Rhodes University

Department of Education

AN INVESTIGATION OF PRIOR KNOWLEDGE ABOUT AMPHIBIANS AMONGST GRADE 7 LEARNERS AND EDUCATORS: TOWARDS THE DEVELOPMENT OF A RESOURCE PACK

Submitted in partial fulfillment of the requirements for the degree of

MASTERS OF EDUCATION IN ENVIRONMENTAL EDUCATION

by

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ABSTRACT

The value of frogs is compared to the value of canaries used in coalmines: they are indicators of the environmental status of our environments, thus crucial to our survival. One third of all frogs worldwide are threatened with extinction. Frogs are found in our immediate environment. Are our Natural Science educators, teaching the Life and Living curriculum aware of this threat, the possible impact that the extinction of frogs will have on our welfare? Are our educators making use of the resources in their immediate environment? This study aimed to investigate the prior knowledge in both the horizontal and vertical discourse, in Grade7 learners and their educators, to inform the design of an amphibian resource pack. By investigating their prior knowledge an insight would be gained in their knowledge of Natural Science concepts as well as their everyday knowledge of their immediate natural environment. It would also highlight any misconceptions formed as well as alternative concepts within both educator and learner groups. These insights would be used to inform the contents of said resource pack.

Acknowledgements

Writing a thesis on order to obtain a masters degree is similar to undergoing a metamorphosis. Ideas start out quite small, contained in an egg capsule, the egg hatches signaling the beginning of development.. The field work is similar to a tadpole swimming in a pond but once the interpretation of data starts, again it signals even more development, ready for the tadpole to turn into a frog, jumping out of the small pond to explore life beyond. More ideas flow only to realize that more eggs are needed and so the process starts all-over again. Just as you think you are done, you need to go back and rethink and rewrite your chapters again – a circular process indeed.

Development needs a lot of support. In this regard I would like to thank the following people and entities for their support.

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LIST OF TABLES AND FIGURES EXCLUDING THOSE FOUND IN THE APPENDIXES

TABLES:

FIGURES:

List of abbreviations including those found in the Appendixes

- A-Ark- Amphibian Ark
- ACAP- Amphibian Conservation Action Plan
- ASG – Amphibian Specialist Group
- CBD –Convention on Biological Diversity
- CBSG - Conservation Breeding Specialist Group
- CD – Compact disk
- CNA – Central News Agency
- DVD – Digital Video Disk
- EWT – Endangered Wildlife Trust
- IUCN- World International Union of Conservation
- PAAZAB- African Association of Zoos and Aquaria
- PNA – Public News Agency
- RNCS- Revised National Curriculum Statement
- SADC - Southern African Development Community
- WAZA- World Association of Zoos and Aquaria
- WESSA - Wildlife and Environment Society of South Africa
- WZACS – World Zoo and Aquaria Conservation Strategy

List of Appendixes

CONTENTS

The Frog

What a funny bird the frog are

When he stand he sit

Almost

When he jump, he fly

Almost

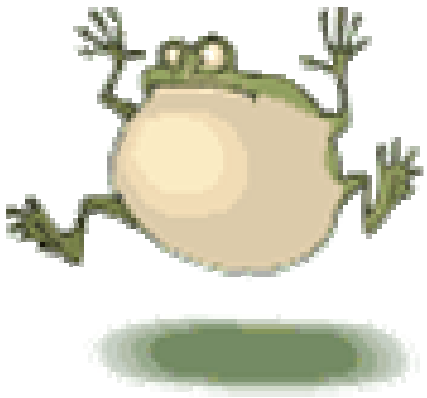
He ain't got no head hardly

He ain't got no tail hardly either.

He sit on what he ain't got

Almost.

Anonymous



CHAPTER ONE

SCOPE OF RESEARCH

"Today more and more of us live in cities and lose any real connection with wild animals and plants."

David Attenborough

1.1 INTRODUCTION

The purpose of the research was to investigate the feasibility of developing an Amphibian Resource Pack for the use and education of learners in South African primary schools as a response to the international amphibian crisis. The primary research resource and base from which information was drawn, was the Johannesburg Zoo, the only zoo in South Africa to have implemented an indigenous frog conservation breeding programme in response to the amphibian crisis.

Zoos in general serve a wide community of children, many of whom come from underprivileged backgrounds. The research was conducted using educators and learners from a range of schools in Gauteng which in the past, have had some form of contact with the Johannesburg Zoo.

The specific field of research selected was due in part to the fact that the researcher is responsible for educational as well as marketing duties at Johannesburg Zoo and had been tasked with the development of an Amphibian Resource Pack as a contribution to the campaign "*2008: The Year of the Frog*". The researcher also serves as the education convener for the Africa Zoos and Aquaria Association (PAAZAB), and is responsible for the implementation of the resource pack throughout African zoos and South African schools as well as developing an amphibian awareness campaign on behalf of the members of PAAZAB.

