you please you | |
| 231 | need to tell me that this question was really | |
| 232 | unfair, and if you feel like maybe there are | |
| 233 | some other questions that you didn't answer | |
| 234 | well you can tell me. Is there any question | |
| 235 | maybe that you would like to ask or anything | |
| 236 | that you want to say? | |
| 237 | **Education officer A**: ahh, not for now. But I | |
| 238 | will ask maybe later on. | Pedagogical |
| 239 | **Researcher**: Ok. | knowledge, simplifying |
| 240 | **Post interview.** | concepts |
| 241 | **RESEARCHER**: (Clears throat). Ok | |
| 242 | Education officer A thank you very much for | |

| | | |
|---|---|---|
| 243 | the wonderful presentation. Ehh I just want | |
| 244 | to ask you some few questions based on the | |
| 245 | lesson that you were presenting. And they | |
| 246 | are just very few, I hope you will bear with | |
| 247 | me they won't take much time. We will finish | |
| 248 | very soon. The first question that I would like | |
| 249 | to know from you, tell me what did you enjoy | |
| 250 | most about presenting this science lesson? | |
| 251 | **EDUCATION OFFICER A**: Yooo. What's so | |
| 252 | interesting about this lesson is that kids are | |
| 253 | not very often exposed to such especially the | **Pedagogical** |
| 254 | reptile lesson so it's…, it's like me | **knowledge, helping** |
| 255 | introducing a new sight of reptiles, them | **learners understand** |
| 256 | seeing them and yah getting to actually | **the content** |
| 157 | touch some of the things that I use during the | |
| 258 | lessons, yah, that's mostly exciting. | |
| 259 | **RESEARCHER**: Ok. Is there anything that | |
| 260 | you find to be difficult when you are | |
| 261 | presenting the lesson? | |
| 262 | **EDUCATION OFFICER A**: | |
| 263 | **RESEARCHER**: With the content of the | |
| 264 | lesson and the information that you were | |
| 265 | presenting was there anything that you find it | |
| 266 | to be difficult on your side? | |
| 267 | **EDUCATION OFFICER A**: No. It wasn't | |
| 268 | difficult because I had to present it in my own | Pedagogical |
| 269 | way although the content… because I can't | knowledge, being able |
| 270 | be too scientific when I present my | to simplify the subject |
| 271 | presentation so I have to at least try to | content |
| 272 | accommodate the kids and understand the | Structured lesson |
| 273 | | according to the lesson |

| | | |
|---|---|---|
| 274<br>275 | age groups there so it wasn't a lot, yah it wasn't difficult. Yah. | plan – resource knowledge |
| 276<br>277<br>278 | **RESEARCHER**: When learners ask you questions and you didn't have an answer for that question how did you respond to that? | |
| 279<br>280<br>281<br>282<br>283<br>284<br>285<br>286<br>287<br>288<br>289<br>290<br>291<br>292<br>293<br>294<br>295<br>296<br>297<br><br><br>298<br>299<br>300<br>301<br>302 | **EDUCATION OFFICER A**: Yooo. Ahhh. I would often say I am not sure but I would tell them referring to something maybe that I am a bit sure about but I would tell them you know what, I am not sure but then you can take a look at that maybe google because now there is a use of technology but I won't dismiss the question or… I would just use a similar comparison to, yah, to what they asked me. So yah, at least they should get a better understanding of yah, what they are trying to know, want to know actually.<br>**RESEARCHER**: If you realise that you didn't understand some of the concepts that you were teaching how do you deal with that? You find out that there is something that want to explain and you don't understand it that much, how do you deal with that?<br>**EDUCATION OFFICER A**: At that moment or before the lesson?<br>**RESEARCHER**: Let's say at the moment of the lesson was there anything that you feel you didn't understand much **(Education officer A clears throat)** and if any, how did you respond? | Pedagogical knowledge plus<br>Resource knowledge<br><br><br><br><br><br><br><br>Resource knowledge by improving the resource used.<br><br><br><br><br><br>Resource knowledge, where aims and goals are stipulated in the lesson plan |

| | | |
|---|---|---|
| 303 | **DUCATION OFFICER A**: If…In particular | |
| 304 | because if I were to explain probably a | |
| 305 | certain part of that reptile especially the | |
| 306 | snakes if I'm not sure of how it really | |
| 307 | functions I'm not gonna try to, try to go deep | |
| 308 | into it. I would just generalise it knowing ok, | |
| 309 | this is what it does but then I'm not gonna | Pedagogical knowledge |
| 310 | specify ok, this one does this in particular | where context is used. |
| 311 | and everything. So I'm not gonna go too | |
| 312 | much into it because I will just try like, it's like | |
| 313 | opening a can of worms, people want to | |
| 314 | know more, ok, how does it work and it is | |
| 315 | just, yah, not good at all. | |
| 316 | **RESEARCHER**: When presenting this | |
| 317 | lesson were you following the lesson plan? | |
| 318 | And looking at the lesson that you presented | |
| 319 | today, were you following the lesson plan as | |
| 320 | it is or? | |
| 321 | **EDUCATION OFFICER A**: I would say yes | |
| 322 | and no because you must have a structured | |
| 323 | lesson plan. Yes you must cover all the | |
| 324 | aspects but sometimes there are things | |
| 325 | where they just arise and you would see that | |
| 326 | kids would want to know certain things which | |
| 327 | were not part of the, the lesson plan. Then | |
| 328 | that's when then I sort of go out of it then try | |
| 329 | to make things to be relevant to, yah, just use | |
| 330 | examples that are relevant to them at the | |
| 331 | moment, so yah. It's both yes and no. Yah. | |
| 332 | **RESEARCHER**: What, what teaching | |
| 333 | | |

| | | |
|---|---|---|
| 334<br>335<br>336<br>337<br>338<br>339<br>340<br>341<br>342<br>343<br>344<br>345<br>346<br>347<br>348<br>349<br>350<br>351<br>352<br>353<br>354<br>355<br>356<br>357<br>358<br>359<br>360<br>361<br>362<br>363<br>364 | method would you prefer or you using to present this lesson?<br>**EDUCATION OFFICER A**: I prefer to actually to go hands -on. I don't just give information to kids. I want them to actually be able to touch whatever that I am using but in doing so I make sure that there is order, there has to be order because kids can't be like…,. I make sure ok I give them what they have to know yet they become hands on during the lesson. So that's what I use mostly.<br>**RESEARCHER**: So on this lesson what is it that you would like to improve?<br>**EDUCATION OFFICER A**: I would like to improve the teaching material because, some of the things they are not as clear but I would like… that's my teaching resources, I would like to improve them. Yah I guess that's what I have to improve at the moment.<br>**RESEARCHER**: Ok what do you think, have you achieved your aims in this lesson?<br>**EDUCATION OFFICER A**: Yah I think I do, I do because especially when it comes to… if I were to use snakes for example. Like we are trying to tell… make these kids aware that you know killing snakes it's not good even if, you know, you might be frightened of it because there is a culture there where kids if there's a snake coming into their houses they have to kill it or something. So I am | Pedagogical knowledge used to introduce the lesson<br>Pedagogical knowledge where question and answer method is used<br>Pedagogical knowledge where the life of snakes is compared with that of humans |

| | | |
|---|---|---|
| 365 | hoping that ehh yah, like I'm really achieving | |
| 366 | like trying to be make these kids to be | |
| 367 | convinced not to kill these snakes. So yah, | |
| 368 | some of them are saying yah I'm | |
| 369 | convinced… | |
| 370 | **RESEARCHER**: Ok. Thank you very much | |
| 371 | Education officer A. Is there anything that | |
| 372 | you would like to tell me about the teaching | |
| 373 | of reptiles? Anything that you feel that I have | |
| 374 | to know? | |
| 375 | **EDUCATION OFFICER A**: Ok. I feel like | Content knowledge on |
| 376 | when teaching reptiles you have to use like | reptiles |
| 377 | scenarios that kids are able to relate with. It's | |
| 378 | not just you telling them all those scientific | |
| 379 | names about reptiles and everything but you | |
| 380 | have to relate it to, like them as human | |
| 381 | beings and for them to understand the | |
| 382 | difference between reptiles and humans is | |
| 383 | that we have a different way of adapting and | |
| 384 | also reptiles have another way of adapting | |
| 385 | so what I often do is like if I ever want to | |
| 386 | explain how they, they adapt in terms of the | |
| 387 | temperature and everything, I would use us | |
| 28 | as humans, we have to wear jerseys and | Content knowledge on |
| 389 | drink coffee and everything but they rely | reptiles |
| 390 | more on the environment. So such things | |
| 391 | they make the kids to be able to understand, | |
| 392 | ok this is what makes reptiles different, this | |
| 393 | is… so it's like using whatever that's | |
| 393 | happening at the moment, something that's | |
| 394 | relevant. So I feel like that is more useful | |

| | | |
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| 395 | when teaching such a lesson. You are not | Content knowledge on |
| 396 | just giving information it's like using | types of reptiles |
| 397 | examples that kids are able to relate with. | |
| 398 | **RESEARCHER**: Alright. Thank you very | Resource knowledge |
| 399 | much. | where exhibits are used |
| 400 | **EDUCATION OFFICER A**: Thank you | to teach about crocodile |
| 401 | | and Alligators |
| 402 | **Observation** | |
| 403 | Education officer A: Good morning. | Resource knowledge |
| 404 | All learners: Good morning. | used to explain |
| 405 | **Education officer A**: I am good as well. I am | Testudines |
| 406 | mam' **……..** I am going to teach you about | |
| 407 | reptiles. Ok, who can tell me what is a | |
| 40 | reptile? What kind of an animal is it? How | |
| 409 | does it look like? Explain to me what kind of | |
| 410 | an animal is a reptile. You can say anything. | |
| 411 | You can rise your hands, don't be afraid. | |
| 12 | All learners laugh. | |
| 413 | **Learner 2**: Crocodile | |
| 414 | **Education officer A**: Crocodile… another | |
| 415 | one… | |
| 416 | **Learner 3**: Lion. | |
| 417 | **Education officer A**: Lion on the reptiles? | Content knowledge on |
| 418 | Another one? Ok | Testudines |
| 419 | **Learner 4**: Lizard | |
| 420 | **Education officer A**: Lizard neh. Ok, most | |
| 421 | of the time it is said that reptiles are cold | |
| 422 | blooded animals. What do we mean when | |
| 423 | we say an animal is cold blooded? | |
| 424 | **Learner 1**: it is dangerous. | |
| 425 | | |

| | | |
|---|---|---|
| 426 | **Education officer A**: it is dangerous. | |
| 427 | Another one says what? **[Pause]** Ok let me | |
| 428 | give you an example. When we people feel | |
| 429 | cold what do we do so that we can keep | |
| 430 | warm? | |
| 431 | **Learner 1**: we stand next to the fire. | Content knowledge plus |
| 432 | **Learner 3**: We wear jerseys. | resource knowledge |
| 433 | **Learner 4**: We use a heater. | |
| 434 | **Education officer A**: We keep warm by a | |
| 435 | heater, we drink coffee because we want to | |
| 436 | keep warm right? But who has seen a snake | |
| 437 | having a cup of tea or coffee? You have not | |
| 438 | seen it neh? | |
| 439 | **All Learners**: No (**laughs**). | |
| 450 | **Education officer A**: Have you seen one? | |
| 451 | Have you seen a crocodile folding its feet | |
| 452 | wearing a jersey? Have you seen it? You | |
| 453 | have not seen it neh? | |
| 454 | **All Learners**: No (**Laughs**) | |
| 455 | **Education officer A**: So what do they do to | |
| 456 | keep warm? How do reptiles keep warm? | |
| 457 | **Learner 3**: They stay inside a cave. | |
| 458 | **Education officer A**: They stay inside a | |
| 459 | cave. What does another one say? | Content knowledge on |
| 460 | **Learner 5**: Inside their enclosure. | Terrapins |
| 461 | **Education officer A**: Ok. **(All laugh).** What | |
| 462 | does another one say? Haven't you seen a | |
| 463 | lizard warming itself on the sun laying on top | |
| 464 | of a rock? | |
| 465 | **All LEARNERS**: We have seen.**Education** | |
| 466 | **officer A**: Yes. Most of the reptiles bask on | |

| | | |
|---|---|---|
| 467 | the sun meaning they keep warm by sitting | |
| 468 | on the sun. | |
| 469 | **Education officer A**: I also want to make an | |
| 470 | example, who knows this animal? What is its | |
| 471 | name? | |
| 472 | **Learner 6**: Crocodile | |
| 473 | **Education officer A**: it is Crocodile neh. So | |
| 474 | when I do this what do you hear? | |
| 475 | **Learner 6**: Sound. | |
| 476 | **Education officer A**: Sound, what kind of a | Content knowledge plus |
| 477 | sound? | Resource knowledge |
| 478 | **Learner 3**: it is rough | on Chameleon |
| 479 | **Education officer A**: its rough neh, it's dry. | |
| 480 | Do you hear that? | |
| 481 | **All Learner**: Yes | |
| 482 | **Education officer A**: So, many reptiles have | |
| 483 | dry scales . So their skin is very dry. Their | |
| 484 | skin is not like that of a human. If I scratch | . |
| 485 | my skin you won't hear that sound. So they | |
| 486 | are cold blooded and they also have dry | |
| 487 | scales. Let us all say that… | |
| 488 | **All Learner**: They are cold blooded and they | |
| 489 | have dry scales. | |
| 490 | **Education officer A**: Yes, dry scales right. | Content knowledge, |
| 491 | **Education officer A**: So we have three | explaining the subject |
| 492 | types of reptiles, we have the first one which | matter on snakes. |
| 493 | is Crocodiles and Alligators. Who knows an | |
| 494 | alligator? Do you know what kind of an | |
| 495 | animal it is? It almost looks like a crocodile, | |
| 496 | often times when people see an alligator | |
| 497 | they say it's a crocodile. But what is the | |