The research falls within the interpretive paradigm as discussed in Chapter Three. A survey was applied to investigate prior knowledge of learners and educators with respect to amphibians and

inductive analysis applied to analyse the data, discussed in Chapters 4 and 5. In this particular study, frogs are the only amphibians that are considered.

The intention of the research was to ascertain the current level of knowledge within the schools and bring to light any shortcomings in the content and teaching regarding amphibians. Based on the findings, it is intended to develop a resource pack for distribution to schools that addresses the needs and requirements of the target population.

1.2 RESEARCH GOALS

The **primary goal** was to investigate prior knowledge about amphibians with Grade 7 learners and their educators who had visited the Johannesburg Zoo, in order to inform the development of an Amphibian Resource Pack. The investigation focused on the different meanings that learners and educator attach to frogs, knowledge of the ecology and the value of frogs therein as well as the fears, fantasies and fascination attached to frogs.

Frogs, as part of a conservation topic are relatively accessible, as many frogs occur in urban areas throughout Gauteng, providing ample opportunities for experiential learning. Educators have not yet realised the potential of using local species commonly found as part of conservation lessons. The Amphibian Resource Pack will attempt to raise awareness of this potential.

The research findings and subsequent development of a resource pack is seen as a critical tool in amphibian conservation which has the potential of widespread use in the education programmes of numerous zoos and aquaria as well as a resource for Share-net. Share-Net is a South African-based informal networking project that supports environmental education and development in the SADC region (WESSA, 1/14/2008).

Secondary goals were to:

- explore potentially supportive links between the proposed Amphibian Resource Pack and the Revised National Curriculum Statement for Grades 4 to 7 in Natural Sciences *Life and Living curriculum*.

- investigate the range and availability of popular amphibian publications in book stores and libraries in order to gain insight as to whether existing literatures resources are adequate and accessible to schools. Without the necessary reading or teaching resources, no progress can be made in educating learners about the threat of biodiversity loss and extinction.

1.3 ASSUMPTIONS UPON WHICH THE RESEARCH WAS BASED

1.3.1 Assumptions relating to frogs based upon the researcher's experience in interacting with schools and educators

Educators in general do not teach about amphibians except under animal classification, using amphibian characteristics such as body covering, reproduction, respiration, movement and feeding. These characteristics are only briefly discussed when comparing frogs to other vertebrate classes. A generic example is used and educators do not expand upon or discuss the variety of frogs or other amphibians.

Frogs commonly found in gardens are not investigated nor discussed although the bullfrog is used as an example of a frog and appears to be well known.

Frogs are not examined in terms of conservation status, nor are the consequences of their extinction. Mammals are typical examples when conservation is discussed.

1.3.2 Assumptions relating to schools

Permission for the research from the Gauteng Department of Education would pose no problem. Schools would be helpful and willing to participate and educators would find the research useful.

1.3.3 Assumptions relating to the potential usefulness of the research findings

The findings would be useful in designing a resource pack. Furthermore, they would also be useful for education in zoos and aquaria, especially Johannesburg Zoo, as very little research has been undertaken by the Zoo to determine the knowledge of concepts or needs of educators. The findings are relevant in environmental and conservation education, particularly since in South Africa, little research has been done on Zoo education.

1.4 THE AMPHIBIAN CRISIS (INCLUDING THREATS)

According to Amphibian-Ark (2005), one third to half of all amphibian species are threatened with extinction, with 35 species having already disappeared in recent years. The Amphibian Ark (A-Ark) was established by the Conservation Breeding Specialist Group (CBSG), a working group of The World Conservation Union (IUCN). The A-Ark is a website with current data on the amphibian crisis. There are 6 000 amphibian species worldwide, but because of the unknown status of many species (approximately 500 species of biologically or phylogenetically unique taxa), the threat of extinction is increased to a potential 50%. These proportions are illustrated graphically in Figure 1.1.

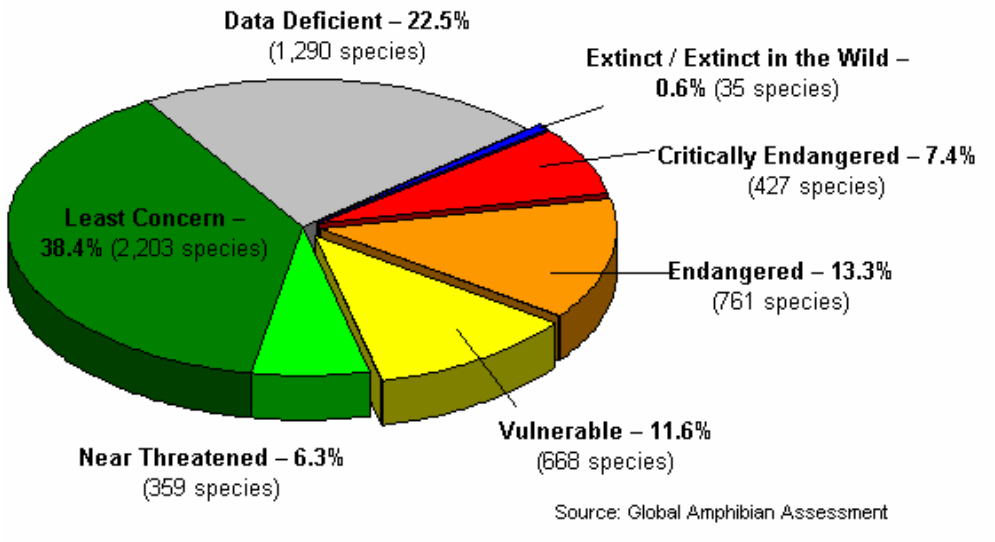


Figure 1.1 Amphibian species threatened worldwide (after Zippel, 2007)

In comparison to the threats to other vertebrate species, 12% of birds and 23% of mammal, it is believed to be the most significant threat to a vertebrate class since the end of the Cretaceous period, sixty-five million years ago (Zippel, 2006).

A crisis in amphibian species worldwide has been declared by The World International Union of Conservation (IUCN) *Global Amphibian Assessment.* Zoos and similar organisations have been called to action. Zipple (2006, p.1) says that "Amphibians have thrived for over 360 million years, having survived the reign and extinction of the dinosaurs, yet today we are on the verge of losing much of this spectacular vertebrate class." Leakey (1996, p. 245) considers the current demise of species as the sixth mass extinction in progress. He further argues that *Homo sapiens* are the direct cause of this impending extinction.

Threats to amphibians are diverse. They are particularly susceptible to pollution. The permeability of amphibian skin makes it extremely sensitive to chemical pollution. As a consequence, the amphibian is an important taxon with which to monitor the health of wetlands (Burger & Harrison,

2001). Litter and sewerage contribute to the deterioration of river health, destruction of amphibian habitats and consequent decline in amphibian populations and species.

Zippel (2006, p.1) states that "One particular disease is of great concern because of its tendency to drive species to extinction and the rate at which it proceeds; amphibian chytrid fungus (*Batrachochytrium dendrobatidis)*". This disease has been associated with the extinction of a number of species on continents such as America, Europe, Africa and Australia. The disease attacks the skin of the frogs restricting respiration as well as the mouth parts of tadpoles preventing them from eating. The fungus can affect 50% of a frog population within three months and thus far no cure has been found for treatment in the wild. The fungus seems to have its origins in South Africa and spread worldwide on the African clawed frogs (platannas) due to their use since the 1930's for research, medicinal purposes and the pet trade (Zippel,2006). In South Africa most frog species are believed to be immune to the fungus.

In Southern Africa there are 130 species of amphibians of which four species are listed by Carruthers (2001) as critically endangered, five species as endangered, two as vulnerable, ten as threatened and four as possibly threatened. This is a total of 25 species out of 130 in danger of extinction.

The biggest threat to amphibians in Southern Africa appears to be the loss of habitat. This is predominantly the result of housing or commercial development and the destruction of wetland systems and the surrounding areas where frogs hibernate during winter. One example is that of bullfrogs. Many thousands of bullfrogs are killed every year as they cross busy roads. A successful intervention has not, as yet, been implemented, as it has in other countries like North America. Another threat to bullfrogs is commercial and housing projects built on top of breeding sites. Bullfrogs hibernate underground and are thus killed during construction.

1.5 THE IMPORTANCE OF AMPHIBIANS

Zippel (2006, p.1) summarises the medicinal value of amphibians as a "source of vital biomedicines including compounds that are being refined for analgesics, antibiotics, stimulants for

heart attack victims, blockers of HIV transmission and treatments for diverse diseases including cancer".

Comparing amphibians to canaries in a coal mine, Zippel explains that just as miners used the sensitive lungs of canaries to alert them to the presence of toxic gases in the mines, amphibians may well be the warning system to people of unsafe environmental conditions that could eventually have serious effects on human health. Amphibian skin, being extremely susceptible to environmental contaminants, including agricultural, industrial and pharmaceutical pollutants, could be regarded in the same light as the canary lung.

Zippel (2006, p.1) expands on the importance of frogs as an early warning system as their demise indicates the deterioration of said environment, and says they are "vital components of their ecosystems" and further explains that the biomass of a single amphibian species in some regions, can exceed the biomass of all the bird or mammal species combined, in the same region.

Amphibians have played, and still play a significant role in human culture, from traditional medicines and religion, to fairy tales, collectable trinkets and live terrarium keeping. In some regions amphibians contribute to the food resources for humans such as the Goliath frogs found in Papua New Guinea and the Giant bullfrog of South Africa.