| | | |
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| 498 | difference between them? I will show you | |
| 499 | when we are done here. They are just | |
| 500 | outside. Crocodile's mouth is shaped like a V | |
| 501 | shape. Can you see how it is shaped? | |
| 502 | However that of an Alligator is shaped like a | |
| 503 | U shape. You will see by the mouth that this | |
| 504 | one is not a crocodile it is an alligator. And | |
| 55 | there is a second one called testudines. I | |
| 506 | want you to tell me first which animal houses | |
| 56 | itself in this shell? Who is it for? | |
| 508 | **Learner 7**: Tortoise. | Content knowledge, |
| 509 | **Education officer A**: It is for tortoise neh. So | subject matter on |
| 510 | why do tortoise have this? What do you call | snakes |
| 511 | this housing? | |
| 512 | **Learner 7**: Shell. | |
| 513 | **Education officer A**: It is a shell neh. So | |
| 514 | why do they have a shell at the back? | |
| 515 | **Learner 3**: So they can be protected. | |
| 516 | **Education officer A**: Yes, they want to be | |
| 517 | protected from what? | |
| 518 | **Learner 3**: when they see a person they hide | |
| 519 | inside. | |
| 520 | **Education officer A**: Yes, it is for protection | |
| 521 | against predators. So that other animals will | |
| 522 | not eat it. And there is also a cousin of | Pedagogical knowledge |
| 523 | tortoise. Often people say that it is a tortoise | used to explain subject |
| 524 | but it is not a tortoise. We have a turtle neh. | matter |
| 525 | Who knows a turtle? Do you know it? | |
| 526 | **Learner 8**: Yes. | |
| 526 | **Education officer A**: Where does it live | |
| 527 | mostly? | |

| | | |
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| 528 | **Learner 5**: In water. | |
| 529 | **Education officer A**: In what kind of water? | |
| 530 | **Learner 7**: Green water. | |
| 531 | **Education officer A**: Green water? But how | |
| 532 | is the water? Is it like the water that you are | |
| 533 | used to? | Using pedagogical |
| 534 | **All Learners**: No | knowledge to explain |
| 535 | **Education officer A**: how is it? Look at the | content |
| 536 | water at the back, in the picture. Where is | |
| 537 | this water found? | |
| 538 | **Few Learners**: Sea water. | |
| 539 | **Education officer A**: Sea water neh, it is salt | |
| 540 | water, you get turtles. Then there is a small | |
| 541 | one called terrapin. What do you call it? | |
| 542 | **All Learners**: Terrapin. | |
| 543 | **Education officer A**: Terrapin neh. In which | |
| 544 | type of water does it live in? If it's not salt | |
| 545 | water how is it? | |
| 546 | **Few Learners**: it is clean. | |
| 547 | **Education officer A**: It does not have salt | |
| 548 | neh. So which water does not have salt? | |
| 549 | **Learner 1**: it is rain water. | |
| 550 | **Education officer A**: it is rain water. But | |
| 551 | often where do you get the water? In rivers | |
| 552 | and dams right? | |
| 553 | **All Learners**: Yes. | |
| 554 | **Education officer A**: that is where you find | |
| 555 | them most. And who can tell me where can | |
| 556 | you find a tortoise? Where does it live? | |
| 557 | Where do you see it often? You find turtle in | |
| 558 | | |

| | | |
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| 559 | salt water, Terrapin in water that does not | |
| 560 | have salt. What about tortoise? | |
| 561 | **Learner 3**: In the bushes. | |
| 562 | **Education officer A**: Ok. On the land. It | |
| 563 | does not live in the water right? | |
| 564 | **All Learners**: Yes. | |
| 565 | **Education officer A**: Then the last group we | |
| 566 | call it schoamata. Where there are lizards | |
| 567 | and snakes. | |
| 568 | Ok so who can tell me what is this? | |
| 568 | **Learner 3**: It is a chameleon. | |
| 569 | **Education officer A**: Chameleon neh. So | |
| 570 | what is it known for? | |
| 571 | **Education officer A**: For changing colour | |
| 572 | neh. So when it changes colour does it mean | |
| 573 | it likes fashion or what? Why does it change | |
| 574 | colours? | |
| 575 | **Learner 6**: For protection. | |
| 576 | **Education officer A**: For protection. When it | |
| 577 | does not want other animals to see it and | |
| 578 | also when it wants food. Say there was a | |
| 579 | grasshopper and the chameleon wants to | |
| 580 | eat it, it has to change to the colour of its | |
| 581 | environment so that the grasshopper will not | |
| 582 | be able to see it. The last group that I love | |
| 583 | with all my heart is snakes. Who loves | |
| 584 | snakes in here? No one?? No ways! They | |
| 585 | are loved by the young ones. Is it the older | |
| 586 | ones who throw stones at snakes? You pour | |
| 587 | paraffin on them? You set them on fire? | |
| 588 | What do you do when you see a snake? | |

| | | |
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| 589 | **Learner 9**: I run. | |
| 590 | **Education officer A**: You run? | |
| 591 | **Other Learners**: we kill it. | |
| 592 | **Education officer A**: You see. What do you | |
| 593 | kill it with? | |
| 594 | **Other Learners**: With rocks. | |
| 595 | **Education officer A**: Ok. In the group of | |
| 596 | snakes, we have snakes with venom and | |
| 597 | those without venom. We don't say a snake | |
| 598 | has poison we called it venom. What is it | |
| 599 | called? | |
| 600 | **All Learners**: Venom. | |
| 601 | EDUCATION OFFICER A: Yes, we don't say | |
| 602 | a snake has poison it has venom. Those that | |
| 603 | don't have venom, who knows this snake? | |
| 604 | Don't you watch movies? | |
| 605 | **Learners**: We do. | |
| 606 | **Education officer A**: what is this snake? | |
| 607 | **Learner 3**: Anaconda. | |
| 608 | **Education officer A**: Yes but we don't say | |
| 609 | 'underconda' right, it is ana-conda. What do | |
| 610 | we say? | |
| 611 | **All Learners**: Anaconda. | |
| 612 | **Education officer A**: Anaconda neh. So on | |
| 613 | the movie they say it eats people. Is it true? | |
| 614 | **Some Learners**: No. | |
| 615 | **Other Learners**: Yes. | |
| 616 | **Education officer A**: Ok. So anaconda | |
| 617 | cannot swallow a person like me, can you | |
| 618 | see how broad are my shoulders, I am big. | |
| 619 | However it can a swallow a small child | |

| | | |
|---|---|---|
| 620 | because they are still small. And it can also | |
| 621 | swallow a goat because its shoulders are | |
| 622 | straight. Yes. So when it is about to swallow | |
| 623 | that goat what will it do first? | |
| 624 | **Learner 6**: It wraps you. | |
| 625 | **Education officer A**: It wraps you around | |
| 622 | first neh, then what does it do? | |
| 627 | **Learner 6**: it breaks your bones. | |
| 628 | **Education officer A**: It breaks your bones | |
| 629 | and you suffocate. Then what does it do? | |
| 630 | **Learner 6**: Then it eats you. | |
| 631 | **Education officer A**: Yes. This one does not | |
| 632 | have venom. Then there are ones which | |
| 633 | have venom like this one (demonstrates with | |
| 634 | a picture). It is puff adder. This one insert its | |
| 635 | fangs in the flesh and releases venom but | |
| 636 | there are other ones that look like this | |
| 637 | (demonstrates with a picture). | |
| 638 | **Education officer A**: It is cobra . It is called | |
| 639 | Mozambique spitting cobra. Where does | |
| 640 | this one insert venom? | |
| 641 | **Learner 4**: It spits it. | |
| 642 | **Education officer A**: Where? | |
| 643 | **Learner 4**: On the eyes. | |
| 644 | **Education officer A**: On the eyes neh. So | |
| 645 | let us say it is standing three meters away | |
| 646 | from me it can spit its venom on my eyes, if I | |
| 647 | am not wearing my reading glasses then it | |
| 648 | will enter my eyes. So what must one use to | |
| 649 | remove the venom from the eyes? What | |
| 650 | must you remove it with? If you don't remove | |

| | | |
|---|---|---|
| 651 | you will go blind. So then what must you | |
| 652 | remove it with? | |
| 653 | **Learner 1**: You go to the doctor. | |
| 654 | **Education officer A**: Ok. Before you got to | |
| 655 | the doctor? You know we take time before | |
| 656 | going to the doctor. So before you go to the | |
| 657 | doctor what must you remove it with? | |
| 658 | With water neh. Clean water, you don't add | |
| 659 | anything just clean water. Then you can see | |
| 660 | a doctor. | |
| 661 | **Learner 1**: Yes. | |
| 662 | **Education officer A**: Let us say you are at | |
| 663 | the mountain, you are playing then a snake | |
| 664 | spit its venom on your eyes and there is no | |
| 665 | water, there is no river nearby. What must | |
| 666 | you use? You must use urine. Immediately | |
| 667 | when you pass urine you must use it to wash | |
| 668 | your eyes then you will go to the hospital. | |
| 669 | Say you don't have urine and your friend | |
| 670 | nearby has it, you will have to use your | |
| 671 | friend's urine to wash your eyes. Who can do | |
| 672 | that? You have to do it. | |
| 673 | **(All Laugh)** | |
| 674 | **Education officer A**: Ok. The last one, I | |
| 675 | want show you what you must do when you | |
| 676 | see a snake inside the house. What will you | |
| 677 | do? Let's say you are from playing, then | |
| 678 | when you get inside the house you see a | |
| 679 | snake, what must you do? | |
| 680 | | |
| 681 | | |

| | | |
|---|---|---|
| 682 | **Learner 8**: I will hit it with a rock. **Education** | |
| 683 | **officer A**: You will do what? Hit it with a | |
| 684 | rock? What will another one do? | |
| 685 | **Learner 4**: I will call my parents. | |
| 686 | **Education officer A**: Ok. Before you call | |
| 687 | them, you know what you must do? The | |
| 688 | moment you see it you go back while looking | |
| 689 | at it otherwise it might go under the bed then | |
| 690 | you will have to turn every furnisher in the | |
| 691 | house to find the snake. So you must look at | |
| 692 | it to make sure it doesn't go anywhere. When | |
| 693 | you are a bit far from it then you will call a | |
| 694 | parent and then a parent will call the people | |
| 695 | who work at SPCA who will come and collect | |
| 696 | it. Don't pour patrol or paraffin and throw | |
| 697 | stones at it please, don't kill the snakes. | |
| 698 | What do they help with? | |
| 699 | **Education officer A**: Snakes help with | |
| 700 | eating rats. When there are too many rats | |
| 701 | what is going to happen? | |
| 702 | **Few Learners**: They are going to eat | |
| 703 | clothes. | |
| 704 | **Education officer A**: You will find your | |
| 705 | school jersey with holes because it was | |
| 706 | eaten by rats or your lunch box eaten by rats. | |
| 707 | It is not nice . So snakes help with eating rats | |
| 708 | . Ok thank you. Who has a question then you | |
| 709 | will go to national symbols? You can ask | |
| 710 | anything you want to know about snakes. | |
| 711 | You will go out with a line and you will touch, | |
| 712 | whoever is not scared if you are not scared | |

| | | |
|---|---|---|
| | don’t touch, you will touch the crocodile skin, the shell of a tortoise then go out. As you go out you will see alligators. | |

## APPENDIX I:
## INTERVIEW OF EDUCATION OFFICER B

### PRE INTERVIEW

**Researcher**: “Yes! Eh! How are you?”

**Education Officer B**: “I'm good, thanks! How are you Sir?”

**Researcher**: “I’m good. I’m good. Do you mind if I call you ‘Education Officer B'?”

**Education Officer B:** “No problem.” (giggles)

**Researcher**: “Is 'B' fine? Is 'B' fine?”

**Education Officer B:** “Yes”

**Researcher:** “Ok! Ok! Alright! Eh! I just want to ask you some few questions… eh…. regarding the Science Centre, what is happening around you here? Ok! Let me start with this question: Tell me, do you have any science qualification and if 'yes' what are your major subjects?”

**Education Officer B:** “Yes Sir! I do have a science qualification. It’s in Nature Conservation and uhmm I hold a BTech in Nature Conservation.”

**Researcher**: “Wow! That’s good.”

**Education Officer B:** “Yes! And my majors were Coastal and Marine Management including Fresh Water Management.”

**Researcher:** “Hmmm"

**Education Officer B**: “Yes!"

**Researcher:** “Ok. Now that here we don’t have Coastal or even the… Have you ever been to the reptile and check what is happening in terms of…..?”

**Education Officer B:** “Yes I have been to the fish aqua... the fish breeding facility where they grow the fish. It’s the aquarium.”

**Researcher:** “Ok! Ok! Alright! Ja! So tell me, have you ever been trained on how to present a science education or science lesson or do you have any experience in teaching science?”

**Education Officer B:** “Yes! uhm…. I do have experience but then more in the environmental education side. I started being exposed in 2015. I was volunteering in this project at Uni and then when I came here, started working at the National Zoological Gardens. It’s where I actually got more exposure than actually doing the environmental education programs. They just the daily lessons. I was trained to go into detail with specific lessons like your themed lessons. So I do have that experience.”