1.6 INTERNATIONAL MOBILISATION AND POLICY

Responses to the amphibian crisis

A global response to the amphibian crisis resulted in an Amphibian Conservation Summit in Washington, D.C, United States of America, arranged in 2005 by Conservation International and the IUCN. An Amphibian Conservation Action Plan (ACAP) was formulated to be implemented by the Amphibian Specialist Group (ASG).

In 2008, A-Ark led a globally co-coordinated public awareness campaign '*2008: The Year of the Frog'* to launch the worldwide campaign and to raise sufficient funding to support the amphibian conservation programme of every member zoo in the world. Its aims are to save hundreds of frog species and to establish partnerships that can respond to future species conservation risks in both

ex-situ and *in-situ* conservation components. The partnerships also intend to demonstrate to the world that zoos and aquaria are essentially conservation organizations (Amphibian Ark, 2007). The IUCN has urged that "all critically endangered and extinct-in-the-wild taxa should be subject to *ex situ* management, to ensure recovery of wild populations" and the 2005 IUCN ACAP White Papers echo that "survival assurance colonies are mandatory for amphibian species that will not persist in the wild long enough to recover naturally once environments are restored; these species need to be saved now through *ex-situ* measures so that more complete restoration of ecosystems is possible in the future". Comparable calls to action are included in the Global Amphibian Assessment and other IUCN documents. Every zoo and aquaria was requested to save at least one species of amphibian (Amphibian Ark, 2007).

In response to this call for action, zoos and aquaria worldwide have added a detailed amphibian conservation strategy which now forms part of the overall *World Zoos and Aquaria Conservation Strategy* (WAZA, 2005).

The first *World Conservation Strategy for Zoos and Aquaria* was written over a decade ago, based on the IUCN World Conservation Strategy, "*Caring for the Earth*". This followed the acceptance of the Convention on Biological Diversity (CBD) at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992. The revised version of 2005 defines and explains the strategic vision held by the members of WAZA in support of its overarching conservation mission. This document is the basis upon which WAZA members develop their operational principles.

The responsibilities and functions that epitomise the future ideals for all zoos and aquaria include amongst others, integrated conservation, research both *in-situ* and *ex-situ,* innovative exhibitions, and operating within the highest ethical business standards to raise funding to support conservation actions and development of effective education programmes (WAZA, 2005).

Junhold (2007) is of the opinion that awareness of the fragility of amphibians should be raised not just in schools, but among national governments, world media, corporations, philanthropists and the general public. He further argues that the responsibility of saving Amphibians lies with us all.

1.7 THE ROLE OF ZOOS IN EDUCATION

"The major goal of zoos and aquaria will be to integrate all aspects of their work with conservation activities" (WAZA, 2005, p.11). Zoos and aquaria are seen as ideally positioned to contribute to the conservation of biodiversity worldwide as described in the *World Conservation Strategy of Zoos and Aquaria.* "Zoos and aquariums are excellent centres in which to inform people about the natural world and the need for its conservation. Awareness will be converted into action with positive benefits for wildlife, people and conservation" (WAZA, 2005). This document also stated that zoos and aquaria address a broad and very large audience and emphasised the potential of zoos and aquaria to become important centres of environmental awareness.

With over 1 200 institutions, 100 000 employees and 600 million visitors per year, zoos and aquaria are uniquely positioned to react speedily to conservation crises. They are able to assist with rapid response rescues, captive assurance colonies, provide animals for release and research, undertake conservation education, capacity building, fundraising and help in developing recovery plans for threatened species.

Most zoos and aquaria are established in well-populated areas or urban centres and attract many visitors. Progress in conservation depends upon the development of public understanding of the relationship between species, the environment and peoples' own attitudes and actions (WAZA, 2005).

1.8 THE JOHANNESBURG ZOO

The Johannesburg Zoo is the first and thus far, the only zoo in Africa to have initiated frog conservation programmes in line with the recommendations of the IUCN *Global Amphibian Assessment*. It is at present focused on establishing the correct procedures with less threatened but similar frog species before it embarks on conserving the five most endangered species in South Africa. The pilot breeding programme is well established and the next step is to design education programmes and materials to educate learners about the amphibian crisis.

The Johannesburg Zoo is located in one of the most affluent areas of Johannesburg, neighboured by Westcliffe, Parkview, Houghton, Rosebank and Killarney. It is situated in an urban sprawl of 50km and is easily accessible from main roads and motorways. The Johannesburg Zoo is recognized as one of the region's major family recreational and leisure centres (Johannesburg Zoo Business Plan, 2005/2006).

Johannesburg is the largest and wealthiest city in South Africa and is situated in Gauteng which has a population of 9 018 000 (Stats in Brief, 2005). There are approximately 2 340 schools in Gauteng according to the Gauteng Department of Education (Budget Report, 2005).

The Johannesburg Zoo is a popular choice for excursions by schools and welfare organizations as indicated by the approximately 500 000 visitors per year. The Zoo hosts 150 000 learners annually (Johannesburg Zoo, 2006). In comparison to similar institutions such as the National Zoo (Pretoria), Montecasino Bird Gardens, South African Lion Park and the De Wildt Cheetah and Wildlife Trust, the Johannesburg Zoo is the second largest attraction in Gauteng.

Schools booking for education courses at the Johannesburg Zoo often request programmes on biodiversity loss or conservation relating to the popular 'Big 5', or charismatic animals such as the African Wild Dog. Reptiles have often been a favourite topic as snake demonstrations are part of the presentation.

1.9 LINKS WITHIN THE NATURAL SCIENCES' *LIFE AND LIVING CURRICULUM*

It was necessary to link zoo education materials and programmes with the *Revised National Curriculum Statement* (RNCS) to ensure their inclusion in school learning programmes. The topic Is potentially very well positioned in Natural Sciences *Life and Living curriculum*, Intermediate and Senior Phase, Grades Four to Nine, under the broad heading of biodiversity where the effect of the loss of biodiversity is addressed as 'core knowledge and concepts in matter and materials' (RSA, 2002). Grades Four to Seven were targeted in this research as these grades frequent the Johannesburg Zoo most often.

The African Association of Zoos (PAAZAB) – the African arm of The World Association of Zoos and Aquaria, has also requested the development of education materials to be coordinated by Johannesburg Zoo. The materials must be linked to the RNCS.

In order to formalise the link between school education and the education programmes offered by the Johannesburg Zoo, it makes sense to design an education resource pack and education programmes with emphasis on the Intermediate school phases.

1.10 CONTEXT OF THE STUDY

The majority of schools visited were in underprivileged areas, where learners and their parents lived in relatively impoverished circumstances. Schools were situated in Alexandra, Fourways, next to Diepsloot, Tokoza and Alberton as indicated in Figure 1.2.