**Researcher:** “So in other words you are saying, here at this Science Centre, you were once trained?”

**Education Officer B:** “I was once trained.”

**Researcher:** “Once trained.”

**Education Officer B:** “Yes"

**Researcher:** “How was the training? Would you say the training was effective? Did it help you in any way? Or what do you think of the training that you received here?”

**Education Officer B:** “The training is very effective because for each and every lesson I can see that I’m improving myself. It was very effective. I think it’s because the training was not too formal so I got to be comfortable. I also had the chance to also reveal or show out the real me. So in whatever lesson I’m doing or I’m conducting I always bring out my personality. So I’m improving in that way.”

**Researcher:** “Oh! What’s your view of science education at the science centre? The way science is being…. The way lessons are being conducted particularly at the science centre, what’s your view?”

**Education Officer B:** “Uhmm my view I…. What I like about here at the Zoo is that we try to accommodate different schools from different backgrounds. If the schools don’t understand English we try by all means to teach them by their language or their mother-tongue. And I also find them very informative but I wish we could also like add more activities for the students. But the ones that we currently have I think we are doing eh very well in them. But we do find situations where we have too many schools and I wish we could have more activities.”

**Researcher:** “Ok. When you present a lesson, what are the important points to consider before one can present a lesson in your view?”

**Education Officer B:** “(Sigh) The important things to consider first of all it’s the presenter him/herself. It’s how you look, the way you are, like, your clothes. If you are wearing inappropriately I think that will be the first distraction. Second of all, you

should also check also the language of the students. And then also you should be able to, in your lesson you should let them engage with you than you actually teaching them. So you should ask those questions or let them come up with answers. And also, I also make sure that after each lesson I ask them if they don't have any questions. So those are the……"

**Researcher:** "Ok! Which lesson would you prefer to teach or to present here and why?"

**Education Officer B:** "I prefer National Symbols. Firstly it's because the first time I started working here that was the very first lesson I was actually exposed to. And you do find people even the teachers who do not know the basic stuff which are your national symbols. And I feel like it's a lesson everyone can actually participate in because some of the lessons they are not complicated but they are designed for certain groups. So with National Symbols it caters all grades or all backgrounds."

**Researcher:** "Ok! Ok! What's your view on the use of interactive exhibits or interactive resources in teaching science at the Science Centre?"

**Education Officer B:** "The exhibits are important because you do not only teach. You get them to actually feel the object you are talking about. They start to understand how it operates especially with vulture or the elephant head. People actually also understand the physics behind it. Like with the elephant exhibit the distance where you have to stand in order to operate it. And they can actually feel the actual size of an elephant skull."

**Researcher:** "Do you think it's necessary to teach the school groups that visit the centre?"

**Education Officer B:** "It is necessary. As I have said you get groups from Limpopo who has never been to the zoo. And I think environmental education is one element we are missing in education. So by them coming here to the Zoo, they get to learn about things they don't learn about in the classroom. Not that we emphasize but we incorporate about nature like how to conserve nature also the animals that we have."

**Researcher:** "So you think if we were to leave these learners that are coming in not interacting with them. We just leave them, they go around the centre, they leave out. Wouldn't that work? Without like having to teach them or interact with them?"

**Education Officer B:** "If we had to cancel the lessons out, I think even this department wouldn't need to be here in the school. Because, I believe, yes we do teach the general public but I believe our target it's mainly the school kids since some of the things are not included in their curriculum. So if we don't have those

lessons people wouldn't have knowledge. They would only be exposed at varsity like I was exposed at varsity. I had never been to the Zoo until I went to varsity. So I missed a lot of that in my life during my childhood. So this is playing a very important role in their development."

**Researcher:** "In teaching science education at this Science Centre, what can we do to arouse the learners' interest in science generally?"

**Teacher:** "I think what would arouse their interest is also, I think it's impossible, but also like try to get ideas from them that next time when they come, which activity will they like to do or give them homework and come up with ideas of a science related game they would like to play. Cause it's also about them at the end of the day. With the infrastructure, I think for now its fine but then get their input. I feel like if they make an input, they will feel responsible for the conservation or the running of this organization. So if we could also let them involved, feel like scientists already. Some would also feel like they have invented something new. Give them that, those ideas, gore guys, what would you like to play next time you come here? What do you think you would enjoy more? And then they come with their own ideas."

**Researcher:** "Erhmm. The groups that you get here, do you think the number of learners, like a large group or a smaller group, does it have any effect on your presentation or teaching of your science lesson?"

**Education Officer B:** "It has a very big impact because I have noticed that if you have to present to a very large group, you have to make sure that you discipline them all the time. You tell them to keep quiet because at the back some lose interest or they lose concentration. And, not that you have to yell, but you have to project your voice even more. But even if you do they lose concentration. When you are teaching a smaller group, they all pay attention. And I think it's also got to do with the set-up or the layout of the station. There's a very few chairs so if maybe there could be more seats or a plan could be made to accommodate more seats because some of them are sitting down some of them are standing. So it's kind of hard to make everyone pay attention. So group science has an impact on how you present."

**Researcher:** "Your lessons, the time allocated. When I look at the lessons it's like they are allocated 20-25 minutes. Do you think that is enough time that you can be able to teach or to present whatever information you have to present to these groups?"

**Education Officer B:** "I think 25 minutes is more than enough. I believe in making your presentations as short as possible before they could lose concentration. But within that short period, you must make it fun for them. Let them engage because you find that some of them they are actually rushing off to do other things, to go to

the find a picnic area to actually braai and eat. So I think 25 minutes is more than enough, even 20 minutes are a bit too much."

**Researcher:** "Alright thank you so much Education Officer B for the information you have just given me. Like I've said in our meeting, this was a semi-structured interview and it ends up here. No-one will have access to these records. If you have any questions or anything you would like to say, you can tell me now."

**Education Officer B:** "Alright. No. I am happy. I don't have questions."

**Researcher:** "Thank you so much."

## EDUCATION OFFICER B POST INTERVIEW

**Researcher:** "Ok! Eh! Good afternoon Education Officer B."

**Education Officer B:** "Good afternoon Sir."

**Researcher:** "And how are you?"

**Education Officer B:** "I'm good thanks! How are you Sir?"

**Researcher:** "I'm good! I'm good! Thank you so much for the lesson that you presented to the learners. I just want to ask you a few questions based on the lesson that you have just presented. I just want to know a few things here. Tell me did you enjoy your lesson?"

**Education Officer B:** "I enjoyed the lesson very much because of the response from the learners. And also the topic itself for me it was very very interesting because it was not a topic I was interested in but immediately I learnt about it, it became an interesting topic. So I enjoyed it a lot."

**Researcher:** "OK. That's good. I mean teaching about flight, mainly bringing in physics, bringing in life science, and what do you think of your learners, did they enjoy it?"

**Education Officer B:** "They enjoyed it a lot because they were Grade 10 learners and some of the aspects I touched on the topic they were life science. It's like a topic they also covered in life science. And then it also became more interesting for the learners who did Physics because I did touch in Physics in the lesson."

**Researcher:** "OK. What did you find it to be difficult when presenting this lesson?"

**Education Officer B:** “What I found difficult is actually because this is a very….erhm….It’s not complicated but the content of the topic it’s very very broad so I had to squeeze in everything without… like I had to explain things thoroughly but I also had to squeeze in everything within that allocated time. So I had to try to be quick but explain things as thoroughly as possible and also try to get the students to do the activity. So that’s the problem I encountered.”

**Researcher:** “I heard you on the lesson mentioning that an aeroplane as it flies, before it flies, it has to run on the runway in order to gain momentum. Did your learners understand what momentum is? What could have happened? Do you think the learners understood the concept of momentum?”

**Education Officer B:** “They did understand it especially the students who are doing Physics. Because most of the students who are attending this lesson they are doing Physical Science. Some of them even brought the examples that I didn’t think of and they were relevant to my example. So they did understand that concept.”

**Researcher:** “So, as you were presenting, if you realise that your learners didn’t understand some of the concepts, how did you go about making sure that they understand it?”

**Education Officer B:** “First of all, I had to change my language, first of all because most were from schools in the townships. So if you have to be too formal with them some might be ignorant, some might be interested but not understand at all. So I kind of had to adjust my language that I use and also apply examples that they see every day in their lives. So that’s the approach I used.”

**Researcher:** “Ok. If I were to talk about teaching method, what teaching method were you using or what teaching method do you prefer to use when teaching a lesson like this one?”

**Education Officer B:** “The method was to… Ok. I told them about the flight of vultures. And then I also showed them some things. I didn’t ask questions on things that I felt were too difficult for them. But I also got them to participate. So I demonstrated to them some things but in some they had to come and do that activity to show me their level of understanding.”

**Researcher:** “OK. Tell me, what do you think can be done to make science lessons like this one more interesting at the Science Centre?”

**Education Officer B:** “What could be done is that….ok, I think some of the things should be like experiments. Not something that you have to tell them every day. Like you go through the internet then you read about it, then you just…. I wish like some

of the activities, especially the ones related to science, I wish they could always include experiments. Where they kind of feel like scientists but not too difficult experiments."

**Researcher:** "Coming back to your lesson, you talking about flying of birds, you talk about an aeroplane. My understanding the whole concept talks about aerodynamics, am I right?"

**Education Officer B:** "Yes!"

**Researcher:** "Ok can you tell me anything about aerodynamics, anything at all that you know?"

**Education Officer B:** (giggles) "Uhmmm, first of all, what I can tell you is that aerodynamics is a concept that deals with the wind and the air and the sky. And also how a flying object is able to resist the pressures. It also involves the design of that flying part of an object to make it fly smoothly in the sky. That's what I understand."

**Researcher:** "Would you say you have achieved your goals with your presentation or not?"

**Education Officer B:** "I do believe I have achieved it because after doing the lessons we would normally evaluate ourselves as the educators and then discuss what the students were saying. So for the ones who came to my station and had to go to another station that talks about vultures, they were able to take some of the information that I taught them and take it to that other station. So I could say that they grasped quite a lot."

**Researcher:** "If you were to improve this lesson, what are the things that you would do to improve the presentation or even the lesson?"

**Education Officer B:** "OK, one thing I will do, first of all, is to first have that lesson by the vulture in closure. And also get the people who are working hand-in-hand with the vultures, I believe, because I'm just an educator. But I wish they could also get to talk to someone who works with them daily, who knows more than I know as an educator. So if they could only bring those people instead of putting them away, I think that would also be interesting. And also get involved in maybe making the diet of a vulture, behind the scenes."

**Researcher:** "Alright! Thank you very Education Officer B. Is there anything or any question. Anything you would like to say?"

**Education Officer B:** "No Sir. I think we've covered….." (giggles)

**Researcher:** "Ok. Thank you!"

## Appendix J: Observation for education officer B

**Education Officer B:** "We're going to be talking about vultures. So this is going to be like a discussion because I am also expecting you guys to also respond. So one thing you should also remember is that if you have an answer or you want to say something to add onto what we are going to be talking about, it's fine you can raise your hand and feel free to answer in your mother tongue. I'm only speaking English since kele moXhosa slash moSotho. So I don't know how to speak Sepedi kapa kaSeTswana fluently alright? So when you know an answer okana waboa kasiZulu kapa kaSepedi anything, feel free. And then…."

**Learner:** "lekaSeTshangane?"

**Education Officer B:** (laughs) "Ehhe ketlotlaka translator. Ok, and then, ummm, please do not hold secret meetings. I should be the only one talking unless you raise your hand. And please do not eat while we having a lesson, alright?"

**Learners:** "Yes"

**Education Officer B:** "Ok, uhmmm, can anyone tell me, what makes vultures interesting or what makes them unique from other birds. Are you guys familiar with vultures, first of all?"

**Learners:** (mumbling)

**Education Officer B:** "You not. When you guys had about vulture anywhere, what did you hear about vultures? Bare di etsang?"

**Learners:** (in chorus) "It eats dead animals."

**Education Officer B:** "It eats dead animals, meaning that it's a scavenger. So when we say 'scavenger' it means that it does not actively hunt for food or for prey. It waits for your lions, your leopards, your cheetahs to make the kill and then it only gets to the scene when the animals are dead. Ok. And then we also said they clean the environment. That is true because if we were to find dead animals all over South Africa, then there will be too much or high disease transmission. Because those dead animals also contain diseases that are harmful to human or also to other animals. So the digestive system of a vulture enables it to digest those bacteria from those dead animals, ok?"

**Learners:** "Ok."

**Education Officer B:** "What else can we also add on vultures?"

**Learner:** "They are vulnerable."

**Education Officer B:** "They are vulnerable. They are endangered because people kill them to do traditional medicine. One thing we need to remember is that 80% of South Africans depend on traditional medicines. They do not have access to right or expensive medical treatment. Ok. And then, they also vulnerable because some of the farmers have started a new practice where, if they find an animal dead, they will just bury it in the ground meaning that there would be shortage of food for the vultures. Another cause of the vulnerability is that the farmers would actually use a cow, a whole cow, as bait or as a trap for the jackals that come dand eats their livestock. So what they normally do is that they would kill that cow, they would poison it and then leave it right here on the fence knowing that the jackals will come at night to come and eat it. So they are trying to kill the jackals and also kill the vultures unintentionally. Alright. So those are the 3... oh, another 4th problem is that they also get shocked by the electric pylons. La bona di pole tse tsa matlhakalo? So when they stand on it, they defecate or they excrete the waste and then since it is wet, they get shocked. So those are the 4 problems we are experiencing in conservation. But you guys, I'm sure you will find other ones in the long run but we are still aware of the four. Ok, so on this station we are going to be talking more about the flight of vultures. So in the world we have two groups of vultures. We have new world vultures which occur in South and North America. And then we have old world vultures which occur in Africa, Asia and Europe. You don't find vultures in Australia because in Australia there's too much competition. So here I have a picture of the vulture that you find in the new world which is North and South America. And the name of this vulture is called a Turkey Vulture. And then, on my right hand we have a picture of a vulture which you find in the old world which is Africa, Asia and Europe. Are you guys familiar with this one?"

**Learners:** "Yes!"

**Education Officer B:** "This one is called the Cape Vulture and during the lesson we are going to be discussing more about this one since it is the most common. We do find other vultures but this one is the most common amongst us, ok. So if we had to know the differences between the 2 groups which are the new world and the old world is that the old world vultures rely on smell to track down food….."

**Learners:** "The old?"

**Education Officer B:** "Did I say the old?"

**Learners:** "Yes!"

**Education Officer B:** "Oh sorry guys, thank you for the correction. So this one from the new world, it relies on smell to track down food. So it spends most of its time walking on the ground. And also the talons, we don't call these the feet or the toes we call them the talons. So these talons are tough. They enable them to walk smoothly on the ground while searching for dead animals. And then, this one, the Cape Vulture from the old world it relies on sight or on vision to track down food. Hence, it spends most of the time flying high in the sky. And also the talons they are not as tough as the ones of new world because they spend most the time flying searching for food high in the sky. Ok, while we still one this Cape Vulture, if someone were to ask how would you know that this vulture is an adult or its old e tsofetse and this one is a juvenile it's a youngster, what characteristics would you normally look at?"

**Learner:** "The juvenile vulture has a pink neck and the adult one has a dark blue neck."

**Education Officer B:** "She's correct. She is saying that the juvenile or the young one has a pinkish red neck and then the adult has a dark neck which is blueish grey. And then the eyes?"

**Learner:** "The adult's eyes are yellow. And then the juvenile's eyes are a bit dark."

**Education Officer B:** "Where did you guys get those answers you told me?" (Class giggles) "From the last session?"

**Learners:** "Yes!"

**Education Officer B:** "Yes? Oooh ba bhora shame because you guys were supposed to come here first ke le bone gore le bhayiza hakakane. But it's fine. So basically to demonstrate or to make people remember is that we wear these shades. These ones they symbolize an adult vulture. So they…you guys can see that in colour they are black and yellow and sorry to warn you, I know I look ugly in these ones but please don't get distracted. So the adult Cape Vulture has the centre of the eyeball its black and then the edges is yellow. Hence the frames of these shades are yellow. And then the neck is blueish grey or it's dark. That's how you know gore this one is an adult Cape Vulture. And then the young one they did say that it has dark eyes and then the neck it's pinkish red. So if you guys had to go to Kruger National Park or wherever, you guys will think of this lesson and remember how I wore the colours of whatever. So this is actually to make you guys remember and not forget, ok. So can anyone tell us what does a bird do, any bird do with its wings

before it takes off? Before it can fly high in the sky, what does it do with the wings? Even if it's a chicken… Ok chicken e fellela gona mo but what does it do with the wings? It opens the……"

**Learners:** "The wings."

**Education Officer B:** "It opens the wings. It only positions them like this and then it flies?"

**Learners:** "No!"

**Education Officer B:** "What does it do?"

**Learners:** (mumbling)

**Education Officer B:** "It flaps the wings. The way they flap the wings it differs according to the bird species. So for the chickens, they flap them like this, fast. And then the vultures they flap them like this and then they run for a short distance. So the reason why they flap their wings and also run for a short distance is to gain momentum. It's the same thing that happens with our aeroplanes. Before they can take off from OR Tambo airport, they first need to be on the runway for a certain distance and then that's when they can take off, ok. So also with our choppers or our helicopters before they could actually take off….for now though, they don't need to run on the runway, but they first need to spin their wings to gain momentum. And then, one thing we also need to remember about vultures is that, you'll never see a vulture at night. You'll never see a vulture early in the morning ka matsha. You only see a vulture when the sun is out. Because, what happens is that, that solar radiation from the sun needs to hear a dark patch on the earth's surface. So when we are talking about dark patches, we are talking about your tar road or a roof that has a dark colour from any kind of building. So when it heats a dark patch, that dark patch gives off a warm wind thermal or a warm air temperature. So that vulture will go down the cliff a bit to get that warm temperature to keep that body warm before it could fly to the higher and colder parts of the atmosphere. So when it gets to the sky, this vulture it changes the way it flies. It stops flapping it's wings. It positions them like this, and we call this a sworen flight. So for the flapping flight, they need to use too much energy but for this flight, they use less energy. So that's how they are able to fly over long distances. They can fly up to 150km and backward. So that is the distance from Pretoria to Ermelo in Mpumalanga. If it had to flap wings in the sky, it would use too much energy and it will only be able to cover a maximum of 40km and it wouldn't be able to find food. So on this picture, if we had to cut the wing like this, the wing of the vulture like this while flying in the sky, this is the kind of shape you would get. It would be like this. So what happens is that, as a vulture is busy flying in the sky, it will experience high air pressure on this side and low air

pressure on this side. And then the wind will hit this part of the wing and then gets distributed unequally on both sides of the wings. So since this side is long, the wind will travel faster on this side, and travel slowly on this side since this side is short. And then when those 2 kind of winds meet up on this side, they form what we call a vortex. Are you guys familiar with the term ‘vortex'?”

**Learners:** “No!”

**Education Officer B:** “Le kele labona movie ya-tornado?”

**Learners:** (mumbling)

**Education Officer B:** “Tornado e etsa so… it moves in this motion. So if you guys watched that movie you get to notice that, whatever object is lying around that vortex it gets to be pulled into the centre of that vortex, of the tornado. So the same thing happens with our vultures. As they are flying in the sky, the vulture form in this pattern. Its intention is to pull or to drag that vulture backwards. So in order for that vulture to withstand or to resist that pulling by that vortex, what it does is that it opens these parts of the wings. It would open these finger-like projections. And we call these parts 'the primary'. So what happens is that the vortex is formed in this part of the wings. They form the cycles here. And when the vortex cycles get to this point, it stops, it gets broken by these primaries. That’s why the vulture is able to fly forward at such speeds. If it had to close the primaries, it would be pulled backwards by that vortex. So I’m sure someone is wondering why we have an aeroplane while we talking about vultures. The reason why we have an aeroplane is because we couldn’t bring an actual vulture. And we are not trained to handle those. So the reason why we have an aeroplane is because it is designed similarly to a vulture. And it also uses the same mechanism as a vulture to fly high in the sky. So when our aeroplane is flying high in the sky, it also experiences vortex right on this part of the wings. And then since it is designed or created by a human being the engineer, they couldn’t design the primaries, those finger-like projections so instead they came up with this idea that says, ‘why don’t we bend the wings on the edges of the wings?' So then the vortex is formed here and when it gets to this point it gets broken. Because this part forms the same function as the primaries. Le kile la bona di jet tsa masole ha di fofa diintsa smoke on this part of the wing high in the sky. Sometimes they also dye that gas into colours especially ka di national days like, I don’t know, Freedom Day then they display nntho tsa teng. That gas that you see, it’s the vortex. That vortex is visible but from this aeroplane ya di passenger, it’s not visible but it is there. So if you were to fly behind a military jet, you would go hit that building and die immediately because it’s powerful, alright. So, another thing is, are you guys doing Physics?”

**Learners:** "Yes!"

**Education Officer B:** "Alright. Some of you. Ok. So we are well aware that, for any flying object there are four forces which are involved. Right? Have you guys been taught forces?"

**Learners:** "Yes."

**Education Officer B:** "Ok. So what we going to do now is, I need a volunteer. Someone who is going to take the labels from this table and show us which force do we find where on this flying object on this picture. If you are struggling, it's fine, you can ask your peers to help you out. This is not a competition, you are all here to learn. So does anyone want to volunteer and show us? You just take the label from this table and plug it on this chart."

**Learner:** "I volunteer."

**Education Officer B:** "If you are stuck, it's fine, your friends can help you out. It's fine. When he is done, we will go through each force thoroughly so that everyone can understand. Re kgone go rectifier di mistakes. If you are at the back don't worry I will just raise it up le kgone go bona le lona. If you see something wrong, you will be allowed to change it, ok? Le ska wara. Guys are you happy?"

**Learners:** "Yes."

**Education Officer B:** "Ok, guys this is the end product, is he correct?"

**Learner:** "I think so."

**Education Officer B:** "You think so? Does anyone beg to differ? Le sharp? Alright, let's go through it on this picture. Remember I talked about the warm wind thermal or the warm air temperature from dark surfaces? So what happens is that when that vulture goes down from the cliff to get that warm air temperature, it goes there to make the body warm and also to gain lift. So that warm wind thermal helps the vulture to apply a lift form. So if you had to define a lift force in simple terms, it's a force that adds right angle to the direction of motion. So basically in simple terms, it's a force that pulls an object upwards. So our mate was correct, ok. So we know that if you had to throw your phone up in the sky, you are giving the lift force more advantage. But eventually it will go down. And it will be pulled by the weight force or the gravitational force. Akere? So you are correct. So moving onto our 2 horizontal forces, we have a thrust force. A thrust force is a force that propels a flying object towards the direction of motion. So basically it's a force that pulls a flying object forward neh? So if we had to go to our vulture, how does it apply a thrust force? The design of the body, it's streamlined. When we say streamlined, we mean it's pointy

here at the front. And then the surface of the body here it's smooth. There's no kind of disruption or interruption on its body. So the same thing with our aeroplane. Our aeroplane is also streamlined meaning that it's pointy here at the front and there's no kind of obstruction. If this wing had to be positioned like this, it was going to have difficulty in flying. So they position like this so that the air can pass through smoothly. Ok. So… and also by the way, since this aeroplane is designed by human beings, it doesn't have its natural thrust. Ok, first of all it's the streamlined body. Another thing it needs to apply the thrust, it's the engine. So what the pilot or the engineers have done is they have created this aeroplane to have thrust force here on the engine. So when the wind enters here through the turbine, it gets burnt and converted into a thrust force. That's why the aeroplane is able to go forward. Alright, so moving on to our very last force which is the drag force. A drag force, is a force that pulls an object backwards. It acts opposite direction to the direction of motion. So this drag force it's a result of a vortex. La hopola le boa ka vortex gore it pulls the vulture backwards?"

**Learners:** "Yes!"

**Education Officer B:** "Yes. So it eventually results into a drag force. You guys also experience a drag force especially now in August ka nako tsa di autumn so. You notice that, as you going forward, the wind will come opposite direction and will try to push you backwards. So you, although you are not aware, you are also experiencing drag force. Ok, so can anyone tell us, we discussed these forces, which forces are important or which forces are most active when a vulture is about to land on the ground or when an aeroplane is about to land on the ground? Which forces are involved and what does it do with the wind?

**Learner:** "It applies a drag force."

**Education Officer B:** "He says, it applies a drag force. He is correct. So as the vulture or the aeroplane in the sky, the vulture, to be specific, it will tilt the wings like this to apply the drag force. Ok. So basically the wind will come hit the wing and then it will force it to stop where it is supposed to stop. And then when it has landed, it will start flapping the wings for a short while then it will stop. So the same thing happens with the aeroplane. When the aeroplane is about to land, the pilot will open these blocks. These blocks are called the gliders. So as it's busy flying in the sky, these gliders are normally closed but when it's about to land, the pilot will open these gliders to apply the drag force. If he doesn't apply the drag force, this aeroplane will go crash into the OR Tambo building. Do you guys understand?"

**Learners:** "Yes!"

**Education Officer B:** "Do you guys have any questions?"

**Learners:** (no response)

**Education Officer B:** "Did you guys enjoy the lesson?"

**Learners:** "Yes!"

**Education Officer B:** "So, nna I do have a question for you guys. How high do you think vultures can fly?"

**Learners:** (mumbling)

**Education Officer B:** "How much? Ke o tlwile motho are 6 feet. Ok, by the way, when you mention the term feet, akere it's a unit they use oversees? So before you mention feet, you will have to convert it for us South Africans into metres above sea level. So how much is 6 feet if you have to convert it? So basically the unit we use for elevation, for altitude or height it's metres above sea level. So the minimum that was recorded, although they can go a bit lower than that, was 1500 metres above sea level. And then the highest that was recorded was 11 000 metres above sea level. And that one that flew to that elevation or that height was the Rupel vulture. The Rupel vulture you also find it here in South Africa. But not too common here in South Africa although you can find it. So what happened is that as the aeroplane is flying like this, nicely in the sky, this vulture decided to fly in front of an aeroplane. How smart is this? So, akere le boile ka thrust force gore the wind enters here. So moya ha o kena ka mo, o kena ka force. And this gets converted to thrust force. So as this bird is busy flying, the drag force became more powerful than the thrust force. And then it got sucked into these turbines. It got pulled and stuck into the engine then it got sliced into mince meat. These guys they do need to be careful. And also these students yesterday asked me gore what happened to the aeroplane? Basically, there's nothing that could happen to the aeroplane because it was only one vulture. But if they were to come in a large group like 20 individuals, an aeroplane would crash because they are not interfering with the thrust force. Do you guys understand?