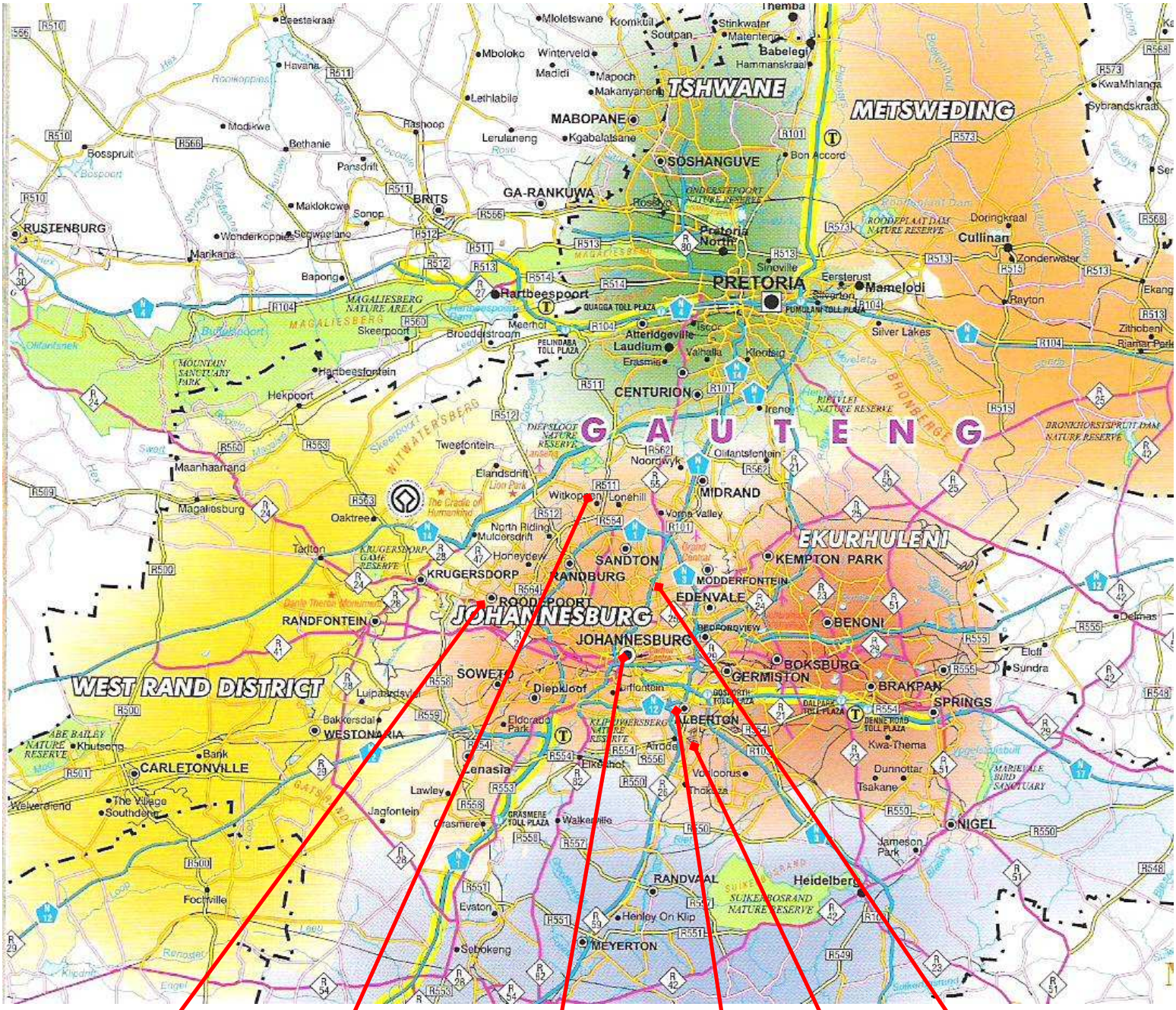


Figure 1.2. Location of Johannesburg Zoo and the schools included in the research

1.11 OVERVIEW OF CHAPTERS

The contents of each chapter are highlighted. Chapter 2 discusses the theoretical underpinnings of constructivism, social constructivism and experiential learning contributing to prior knowledge in Bernstein's horizontal and vertical discourse. Chapter 3 looks at the choice of methodology, the research framework and the data gathering tools. Chapter 4 presents the data obtained from educators through the questionnaires and interviews used in the survey. Their prior knowledge with regards to amphibians in terms of their understanding of scientific concepts, misconceptions formed and alternative conceptions held, were investigated. In Chapter 5 learners' responses to the administered questionnaire are presented. Chapter 6 discusses the potential and possible content of an Amphibian Resource Pack and Chapter 7 contains the conclusions and reflections on the research. The references and appendixes follow Chapter 7.

CHAPTER TWO

THEORETICAL UNDERPINNINGS

"Thinking is past experience guiding present actions"

William Kilpatrick

"The real process of education should be the process of learning to think through the application of real problems"

John Dewey

2.1 INTRODUCTION

In this chapter, the theoretical underpinnings of learning in a constructivist way, social constructivist way and experiential way is discussed with reference to how it contributes to the formation of prior knowledge. The investigation of prior knowledge is aimed at understanding the foundation on which future learning can be based. Prior knowledge is considered in this research as part of Everyday and science knowledge. Everyday and Science knowledge is differentiated according to Bernstein's model of horizontal and vertical discourse.

2.2 PRIOR KNOWLEDGE IN SELECTED THEORIES OF LEARNING

2.2 .1 Constructivism

Constructivism is the belief that "meaning is constructed and not discovered" (Gray, 2004, p.17). According to Arksey and Knight (1999, p.19), this philosophical perspective concerns "the ways human beings individually and collectively interpret or construct the social and psychological world in specific linguistic, social and historical contexts". Brooks and Brooks (1993) say that the constructivist learning theory states that learning is an active process of creating meaning from different experiences. Interpretations of constructivism consider the learner as an individual and active in making meaning of concepts, as opposed to just absorption of information. The learners will have their own preconceptions or prior knowledge and knowledge is considered as a human construct.

Constructivist theories are based on the work of Piaget. Roschelle elaborates on Piaget's theory of learning concerning the "development of schemata in relation to new experiences" and says people combine prior schemata with experience. Roschelle further explains that Piaget provides a theory of conceptual changes of schemata from childhood to maturity reasoning that "prior knowledge in the form of structural schemata plays a determining role in how children make sense of interactive experiences". Piaget says "knowledge grows by reformulation" according to Roschelle (1995, p.10).

As explained by Roschelle (1995, p.10) Piaget identified a set of functions: assimilation, accommodation and equilibration, his precepts of how learning takes place.

Assimilation is defined as the process where knowledge is increased but the structure of knowledge remains the same, whilst the new information is integrated into the existing schemata (Roschelle, 1995). Fosnot (1996, p.13) explains assimilation as the "organization of experience with one's own logical structures of understanding". She elaborates by saying that the individual asserts himself by viewing the world through his own constructs in order to preserve his autonomy as a part within a whole system (ibid). By way of an example of assimilation, learners are taught to define an amphibian as a vertebrate animal that lives both on land and in water and a frog is such an animal.

Accommodation is described as an increase of knowledge by "modifying structure to account for new experience" (Roschelle, 1995, p.10). Fosnot's (1996, p.13) explanation of accommodation is that when new knowledge occurs, there is an attempt to conserve the previous concept. However, when new knowledge is experienced, it sometimes results in a contradiction in the present understanding. The previous understanding becomes insufficient and disequilibrium is created, leading to an accommodation. Learners have learned that animals that live both on land and in water are amphibians, but in applying this definition to animal examples such as crocodiles, snakes, hippopotami and others, the definition as it is, is not sufficiently comprehensive to identify amphibians correctly. Further investigation and new information is thus necessary to provide an adequate definition to correctly identify amphibians. "Accommodation is the process where, through reflection and integration of new knowledge, **equilibrium** is once again achieved. This is a stasis point where the new knowledge becomes part of the entire knowledge system and new concepts are understood thus enlarging the boundaries through which the world is viewed" Rochelle (1995, p.11). Roschelle

further argues that the critical episodes of learning for Piaget occurred when there was tension between assimilation and accommodation and to reach a state of equilibrium, prior knowledge and the new experience had to be integrated. Prior knowledge is not replaced but a reorganization of existing and new knowledge takes place, leading to a more coherent whole. New knowledge is constructed upon prior knowledge. Amphibians, such as frogs, are animals that live both on land and in water (prior knowledge) and develop through a process of metamorphosis from an egg to a tadpole to a frog (new knowledge added to prior knowledge).

Piaget's learning theory was based on the growth of structuring schemata mainly in individuals, but he did not overlook the effect of social interaction on learning. In later translations of Piaget's writing, it was revealed that he held that learning cannot take place in isolation, but in a community, a social interaction amongst community members. He said "human knowledge is essentially collective and social life constitutes an essential factor in creation and growth of knowledge, both pre-scientific and scientific" (Piaget, p.30, 1995 as quoted in Daniels, 2001, p. 38).

By focussing on Vygotsky's work in Social Constructivism one can come to understand these social interactions better and how they are able to contribute to the construction of prior knowledge.

2.2.2 Social constructivism

Berger and Luckmann as cited by Janse van Rensburg (Janse van Rensburg & Lotz-Sisitka,2000, p.12) describe social constructivism as "knowledge constructed socially by human beings in interaction with one another and with the cultural understandings into which they become socialized". Janse van Rensburg says "Social constructivism … emphasises the role played by culture, context and language in shaping the way in which individuals construct knowledge. It suggests that this knowledge has to some extent already been constructed for us" (Janse van Rensburg & Lotz-Sisitka 2000, p.11). Animals are perceived in different ways in different communities and cultures. For instance frogs may be seen as part of witchcraft or by other communities as animals not to be harmed or as a useful food resource. Culture, context and language thus contribute to prior knowledge through social learning. The importance of culture and context is emphasised by social

constructivism according to Slezak (2007) in understanding what is happening in society and the world, and constructing knowledge based on this understanding (See Derry,1999 & McMahon,1997).

According to Kim (2001), social constructivism is based on assumptions about reality, knowledge and learning and she refers to different authors in explaining what she means. The assumptions about reality (Kukla, 2000) is based on the belief that it is constructed through human activity, meaning that it cannot be discovered and does not exist prior to its social intervention. The assumption about knowledge (Ernest, 1999., Gredler, 1997., Prat & Floden, 1994) is that it is socially and culturally constructed. Meaning is created through the interactions amongst people and the environment they live in. With regards to the assumption about learning (McMahon, 1997) it is viewed as a social process and "does not take place only within an individual, nor is it a passive development of behaviours shaped by external forces (Kim, 2001, p.3). She further states (2001, p 2) "… [that the perspective] of social constructivism placing emphasis on culture and on the understanding of what occurs in society and constructing knowledge based on this understanding … is closely associated with many contemporary theories such as the developmental theories of Vygotsky".

According to Roschelle (1995, p13), "Vygotsky argued that advanced concepts appear first in social interaction and only gradually become accessible to an individual" and Roschelle (ibid) adds that "Vygotsky primarily elaborated the role of social interaction in the transformation of prior knowledge". Daniels (1996, p.6) also places an emphasis on this aspect and explains that Vygotsky believed that "Every function in the child's cultural development appears twice: first on the social plane and then on the psychological plane." He believed the same process happened when concepts were formed. This indicated that learners may learn a certain science concept in the social community of a classroom and then internalize it afterwards. Kim (2001) summarised it as social learning preceding development.

A central notion in social constructivism is assisted learning which occurs in the zone of proximal development No author (retrieved 08/03/2009 from htpp://edutechwiki.unige.ch/en/Socio-constructivism). Vygotsky focussed on the zone of proximal development which is defined as the difference between what a child can do without mediation, and the competencies developed through mediation. In this mediation process, the child can be part of cultural processes slightly above his

own capabilities thus constructing new knowledge in a socially interactive way. As an example, learners are given a problem to solve and through their shared social interaction, despite their different backgrounds/perspectives would be able to solve the problem more effectively. Learners would also be able to rely on a 'more knowledgeable other' which could be the educator or a learner, for the provision of instruction or guidelines to solve the problem. Problem- solving thus becomes a social interaction influenced by the cultural and developmental background of each participant. Each participant in the learning process has their own prior knowledge based on their everyday experiences as well as their scientific knowledge, and when they work together in solving problems, they bring their different perspectives into play. According to Roschelle (1995,p.13), Vygotsky says the 'the primary resource for restructuring of prior knowledge comes from culture". Social constructivism contributes to prior knowledge through the social interactions amongst learners, and through the learners and their educators.