**Learners:** "Yes!"

**Education Officer B:** "Thank you so much guys for listening attentively. If you would like any pamphlets or print outs, you guys can just take. You can also take them home. You can take as many as you want. Alright. Thank you so mu

**APPENDIX K:**
**TYPOLOGY OF EDUCATION OFFICER B**

| | | |
|---|---|---|
| | **Researcher: "Yes! Eh! How are you?"** | |
| 1. | **Education officer B:** "I'm good, thanks! How are you Sir?" | |
| 2. | **Researcher:** "I'm good. I'm good. Do you mind if I call you 'Education officer B'?" | |
| 3. | **Education officer B:** "No problem." (giggles) | |
| 4. | **Researcher:** "Is 'B' fine? Is 'B' fine?" | |
| 5. | **Education officer B:** "Yes" | |
| 6. | **Researcher:** "Ok! Ok! Alright! Eh! I just want to ask you some few questions… eh… | |
| 7. | regarding the Science Centre, what is happening around you here? Ok | |
| 8. | Let me start with this question: Tell me, do you have any science | |
| 9. | qualification and if 'yes' what are your major subjects?" | |
| 10. | **Education officer B:** "Yes Sir! I do have a science qualification. It's in Nature Conservation and | |
| 11. | uhmm I hold a BTech in Nature Conservation." | |
| 12. | **Education officer B:** "Yes! And my majors were Coastal and Marine Management including | |
| 13. | Fresh Water Management." | |
| 14. | **Researcher:** "Hmmm" | |
| 15. | **Education officer B:** "Yes!" | |
| 16. | **Researcher:** "Ok. Now that here we don't have Coastal or even the… Have you ever | |

| | | |
|---|---|---|
| 17. | been to the reptile and check what is happening in terms of…..?" | |
| 18. | **Education officer B:** "Yes I have been to the fish aqua... the fish breeding facility where they | |
| 19. | grow the fish. It's the aquarium." | |
| 20. | **Researcher:** "Ok! Ok! Alright! Ja! So tell me, have you ever been trained on how to | |
| 21. | present a science education or science lesson or do you have any | |
| 22. | experience in teaching science?" | |
| 23. | **Education officer B:** "Yes! uhm…. I do have experience but then more in the environmental | |
| 24. | education side. I started being exposed in 2015. I was volunteering in this | |
| 25. | project at Uni and then when I came here, started working at the National | |
| 26. | Zoological Gardens. It's where I actually got more exposure than actually | |
| 27. | doing the environmental education programs. They just the daily lessons. | |
| 28. | I was trained to go into detail with specific lessons like your themed | |
| 29. | lessons. So I do have that experience." | |
| 30. | **Researcher:** "So in other words you are saying, here at this Science Centre, you were | |
| 31. | once trained?" | |
| 32. | **Education officer B:** "I was once trained." | |
| 33. | **Researcher:** "So in other words you are saying, here at this Science Centre, you were | |
| 34. | once trained?" | |

| | | |
|---|---|---|
| 35. | **Education officer B:** “I was once trained.” | |
| 36. | **Researcher:** “Once trained.” | |
| 37. | **Education officer B:** “Yes" | |
| 38. | **Researcher:** “How was the training? Would you say the training was effective? Did it help | |
| 39. | you in any way? Or what do you think of the training that you received here?” | |
| 40. | **Education officer B:** “The training is very effective because for each and every lesson I can see | |
| 41. | that I’m improving myself. It was very effective. I think it’s because the | |
| 42. | training was not too formal so I got to be comfortable. I also had the | |
| 43. | chance to also reveal or show out the real me. So in whatever lesson I’m | |
| 44. | doing or I’m conducting I always bring out my personality. So I’m | |
| 45. | improving in that way.” | |
| 46. | **Researcher:** “Oh! What’s your view of science education at the science centre? The way | |
| 47. | science is being…. The way lessons are being conducted particularly at | |
| 48. | the science centre, what’s your view?” | |
| 49. | **Education officer B:** “Uhmm my view I…. What I like about here at the Zoo is that we try to | Pedagogical Knowledge |
| 50. | accommodate different schools from different backgrounds. If the schools | |
| 51. | don’t understand English we try by all means to teach them by their | |

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| 52. | language or their mother-tongue. And I also find them very informative | |
| 53. | but I wish we could also like add more activities for the students. But the | |
| 54. | ones that we currently have I think we are doing eh very well in them. But | |
| 55. | we do find situations where we have too many schools and I wish we | |
| 56. | could have more activities." | |
| 57. | **Researcher:** "Ok. When you present a lesson, what are the important points to | |
| 58. | consider before one can present a lesson in your view?" | |
| 59. | **Education officer B:** "(Sigh) The important things to consider first of all it's the presenter | |
| 60. | him/herself. It's how you look, the way you are, like, your clothes. If you | |
| 61. | are wearing inappropriately I think that will be the first distraction. Second | |
| 62. | of all, you should also check also the language of the students. And then | Pedagogical knowledge. |
| 63. | also you should be able to, in your lesson you should let them engage | |
| 64. | with you than you actually teaching them. So you should ask them | |
| 65. | questions or let them come up with answers. And also, I also make sure | |
| 66. | that after each lesson I ask them if they don't have any questions. So | |
| 67. | those are the……" | |

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| 68. | **Researcher:** "Ok! Which lesson would you prefer to teach or to present here and why?" | |
| 69. | **Education officer B:** "I prefer National Symbols. Firstly it's because the first time I started | |
| 70. | working here that was the very first lesson I was actually exposed to. And | |
| 71. | you do find people even the teachers who do not know the basic stuff | |
| 72. | which are your national symbols? And I feel like it's a lesson everyone can | |
| 73. | actually participate in because some of the lessons they are not | |
| 74. | complicated but they are designed for certain groups. So with National | |
| 75. | Symbols it caters all grades or all backgrounds." | |
| 76. | **Researcher:** "Ok! Ok! What's your view on the use of interactive exhibits or interactive | |
| 77. | resources in teaching science at the Science Centre?" | |
| 78. | **Education officer B:** "The exhibits are important because you do not only teach. You get them | |
| 79. | to actually feel the object you are talking about. They start to understand | Pedagogical knowledge |
| 80. | how it operates especially with vulture or the elephant head. People | |
| 81. | actually also understand the physics behind it. Like with the elephant | |
| 82. | exhibit the distance where you have to stand in order to operate it. And | |
| 83. | they can actually feel the actual size of an elephant skull." | |

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| 84. | **Researcher:** “Do you think it’s necessary to teach the school groups that visit the | |
| 85. | centre?” | |
| 86. | **Education officer B:** “It is necessary. As I have said you get groups from Limpopo who have never | |
| 87. | been to the zoo. And I think environmental education is one element we | |
| 88. | are missing in education. So by them coming here to the Zoo, they get to | |
| 89. | learn about things they don’t learn about in the classroom. Not that we | |
| 90. | emphasize but we incorporate about nature like how to conserve nature | |
| 91. | also the animals that we have.” | |
| 92. | **Researcher:** “ So you think if we were to leave these learners that are coming in not | |
| 93. | interacting with them. We just leave them, they go around the centre, they | |
| 94. | leave out. Wouldn’t that work? Without like having to teach them or | |
| 95. | interact with them?” | |
| 96. | **Education officer B:** “If we had to cancel the lessons out, I think even this department wouldn’t | |
| 97. | need to be here in the school. Because, I believe, yes we do teach the | |
| 98. | general public but I believe our target it’s mainly the school kids since | |
| 99. | some of the things are not included in their curriculum. So if we don’t have | |

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| 100. | those lessons people wouldn't have knowledge. They would only be | |
| 101. | exposed at varsity like I was exposed at varsity. I had never been to the | |
| 102. | Zoo until I went to varsity. So I missed a lot of that in my life during my | |
| 103. | childhood. So this is playing a very important role in their development." | |
| 104. | **Researcher:** "In teaching science education at this Science Centre, what can we do to | |
| 105. | arouse the learners' interest in science generally?" | |
| 106. | **Teacher:** "I think what would arouse their interest is also, I think it's impossible, but | |
| 107. | also like try to get ideas from them that next time when they come, which | Pedagogical knowledge |
| 108. | activity will they like to do or give them homework and come up with ideas | |
| 109. | of a science related game they would like to play. Cause it's also about | |
| 110. | them at the end of the day. With the infrastructure, I think for now it's fine | |
| 111. | but then get their input. I feel like if they make an input, they will feel | |
| 112. | responsible for the conservation or the running of this organization. So if | |
| 113. | we could also let them involved, feel like scientists already. Some would | |
| 114. | also feel like they have invented something new. Give them that, those | |

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| 115. | ideas, gore guys, what would you like to play next time you come here? | |
| 116. | What do you think you would enjoy more? And then they come with their | |
| 117. | own ideas." | |
| 118. | **Researcher:** "Erhmm. The groups that you get here, do you think the number of | |
| 119. | learners, like a large group or a smaller group, does it have any effect on | |
| 120. | your presentation or teaching of your science lesson?" | |
| 121. | **Education officer B:** "It has a very big impact because I have noticed that if you have to | |
| 122. | present to a very large group, you have to make sure that you discipline | |
| 123. | them all the time. You tell them to keep quiet because at the back some | |
| 124. | lose interest or they lose concentration. And, not that you have to yell, | |
| 125. | but you have to project your voice even more. But even if you do they | |
| 126. | lose concentration. When you are teaching a smaller group, they all pay | |
| 127. | attention. And I think it's also got to do with the set-up or the layout of the | |
| 128. | station. There's a very few chairs so if maybe there could be more seats | |
| 129. | or a plan could be made to accommodate more seats because some of | |
| 130. | them are sitting down some of them are standing. So it's kind of hard to | |

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| 131. | make everyone pay attention. So group science has an impact on how | |
| 132. | make everyone pay attention. So group science has an impact on how | |
| 133. | you present.” | |
| 134. | **Researcher:** “Your lessons, the time allocated. When I look at the lessons it’s like they | |
| 135. | are allocated 20-25 minutes. Do you think that is enough time that you | |
| 136. | can be able to teach or to present whatever information you have to | |
| 137. | present to these groups?” | |
| 138. | **Education officer B:** “I think 25 minutes is more than enough. I believe in making your | |
| 139. | presentations as short as possible before they could lose concentration | |
| 140. | But within that short period, you must make it fun for them. Let them | |
| 141. | engage because you find that some of them they are actually rushing off | |
| 142. | to do other things, to go to the find a picnic area to actually braai and eat. | |
| 143. | So I think 25 minutes is more than enough, even 20 minutes is a bit too | |
| 144. | much.” | |
| 145. | **Researcher:** “Alright thank you so much Education officer B for the information you have just | |
| 146. | given me. Like I’ve said in our meeting, this was a semi-structured | |
| 147. | interview and it ends up here. No-one will have access to these records. | |

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| 148. | If you have any questions or anything you would like to say, you can tell | |
| 149. | me now.” | |
| 150. | **Education officer B:** “Alright. No. I am happy. I don’t have questions.” | |
| 151. | **Researcher:** “Thank you so much.” | |
| 152. | **Post interview** | |
| 153. | Post interview. | |
| 154. | Researcher: Ok, ehh Good afternoon Education officer B. | |
| 155. | T: good afternoon sir. | |
| 156. | R: and how are you? | |
| 157. | T: I’m good thanks, how are you sir? | |
| 158. | R: I’m good, I’m good. Thank you so much for the lesson that you presented to the learners. I just | |
| 159. | want to ask you some few questions based on your lesson that you have just presented. Ehh, I just | |
| 160. | want to know few things here. Tell me did you enjoy your lesson? | |
| 161. | T: I enjoyed the lesson very much ehh because of the response from the learners. And also the topic | |
| 162. | itself for me it was very, very interesting because it was not a topic I was interested in but | |
| 163. | immediately I learnt about it and it became very interesting to me. So I enjoyed a lot. | |
| 164. | **Observation** | |
| 165. | **Education officer B:** | |
| 166. | cause I am also expecting you guys to also respond. So one thing you should | |

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| 167. | also remember is that if you have an answer or you want to say something to | |
| 168. | add onto what we are going to be talking about, it's fine you can raise your | |
| 169. | hand and feel free to answer in your mother tongue. I'm only speaking English | |
| 170. | since kele moXhosa slash moSotho. So I don't know how to speak Sepedi kapa | |
| 171. | kaSeTswana fluently alright? So when you know an answer okana waboa | |
| 172. | kasiZulu kapa kaSepedi anything, feel free. And then…." | |
| 173. | **Learner:** "lekaSeTshangane?" | |
| 174. | **Teacher:** (laughs) "Ehhe ketlotlaka translator. Ok, and then, ummm, please do not hold | |
| 175. | secret meetings. I should be the only one talking unless you raise your hand. | |
| 176. | And please do not eat while we having a lesson, alright?" | |
| 177. | **Learners:** "Yes**"** | |
| 178. | **Education officer B:** "Ok, uhmmm, can anyone tell me, what makes vultures interesting or what | |
| 179. | makes them unique from other birds. Are you guys familiar with vultures, first | |
| 180. | of all?" | Pedagogical method (asking learners question) |
| 181. | **Learners:** (mumbling) | |
| 182. | **Education officer B:** "You not. When you guys had about vulture anywhere, what did you hear | |
| 183. | about vultures? Bare di etsang?" | |
| 184. | **Learners:** (in chorus) "It eats dead animals." | |

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| 185. | **Education officer B:** “It eats dead animals, meaning that it’s a scavenger. So when we say | Content knowledge |
| 186. | ‘scavenger' it means that it does not actively hunt for food or for prey. It waits | (explanation of |
| 187. | for your lions, your leopards, your cheetahs to make the kill and then it only | Scavengers and their |
| 188. | gets to the scene when the animals are dead. Ok. And then we also said they | Role in the |
| 189. | clean the environment. That is true because if we were to find dead animals | Environment). |
| 190. | all over South Africa, then there will be too much or high disease transmission. | |
| 191. | Because those dead animals also contain diseases that are harmful to human | |
| 192. | or also to other animals. So the digestive system of a vulture enables it to | |
| 193. | digest that bacteria from those dead animals, ok?” | |
| 194. | **Learners:** “Ok.” | |
| 195. | **Education officer B:** “What else can we also add on vultures?” | Pedagogical |
| 196. | **Learner:** “They are vulnerable.” | |
| 197. | **Education officer B:** “They are vulnerable. They are endangered because people kill them to do | |
| 198. | traditional medicine. One thing we need to remember is that 80% of South | |
| 199. | Africans depend on traditional medicines. They do not have access to right or | |
| 200. | expensive medical treatment. Ok. And then, they also vulnerable because | |

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| 201. | some of the farmers have started a new practice where, if they find an animal | Content knowledge (the |
| 202. | dead, they will just bury it in the ground meaning that there would be | reason their vulnerable is explained) |
| 203. | shortage of food for the vultures. Another cause of the vulnerability is that | |
| 204. | the farmers would actually use a cow, a whole cow, as bait or as a trap for the | |
| 205. | jackals that come and eat their livestock. So what they normally do is that they | |
| 206. | would kill that cow, they would poison it and then leave it right here on the | |
| 207. | fence knowing that the jackals will come at night to come and eat it. So they | |
| 208. | are trying to kill the jackals and also kill the vultures unintentionally. Alright. | |
| 209. | So those are the 3... oh, another 4th problem is that they also get shocked by | |
| 210. | the electric pylons. La bona di pole tse tsa matlhakalo? So when they stand on | Content knowledge. |
| 211. | it, they defecate or they excrete the waste and then since it is wet, they get | |
| 212. | shocked. So those are the 4 problems we are experiencing in conservation. | |
| 213. | But you guys, I'm sure you will find other ones in the long run but we are still | |
| 214. | aware of the four. Ok, so on this station we are going to be talking more about | |
| 215. | the flight of vultures. So in the world we have two groups of vultures. We have | |

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| 216. | new world vultures which occur in South and North America. And then we | Content knowledge (Two groups of vultures) |
| 217. | have old world vultures which occur in Africa, Asia and Europe. You don't find | |
| 218. | vultures in Australia because in Australia there's too much competition. So | |
| 219. | here I have a picture of the vulture that you find in the new world which is | |
| 220. | North and South America. And the name of this vulture is called a Turkey | |
| 221. | Vulture. And then, on my right hand we have a picture of a vulture which you | |
| 222. | find in the old world which is Africa, Asia and Europe. Are you guys familiar | Pedagogical knowledge (Question & answer method). |
| 223. | with this one?" (Demonstrate with a picture.) | Knowledge of resource. |
| 224. | **Learners:** "Yes!" | |
| 225. | **Education officer B:** "This one is called the Cape Vulture and during the lesson we are going to be | |
| 226. | discussing more about this one since it is the most common. We do find other | |
| 227. | vultures but this one is the most common amongst us, ok. So if we had to | |
| 228. | know the differences between the 2 groups which is the new world and the | |
| 229. | old world is that the old world vultures rely on smell to track down food….." | |
| 230. | **Learners:** "The old?" | |
| 231. | **Education officer B:** "Did I say the old?" | |
| 232. | **Learners:** "Yes!" | |

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| 233. | **Education officer B:** "Oh sorry guys, thank you for the correction. So this one from the new world, | |
| 234. | it relies on smell to track down food. So it spends most of its time walking on | |
| 235. | the ground. And also the talons, we don't call these the feet or the toes we | |
| 236. | call them the talons. So these talons are tough. They enable them to walk | Content knowledge (The difference between the two |
| 237. | smoothly on the ground while searching for dead animals. And then, this one, | Groups of vultures are |
| 238. | the Cape Vulture from the old world it relies on sight or on vision to track | explained). |
| 239. | down food. Hence, it spends most of the time flying high in the sky. And also | |
| 240. | the talons they are not as tough as the ones of new world because they spend | |
| 241. | most the time flying searching for food high in the sky. Ok, while we still on | |
| 242. | this Cape Vulture, if someone were to ask how would you know that this | Pedagogical knowledge |
| 243. | vulture is an adult or its old, e tsofetse and this one is a juvenile it's a youngster, | (Question & answer method) |
| 244. | what characteristics would you normally look at?" | |
| 245. | **Learner:** "The juvenile vulture has a pink neck and the adult one has a dark blue neck." | |
| 246. | **Education officer B:** "She's correct. She is saying that the juvenile or the young one has a pinkish | |
| 247. | red neck and then the adult has a dark neck which is blueish grey. And then | Pedagogical knowledge |

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| 248. | the eyes?” | (Question & answers method continues) |
| 249. | **Learner:** “The adult's eyes are yellow. And then the juvenile's eyes are a bit dark.” | |
| 250. | **Education officer B:** “Where did you guys get those answers you told me?” (Class giggles) “From | |
| 251. | the last session?” | |
| 252. | **Learners:** “Yes!” | |
| 253. | **Education officer B:** “Yes? Oooh ba bhora shame because you guys were supposed to come here | |
| 254. | first ke le bone gore la bhayiza hakakane. But it’s fine. So basically to | |
| 255. | demonstrate or to make people remember is that we wear these shades. | |
| 256. | These ones they symbolize an adult vulture. So they…you guys can see that in | |
| 257. | colour they are black and yellow and sorry to warn you, I know I look ugly in | |
| 258. | these ones but please don’t get distracted. So the adult Cape Vulture has the | Resource knowledge |
| 259. | centre of the eyeball it’s black and then the edges is yellow. Hence the frames | (Difference between male & |
| 260. | of these shades are yellow. And then the neck is blueish grey or it’s dark. That’s | female demonstrated). |
| 261. | how you know gore this one is an adult Cape Vulture. And then the young one | |
| 262. | they did say that it has dark eyes and then the neck it’s pinkish red. So if you | |
| 263. | guys had to go to Kruger National Park or wherever, you guys will think of this | |

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| 264. | lesson and remember how I wore the colours of whatever. So this is actually | |
| 265. | to make you guys remember and not forget, ok. So can anyone tell us what | |
| 266. | does a bird do, any bird do with its wings before it takes off? Before it can fly | |
| 267. | high in the sky, what does it do with the wings? Even if it's a chicken… Ok | |
| 268. | chicken e fellela gona mo buy what does it do with the wings? It opens the……" | |
| 269. | **Learners:** "The wings." | |
| 270. | **Education officer B:** "It opens the wings. It only positions them like this and then it flies?" | |
| 271. | **Learners:** "No!" | |
| 272. | **Education officer B:** "What does it do?" | |
| 273. | **Learners:** (mumbling) | |
| 274. | **Education officer B:** "It flaps the wings. The way they flap the wings it differs according to the bird | |
| 275. | species. So for the chickens, they flap them like this, fast. And then the | |
| 276. | vultures they flap them like this and then they run for a short distance. So the | |
| 277. | reason why they flap their wings and also run for a short distance is to gain | |
| 278. | momentum. It's the same thing that happens with our aeroplanes. Before | |
| 279. | they can take off from OR Tambo airport, they first need to be on the runway | |
| 280. | for a certain distance and then that's when they can take off, ok. So also with | |

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| 281. | our choppers or our helicopters before they could actually take off….for now | |
| 282. | though, they don't need to run on the runway, but they first need to spin their | |
| 283. | wings to gain momentum. And then, one thing we also need to remember | |
| 284. | about vultures is that, you'll never see a vulture at night. You'll never see a | |
| 285. | vulture early in the morning ka matsha. You only see a vulture when the sun | |
| 286. | is out. Because, what happens is that, that solar radiation from the sun needs | |
| 287. | to hear a dark patch on the earth's surface. So when we are talking about dark | |
| 288. | patches, we are talking about your tar road or a roof that has a dark colour | |
| 289. | from any kind of building. So when it heats a dark patch, that dark patch gives | |
| 290. | off a warm wind thermal or a warm air temperature. So that vulture will go | |
| 291. | down the cliff a bit to get that warm temperature to keep that body warm | |
| 292. | before it could fly to the higher and colder parts of the atmosphere. So when | |
| 293. | it gets to the sky, this vulture it changes the way it flies. It stops flapping its | |
| 294. | wings. It positions them like this, and we call this a soaring flight. So for the | |
| 295. | flapping flight, they need to use too much energy but for this flight, they use | |

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| 296. | less energy. So that's how they are able to fly over long distances. They can fly | |
| 297. | up to 150km and backward. So that is the distance from Pretoria to Ermelo in | |
| 298. | Mpumalanga. If it had to flap wings in the sky, it would use too much energy | |
| 299. | and it will only be able to cover a maximum of 40km and it wouldn't be able | |
| 300. | to find food. So on this picture, if we had to cut the wing like this, the wing of | |
| 301. | the vulture like this while flying in the sky, this is the kind of shape you would | |
| 302. | get. It would be like this. So what happens is that, as a vulture is busy flying in | |
| 303. | the sky, it will experience high air pressure on this side and low air pressure | |
| 304. | on this side. And then the wind will hit this part of the wing and then gets | |
| 305. | distributed unequally on both sides of the wings. So since this side is long, the | |
| 306. | wind will travel faster on this side, and travel slowly on this side since this side | |
| 307. | is short. And then when those 2 kind of winds meet up on this side, they form | |
| 308. | what we call a vortex. Are you guys familiar with the term 'vortex'?" | |
| 309. | **Learners:** "No!" | |
| 310. | **Education officer B:** "Le kele labona movie ya-tornado?" | |
| 311. | **Learners:** (mumbling) | |
| 312. | **Education officer B:** "Tornado e etsa so… it | |

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| | moves in this motion. So if you guys watched that | |
| 313. | movie you get to notice that, whatever object is lying around that vortex it | |
| 314. | gets to be pulled into the centre of that vortex, of the tornado. So the same | |
| 315. | thing happens with our vultures. As they are flying in the sky, the vulture form | |
| 316. | in this pattern. Its intention is to pull or to drag that vulture backwards. So in | |
| 317. | order for that vulture to withstand or to resist that pulling by that vortex, what | |
| 318. | it does is that it opens these parts of the wings. It would open these finger- | |
| 319. | like projections. And we call these parts 'the primary'. So what happens is that | |
| 320. | the vortex is formed in this part of the wings. They form the cycles here. And | |
| 321. | when the vortex cycles get to this point, it stops, it gets broken by these | |
| 322. | primaries. That's why the vulture is able to fly forward at such speeds. If it had | |
| 323. | to close the primaries, it would be pulled backwards by that vortex. [Analogy | |
| 324. | strategy] So I'm sure someone is wondering why we have an aeroplane while we | |
| 325. | talking about vultures. The reason why we have an aeroplane is because we | |
| 326. | couldn't bring an actual vulture. And we are not trained to handle those. So | |

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| 327. | movie you get to notice that, whatever object is lying around that vortex it | |
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| 339. | talking about vultures. The reason why we have an aeroplane is because we | |
| 340. | couldn't bring an actual vulture. And we are not trained to handle those. So | |
| 341. | the reason why we have an aeroplane is because it is designed similarly to a | |

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| 342. | vulture. And it also uses the same mechanism as a vulture to fly high in the | |
| 343. | sky. So when our aeroplane is flying high in the sky, it also experiences vortex | |
| 344. | right on this part of the wings. And then since it is designed or created by a | |
| 345. | human being the engineer, they couldn't design the primaries, those finger- | |
| 346. | like projections so instead they came up with this idea that says, 'why don't | |
| 347. | we bend the wings on the edges of the wings?' So then the vortex is formed | |
| 348. | here and when it gets to this point it gets broken. Because this part forms the | |
| 349. | same function as the primaries. Le kile la bona di jet tsa masole ha di fofa di | |
| 350. | nosh smoke on this part of the wing high in the sky. Sometimes they also dye | |
| 351. | that gas into colours especially ka di national days like, I don't know, Freedom | |
| 352. | Day then they display ntho tsa teng. That gas that you see, it's the vortex. That | |
| 353. | vortex is visible but from this aeroplane ya di passenger, it's not visible but it | |
| 354. | is there. So if you were to fly behind a military jet, you would go hit that | |
| 355. | building and die immediately because it's powerful, alright. So, another thing | |
| 356. | is, are you guys doing Physics?" | |
| 357. | **Learners:** "Yes!" | |

| | | |
|---|---|---|
| 358. | **Education officer B:** "Alright. Some of you. Ok. So we are well aware that, for any flying object | |
| 359. | there are four forces which are involved. Right? Have you guys been taught | |
| 360. | forces?" | |
| 361. | **Learners:** "Yes." | |
| 362. | **Education officer B:** "Ok. So what we going to do now is, I need a volunteer. Someone who is going to take | |
| 363. | the labels from this table and show us which force do we find where on this | |
| 364. | flying object on this picture. If you are struggling, it's fine, you can ask your | |
| 365. | peers to help you out. This is not a competition, you are all here to learn. So | |
| 366. | does anyone want to volunteer and show us? You just take the label from this | |
| 367. | table and plug it on this chart." | |
| 368. | **Learner:** "I volunteer." | |
| 369. | **Education officer B:** "If you are stuck, it's fine, your friends can help you out. It's fine. When he is | |
| 370. | done, we will go through each force thoroughly so that everyone can | |
| 371. | understand. Re kgone go rectifier di mistakes. If you are at the back don't | |
| 372. | worry I will just raise it up le kgone go bona le lona. If you see something | |
| 373. | wrong, you will be allowed to change it, ok? Le ska wara. Guys are you happy?" | |
| 374. | **Learners:** "Yes." | |

| | | |
|---|---|---|
| 375. | **Education officer B:** "Ok, guys this is the end product, is he correct?" | |
| 376. | **Learner:** "I think so." | |
| 377. | **Education officer B:** "You think so? Does anyone beg to differ? Le sharp? Alright, let's go through | |
| 378. | it on this picture. Remember I talked about the warm wind thermal or the | |
| 379. | warm air temperature from dark surfaces? So what happens is that when that | |
| 380. | vulture goes down from the cliff to get that warm air temperature, it goes | |
| 381. | there to make the body warm and also to gain lift. So that warm wind thermal | |
| 382. | helps the vulture to apply a lift form. So if you had to define a lift force in | |
| 383. | simple terms, it's a force that adds right angle to the direction of motion. So | |
| 384. | basically in simple terms, it's a force that pulls an object upwards. So our mate | |
| 385. | was correct, ok. So we know that if you had to throw your phone up in the | |
| 386. | sky, you are giving the lift force more advantage. But eventually it will go | |
| 387. | down. And it will be pulled by the weight force or the gravitational force. | |
| 388. | Akere? So you are correct. So moving onto our 2 horizontal forces, we have a | |
| 389. | thrust force. A thrust force is a force that propels a flying object towards the | |

| | | |
|---|---|---|
| 390. | direction of motion. So basically it's a force that pulls a flying object forward | |
| 391. | neh? So if we had to go to our vulture, how does it apply a thrust force? The | |
| 392. | design of the body, its streamline. When we say streamline, we mean it's | |
| 393. | pointy here at the front. And then the surface of the body is smooth. There's | |
| 394. | no kind of disruption or interruption on its body. So the same thing with our | |
| 395. | aeroplane. Our aeroplane is also streamlined meaning that it's pointy here at | |
| 396. | the front and there is no kind of obstruction. If this wing had to be positioned | |
| 397. | like this it was going have difficulties in flying. So they are positioned like this | |
| 398. | so that the air can pass through smoothly, ok. So ehh, and also by the way | |
| 399. | since this aeroplane is designed by human being it doesn't have its natural | |
| 400. | thrust. Ok first of all it's the streamlined body, another thing that it needs to | |
| 401. | apply the thrust is the engine. So what the pilots or the engineers have done, | |
| 402. | they have created this aeroplane to have thrust force here on the engine. So | |
| 403. | when the wind enters here on the turbine it gets burned and converted to a | |
| 404. | thrust force. That's why the aeroplane is able to go forward, alright? So | |

| | | |
|---|---|---|
| 405. | moving on to our very last force which is a drag force. A drag force is a force | |
| 406. | that pulls an object backwards. It acts opposite direction to the direction of | |
| 407. | motion, ok. So this drag force is the result of a vortex. La gopola ke buile ka | |
| 408. | vortex, gore it pulls the vulture backwards? | |
| 409. | **Learner:** Yes! | |
| 410. | **Education officer B:** Yes, so it eventually results into a drag force. Le lona, you guys also experience | |
| 411. | a drag force especially now in August ka nako tsa di Autumn so. You see, you | |
| 412. | notice that as you going forward the wind will come opposite direction and | |
| 413. | that wind will try to push you backwards. Le kile la bona? | |
| 414. | **Learners:** Yes. | |
| 415. | **Education officer B:** So you, although you are not aware you are also experiencing drag force. | |
| 416. | That's why re tshwanetse ho tsenya matlapa mo pokhotong so that the drag | |
| 417. | force doesn't become too powerful, ok. So can anyone tell us, we discussed | |
| 418. | this four forces, so which forces are important or which forces are most active | |
| 419. | when a vulture is about to lend on the ground or when an aeroplane is about | |
| 420. | to land on the ground? Which forces are involved and what does it do with | |
| 421. | the wings? | |

| | | |
|---|---|---|
| 422. | **Learner:** Drag force. | |
| 423. | **Teacher:** He says it applies a drag force. He's correct. So as the vulture and an aeroplane | |
| 424. | we're flying like this in the sky, the vulture to be specific, it would tilt the wings | |
| 425. | like this to apply the drag force, ok. So basically the wind will come, hit the | |
| 426. | wing, the wing and then it will force it to stop where it's supposed to stop. | |
| 427. | And then when it's finally landed it will start flapping its wings for a short while | |
| 428. | and then stop. So the same thing happens with the aeroplane. When an | |
| 429. | aeroplane is about to land the pilot will open this blocks. This blocks are called | |
| 430. | the gliders. So as it's busy flying in the sky this gliders are normally closed but | |
| 431. | when it's about to land the pilot will open this gliders to apply the drag force. | |
| 432. | If it doesn't apply the drag the aeroplane will go crush into the O.R Tambo | |
| 433. | building. Do you guys understand? | |
| 434. | **Learners:** Yes. | |
| 435. | **Education officer B:** Yes. Do you guys have any questions? | |
| 436. | **Learners:** No. | |
| 437. | **Education officer B:** Ok. Did you enjoy the lesson? | |
| 438. | **Learners:** Yes! | |
| 439. | **Education officer B:** Alright. So nna I do have a | |

| | | |
|---|---|---|
| | question for you guys? Ehh, how high do you think | |
| 440. | vultures can fly? | |
| 441. | **Learners:** *mumbling* | |
| 442. | **Education officer B:** How high? Ke utlwile motho a re 6 feet. Ok, by the way when you mention the | |
| 443. | term feet, feet akere is the unit they use oversees. So before you could | |
| 444. | mention feet you will have to convert for us South Africans into meters above | |
| 445. | sea level. So how much is 6 feet if you have to convert it? (Education officer B giggles) | |
| 446. | wa ipata. So basically the unit we use for elevation or altitude or height is | |
| 447. | meters above sea level ok. So the minimum that was recorded, although they | |
| 448. | can go a bit lower than that, was 1500 meters above sea level and then the | |
| 449. | highest that was recorded was 11000 meters above sea level. And that one | |
| 450. | that flew to that height or that elevation was the Ruppels vulture. A Ruppels | |
| 451. | vulture you also find it here in South Africa but then it's not too common here | |
| 452. | in South Africa although you can find it here. So what happened is that as the | |
| 453. | aeroplane is flying like this, nicely in the sky. This vulture decided to fly in front | |
| 454. | of the aeroplane, how smart is he? So akere re buile ka thrust force hore the | |

| | | |
|---|---|---|
| 455. | wind enters here. So moya ha o kena ka mo o kena ka force and then it gets | |
| 456. | converted to thrust force. So this bird as it's busy flying the drag force became | |
| 457. | more powerful than the thrust force and then it got stuck into these turbines. | |
| 458. | It got pulled back, stuck into the engine and then it got sliced into minced | |
| 459. | meat. | |
| 460. | Learners: Shame | |
| 461. | **Education officer B:** So, ok. So this guys they do need to be careful. And also other students | |
| 462. | yesterday they asked me hore what happened to the aeroplane. Basically | |
| 463. | nothing happened to the aeroplane because it was only one vulture but if they | |
| 464. | have to come in a colony or a large group maybe 20 then an aeroplane would | |
| 465. | crush because they are now interfering with the thrust force. Do you guys | |
| 466. | understand? | |

## APPENDIX L:
## INTERVIEWS FOR EDUCATION OFFICER C

**Pre interview**

**RESEARCHER:** Good morning Ma'am.

**Education Officer C**: Good morning Sir, how are you?

**RESEARCHER**: I'm fine thanks and you ma'am?

**Education Officer C**: I'm fine thank you very much.

**RESEARCHER**: Do you mind if I call you, Education Officer C?

**Education Officer C**: No, I don't mind.

**RESEARCHER**: Okay, thank you. I just want to ask you some few questions neh.

**Education Officer C**: Yes.

**RESEARCHER**: Can you please state your science qualification and what are your major subjects?

**Education Officer C**: I havea Bachelor of Science Degree in Life Sciences from the University of South Africa (UNISA). my major subjects are Biochemistry and Microbiology and my other elective modules are animal and plant diversity, medical plants and environmental awareness.

**RESEARCHER**: Okay thank you. Ehh. Do you have any experience in science education or lesson presentation?

**Education Officer C**: Yes I do have.

**RESEARCHER**: Okay, can you please explain to me, the kind of experience that you have?

**Education Officer C**: Since from varsity, we've been going out to different schools doing environmental education, we've been giving out lessons about how to take care of the environment.

**RESEARCHER**: Ok. Have you ever received any form of training on lesson presentations here at the science centre?

**Education Officer C**: At the science centre, yes I have, yes formal and informal so I have been trained how to deliver a lesson in terms of what I should wear and how I should… my body language actually and also I've been trained on different lessons that you give out to learners.

**RESEARCHER**: Okay, The training that you have received here at the science centre, was it valuable?

**Education Officer C**: Yes it was, it was it changed me a lot, in terms of my presentation skills, in term of uhm my confidence, it did boost me a lot.

**RESEARCHER**: Ok.Tell me what is your view, on the science education at the science centre?

**Education Officer C**: Uhmmmmmmm I think it's good, yes but then it need a bit of polishing.

**RESEARCHER**: In your view, what do you think are the main important points to consider before you can present a lesson?

**Education Officer C**: Uhmmm I think it is to introduce yourself and also to introduce the lesson and then to get to know the primary language of the leaners as well as uhm you must know as the presenter the content of what you teaching about

**RESEARCHER**: Oh Kay, Which lesson do you prefer to teach, or which lesson would you like to present and why that specific lesson?

**Education Officer C**: Uhmmm Microscope lesson, I think it's too much practical and then I think the kids or learners would enjoy doing it, and then also I think it would be much….. it will be good for them to learn about it, as to why do we have microscope in such facilities because I don't think leaners do understand that or do know that we have a research centre here, so I think it will be something very much good for them know.

**RESEARCHER**: What resources are you going to use to teach this lesson?

**Education Officer C**: Okay, so obviously I will have my microscopes, different microscopes, and then I will have uhmm for now I think I'm going to use an onion of which am going to, we going to, I am going to experiment with them so they going to see or view an animal plant uhm mcm a plant cell through a microscope.

**RESEARCHER**: Okay, tell me eh do you think it is very important to use resources or to use exhibits when you present a lesson?

**Education Officer C**: Yes it is very good.

**RESEARCHER**: Why, why do you think is important to use those kind of things?

**Education Officer C**: I think it helps a lot in terms of memory, because when you do things practically it, it, you won't lose such memory like very fast. Yes. So if you have exhibits or you doing demonstrations then it helps a lot.

**RESEARCHER**: Do you have experience in using microscopes?

**Education Officer C**: Yes, I do have I have been trained here.

**RESEARCHER**: Okay, uhm right. If when teaching this microscope learners what do you think are the most important things that you can do to make learners to be more interested on what you will be teaching? The things that you can do to arouse their interest to make them to be more interested in learning about microscopes?

**Education Officer C**: It's getting them to be interactive, so I won't do much of talking, so it will be a doing activity so we going to experiment together, so I won't talk a lot. (Mumbles)

**RESEARCHER**: Ok. So tell me, on the microscope lesson that you going to teach, like you are saying learners will be looking at an onion, to look at the cells, when they look at the cells what is the main thing you want them to see there?

**Education Officer C**: Uhmmmmmmm

**RESEARCHER**: Or what am trying to find out from you, is there are plant cells and there animal cells and you are saying, they will be seeing a plant cell, will learners be able to recognise that this is a plant cell not an animal cell and what is it that will make it clear that this a plant cell not an animal cell?

**Education Officer C**: Oh okay So I believe many learners or schools, do have a lesson on microscopes and that they do have a lesson on plant cells and animal cells so in this case there is a picture of a plant cell on their textbook so when I give them the microscope to look through or see through and get to see the plant cell I'm hoping that, now they get an understanding on how a microscope works.

**RESEARCHER**: Okay, thank you so much Education Officer C and we wish you the best in your presentation then we will talk about the presentation later on, thank you so much.

**EDUCATION OFFICER C Post-Interview**

**RESEARCHER**: Thank you so much EDUCATION OFFICER C, for your lesson presentation. I would like us to continue and I just want to ask some few questions based on your presentations.

**EDUCATION OFFICER C**: Okay

**RESEARCHER**: Uhm. The first question tell me did you enjoy your lesson? Did you enjoy presenting this lesson?

**EDUCATION OFFICER C**: Yes I did enjoy teaching because the level of participation from the learners was very good it was high, they were paying attention and also they were showing interest.

**RESEARCHER**: Okay. Is there anything you find to be difficult while teaching or presenting this lesson?

**EDUCATION OFFICER C**: Nothing really because I think for many learners they do not have microscopes at school, so this was their opportunity to get to know it get to use

a microscope. So it was something very good for them so I did not experience any bad thing or any difficulty.

**RESEARCHER**: Okay, I heard you talking about different parts of a microscope, there is where you spoke about the lenses, like the microscope you were using has got 3 lenses, can you tell me, what are the main purpose of the lens on the microscope?

**EDUCATION OFFICER C**: Okay uhm. They are for focusing, so as you know they have to put their eye on the eye piece, so they can see through, and then they use those lenses. We've got 3 lenses, one is short, and then the medium one and the last one is the longest one. They also differ in a manner in which they magnify so I give them a microscope, I show them how to use the different lenses, so they put an object on the stage and then they using this one lens and if they cannot see anything or if they are unable to see anything then they change it and they use another one, until they get a nice picture.

**RESEARCHER**: Okay, tell me, when you realise that the learners they do not understand what you are teaching them, how do you go about solving that?

**EDUCATION OFFICER C**: Okay Obviously as the presenter, I have to keep track, I will have to go back and check if the learners are understanding what you are talking about so in this case as the teacher I have to go back and you try to give them questions, and if you see that they are unable or they cannot answer you, it is then, then you have to ask them what exactly is it that is difficult for them to understand. And then that's when you start focusing on that part until they get it right or until they understand.

**RESEARCHER**: So when you teach this lesson, tell me, do you always follow the lesson plan, or you don't? I mean I understand there are lesson plans on this lessons. Do you always follow the lesson plan as is it or do you change some few things on the lesson plan when you present?

**EDUCATION OFFICER C**: Yes, the first three steps yes I do follow the lesson plans but then as the lesson goes then as the presenter you get to introduce maybe some

new concepts and then also the learners they start asking new things, that's when you try to focus on what they want to know but at the end of the day, you have to remember as a teacher or presenter you have to cover your whole lesson.

**RESEARCHER**: Okay…

Eh tell me, which method do you use, or do you prefer to you use, when presenting this kind of lesson? The teaching method that you prefer to use?

**EDUCATION OFFICER C**: Okay, so with this one because it is a practical lesson, it has to be practical but then as giving uhm ai mxm… as continuing with the lesson I have to go back and check if they do understand everything, so I keep asking questions that way I get to track if they are understanding.

**RESEARCHER**: Ok, Ok. If you were asked to improve, do you think there's anything that can be improved on this lesson?

**EDUCATION OFFICER C**: Uhm… so far no, nothing, it's so well.

**RESEARCHER**: Okay. In terms of presenting this lesson using microscopes as teaching aids, do you think it is very important to have those kind of instruments such as microscopes together with the pictures that you were using of different microscopes, do you think it is important to use resources when someone is presenting a lesson?

**EDUCATION OFFICER C**: Yes it is it important because it gets learners to fall in love, to develop love for science, and as well as to be practical because when you do something practically so, then you do not just forget easily, so it is very good.

**RESEARCHER**: I see, I see. So tell me, if you look at the lesson you have presented today, do you think you have achieved your goals or not?

**EDUCATION OFFICER C**: Yes, I think I did achieve my goals, yes.

**RESEARCHER**: Do you think the leaners have learnt something?

**EDUCATION OFFICER C**: Yes, they have learnt a lot because from their schools some they know a microscope some they have not used a microscope some they have not used the microscope at all, so I have achieved a lot.

**RESEARCHER**: I heard you talking about different types of microscopes to say that we have got compound microscope, we have got electron microscope, any other microscope that you know except…

**EDUCATION OFFICER C**: Yes, Yes a digital microscope, it is also a light compound microscope, but then with this one there is no eye pieces then you get to see whatever that you want to view from the stage, on the display screen, it has a display screen.

**RESEARCHER**: Okay. Alright. Thank you so much for coming and also for your lesson I wish you the best. Thank you.

**EDUCATION OFFICER C**: Thank you.

## APPENDIX M:
## OBSERVATION FOR EDUCATION OFFICER C

**Education Officer C:** “My name is Lisa and I’m with my colleague whose name is Martin. Are you guys in Grade 10?

**Learners:** “Yes!”

**Education Officer C:** “OK. All doing Life Sciences?”

**Learners:** “Yes!”

**Education Officer C:** “Ok. Do you guys know a microscope?

**Learners:** “Yes!”

**Education Officer C:** “Have you seen one before?”

**Learners:** “Yes!”

**Education Officer C:** “Have you used it before?”

**Learners:** “No!”

**Education Officer C:** “But then you learnt about it ko skolong?”

**Learners:** “Yes!”

**Education Officer C:** “What is a microscope?”

**Learners:** (mumbling)

**Education Officer C:** “First thing, there’s no wrong answer. We’re here to learn. And then I will not be doing the talking alone, we have to talk together. Akere?”

**Learners:** “Yes!”

**Learners:** “Bare bolela kaSeTswana.”

**Education Officer C:** “Why do want to use SeTswana.”

**Learners:** (mumbling)

**Education Officer C:** “Ya. But then we do home languages in the foundation phase. You guys are now in High School so you should be good with your English. Don’t be shy, neh? And then let’s not sing answers out, we raise up our hands and then, yah..! What’s a microscope?”

**Learner:** “A microscope is an object that helps you see micro organisms.”

**Education Officer C:** “An object that helps you see micro organisms. Another one? What’s a microscope? What’s a microscope? Hmmm? Ok. A microscope is an

optical instrument that is used to view things you cannot see by your naked eye. Now you know what a microscope is. Ok, what's a microscope?"

**Learners:** (mumbling)

**Education Officer C:** "An optical instrument that is used to view things that you cannot see with your naked eye. Yes, that's a microscope. And then I have these 2 microscopes with me. They are different. Can you guys try and tell me at least 2 differences between them. Or maybe just one.

**Learner:** "The first one uses solar power. The next one use energy from somewhere else."

**Education Officer C:** "What's energy solar?

**Learner:** "Energy from the sun."

**Education Officer C:** "And then this one?"

**Learner:** "Uses electricity."

**Education Officer C:** "Uses electricity. Ok, another one?"

**Learner:** "This one uses digital. And then this one is traditional."

**Education Officer C:** "Why do you say this one is digital?"

**Learner:** "Cause the mechanism has a something…."

**Education Officer C:** "It has a screen so it's digital. And then this one, why do you say it's traditional?"

**Learner:** "Cause ke ya kgale."

**Education Officer C:** "So we call it traditional? Why not call it manual? I'm just asking not that it's manual. I'm just asking."

**Learners:** (silence)

**Education Officer C:** "Ok guys. These 2 microscopes, they both use electricity. They are both electronic. This one would use solar energy or solar power. They all use electricity. The difference is that this one is chargeable. You can charge it and then you can carry it around. This one is also digital and then, as you can see it has all these buttons around here. And then, this one you will be able to see whatever it is you are trying to view here, on the display screen. And then this one you cannot see anything without putting your eye here. So you have to put your eye on the eye piece so that you can see through to your specimen. They use electricity, all of them.

This one cannot work without power supply. As long as this one is charged, then you can carry it around. So, ok, can we try and identify all the components of the microscope? The parts of the microscope. Let's start with this one. Ok, we need one of you to come forward. We need one of you, a volunteer to come work with us. Why do we need gloves? Am I scary? Ok, you can use your home language, why do we need gloves?"

**Learner:** "For bacteria."

**Education Officer C:** "You are a not giving me a sentence, you are only giving me a word. For bacteria, why? Ok, we're using gloves so that we don't transfer the germs and bacteria from me to the specimen, or not to contract it with whatever is in here. So imagine if we were working with DNAs and stuff then I put my fingerprint in here, I'm going to be 99% matched with whatever they want. So if there is a criminal case I become the culprit, you understand?"

**Learners:** "Yes."

**Education Officer C:** "So let's now try to identify all the components of the microscope. We have to fast because you guys are going through all the stations neh? Can we start with this part?"

**Learners:** "Eye piece."

**Education Officer C:** "Eye piece. What is it for?"

**Learners:** (mumbling)

**Education Officer C:** "You put your eye on the eye piece so that you are able to see through, akere? And then this part?"

**Learners:** "The arm."

**Education Officer C:** "The arm, what do you think is the function of the arm?"

**Learners:** "The handle"

**Education Officer C:** "So it acts as a handle. So these connect the ID and the body tubes to the rest of the components of the microscope, labona?"

**Learners:** "Yes."

**Education Officer C:** "And then we have these three things, what do we call them?"

**Learners:** "Objective lenses."

**Education Officer C:** “Yes. These are the objective lenses. And then we have this thing. One that I’m holding kamo that I’m using to rotate. The one that I’m using to rotate these objective lenses. What do you think it is? Think! Your came number 2 for the life sciences competition”

**Learners:** “Revolving nose cheeks.”

**Education Officer C:** “Yes. What do we use a revolving nose cheeks for? And thank you to Mr Google ko morao. What’s the function of the revolving nose cheeks?

**Learner:** “So that it can change the objective lenses.”

**Education Officer C:** “Yes. It is used to change the objective lenses. So if you are using this one and then you see that you can’t see anything. You can change it and use another one. We have this black thing, what is it called?”

**Learners:** “The stage.”

**Education Officer C:** “The stage. What’s the function of the stage?

**Learners:** (mumbling)

**Education Officer C:** “This is where we put the specimen. This is where we put this light on. And then, what is this?”

**Learners:** “Clips.”

**Education Officer C:** “Stage clips. What are they for?”

**Learners:** “To hold….”

**Education Officer C:** “Yes, so that it doesn’t…?”

**Learners:** “Fall.”

**Education Officer C:** “Yes. You have to give a full description. You don’t want half marks. And then we have these things.”

**Learner:** “Coarse adjustment!”

**Education Officer C:** “Yes. This is a coarse adjustment. What is it used for Ma'am?”

**Learners:** (mumbling)

**Education Officer C:** “Ok. So the coarse adjustment is used to move the stage up and down and adjust the stage. Then we have the small one, what do we call it?”

**Learners:** “Fine course.”

**Education Officer C:** “Fine course? Fine adjustment. These 2 are the adjustments. This one is coarse, this one is fine. What’s the function of the fine adjustment? It

doesn't move anything so don't mention moving up and down. The fine adjustment, what is the function of it? What does it do? The fine adjustment. Think! So you need help?"

**Learners:** "Uh huh."

**Education Officer C:** "The fine adjustment is for fine focusing. What's fine focusing?"

**Learner:** "Maybe e Tshwane le auto focus."

**Education Officer C:** "What's auto focus?"

**Learner:** "It's like hao focus something, gore o e bone pila."

**Education Officer C:** "Ok, so fine adjustment is for making the object or specimen or whatever you are trying to view here much clearer, ok? So if you have your specimen here, if it looks blurry, you use this part. Then you get a fine image of it. And then, moving forward, what is this part?"

**Learner:** "Illuminator."

**Education Officer C:** "What's illuminator? She's correct. It is the illuminator but then now let's use the simple term so that we can all understand."

**Learner:** "Isn't that the one that gives light to the substance?"

**Education Officer C:** "Yes. This is the light source. You can also call it the illuminator. And then we have this switch. What's the function of the switch?

**Learners:** (mumbling)

**Education Officer C:** "To turn it on and off neh? And then we have this part…"

**Learners:** "The base."

**Education Officer C:** "What's the function of the base?"

**Learners:** "To support the microscope."

**Education Officer C:** "To support all the components of the microscope. And then so, we done. And so you guys you understand now and you understand how it works. Ok, we have this part, we didn't talk about it."

**Learners:** "The Diaphragm."

**Education Officer C:** "The diaphragm, yes. What's the function of the diaphragm?"

**Learners:** (mumbling)

**Education Officer C:** “To control the amount of light passing through to the specimen. Yes correct. So now we will use an onion. So now you know how to use a microscope neh?”

**Learner:** “Yah.”

**Education Officer C:** “So as long as you know how to use all these parts, then it should be simple for you guys to get a picture akere?”

**Learners:** “Yes.**"**

**Education Officer C:** “And then, now in this case what do you call this?”

**Learner:** (silence)

**Education Officer C:** “These are slides, akere? So normally you have your slides and you can tell. This one, it has a mountain specimen on it. This specimen is permanent here. It’s a flower of maize. So it’s permanent here it won’t move away. So we have this which doesn’t have anything but then now we will put a specimen on top of it. So we’re using this fine layer of an onion. Only a few of you will get to see but anyway we will try. Ok, you use the stage clips to hold the specimen so that it doesn't fall off. And then now, yes, you can get us a picture. So now I made one try and we got a picture. And then you will look through that and tell me what you see in there. I won’t tell you. It’s in your lesson, textbook and I’m sure you've learnt about it.”

**Learners:** (taking turns on the microscope)

**Education officer C**: listen guys, did you know that there are many careers where you use microscope. You can be a microbiologist, a lab technician or a geneticist. Many careers guys in science.

**Learners**. Yes sir. Thank you

## APPENDIX N
## EDITOR'S CERTIFICATE

**Academic consultancy**
*"Perfection is our DNA"*

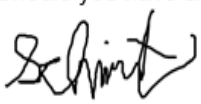
309 Aardal flats
219 Stead avenue
academicconsultancy3@gmail.com
16 November 2018

To whom it may concern

This letter is to confirm that I, Keegan Bruce Schmidt, freelance copy-editor, have edited and proofread the proposal ***"an exploration of the teaching practices of education officers at a science centre in Pretoria, Gauteng province" by Hasani Justice Bilankulu*** for grammar and spelling.

I have not changed any of the ideas presented in this proposal, only the grammar and spelling has been altered for the purposes of clarity. This is to confirm that I have edited the document to a level I deem satisfactory.

Should you have any questions feel free to contact us



Keegan Schmidt
Qualifications:

- BIS (University of Pretoria)
- BIS Hons (University of Pretoria)

**APPENDIX O**
**TURN IT IN REPORT**

An exploration of the teaching practices of education officers at a science centre in Pretoria, Gauteng Province

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