2.2.3 Experiential Learning

"Experience pervades all forms of learning, however, its value is frequently not recognized, or is even disregarded" (Beard and Wilson, 2006, p.2). Constructing knowledge often originates from an experience (Roschelle, 1995). For example, learning about animals from books may create the incorrect concept of the size of the animal. Once the animal is seen, this concept is altered by observing the actual size of such an animal. "Experience is a meaningful engagement with the environment in which we use our previous knowledge (itself built from experience) to bring new meanings to interaction" (Beard and Wilson, 2006, p.2). People may have read about polar bears and it could be assumed that it would be easy to recognize such an animal in a zoo but their actual size may have been underestimated.

Experiential learning is investigated as a learning theory because the subject of Natural Sciences lends itself to learning through experiences and thus contributing to the development of prior knowledge. Experiential learning contributes to both everyday knowledge as well as science knowledge and can be constructed by an individual or socially with other individuals. Everyday learning can be learned in a variety of ways, such as learning via a television programme, digging in the garden, picking up a frog or visiting an animal institution. Scientific learning is often connected to

school learning but it can be experienced at a zoo or even at home if parents endeavour to share such knowledge and experiences with their children.

Dewey is considered by Roschelle (1995) to be the champion of experiential education. He considers the problematic or complex nature of experience, which is not given to us, but is created in our own transactions with nature and with each other in a social setting, and is dependant on the prior knowledge that each participant brings to the situation (Roschelle, 1995). Dewey suggests that children or learners are not passive in the learning situation but they experience an active transmission of knowledge.

According to Dewey's theory on experiential learning, from his classic book 'Experience & Education' as cited in wilderdom.com (2007, p1-2) he proposed that education programmes should be based on a theory of experience. He said that one has to understand the nature of how people have the experiences that they do have, to enable the design of effective education programmes. Dewey referred to continuity which is defined as the notion that people are affected by the experiences they have. "Humans survive more by learning from experience after they are born …" (ibid), meaning that most people learn from previous experiences that could enable them to negotiate future challenges better than when they encountered similar challenges for the first time. He proposed that education is essential for providing people with the skills to live in society. Everyday experiences, whether positive or negative, act as accumulated learned experiences which will in some way influence the nature of one's future experiences.

Beard & Wilson (2006, p.19) note that the link between experience and learning is a strong one, which has been described by a number of authors. One such author is Wilson (2005) as cited in Beard & Wilson (2006) who says that formal education or experience can bring about a permanent change of knowledge, attitude or behaviour. It is speculated by Beard and Wilson in quoting Rogers (1996) that there is a growing consensus that experience forms the basis of all learning. They do clarify this by stating that experience may underpin all learning but if this is not a meaningful engagement, it will not always result in learning.

Interaction, according to Dewey's hypothesis, explained how past experiences interact with the present situation to create the person's present experience. The relevance for educators was that whilst they could not undo past experiences of learners, by understanding those experiences, they could provide better participatory educational situations for learners (wilderdom.com, 2007, p.2). If learners grew up in communities where frogs were seen as a food source, they could be encouraged in the classroom to share their experiences of catching the animals, preparing the meal and what it tastes like. In further investigations learners could learn that these food resources are seasonal, the frogs are only available after the rains have come and this could be linked to further science knowledge of the metamorphosis of frogs as well as sustainable use of a natural resource. "Experiential learning is the sense-making process of active engagement between the inner world of the person and the outer world of the environment." (Beard & Wilson, 2006, p.2).

The challenge for the educator is to recognise prior knowledge from previous experiences, in individuals, to enable him/her to design an effective education experience. "The learner is encouraged to investigate the world to find out about it with others, and engage in collaborative reflections and change-orientated actions" (Wessa/Sharenet, 2006, p.28). A further challenge would be for educators to create opportunities for learners to experience for example, wildlife, through home projects or through creating opportunities within their classrooms despite the fact that they may not be equipped with laboratories. In the zoo experience of the writer, experiential experiences often make sense of theoretical knowledge. In the classroom learners may learn that frogs have moist skins (which can result in different images formed by different learners) but by actually touching a frog, the experience imparts a concrete image which is not easily forgotten, and learners may well all form the same concept of a moist skin.

2.3 THE CONCEPT OF PRIOR KNOWLEDGE IN A HORIZONTAL AND VERTICAL DISCOURSE

William and Thomas (1991, p.1) state "that engaging students in prior knowledge … experience is an important step in learning… and creates a non-threatening, familiar and stable environment in the classroom". Students are encouraged to call on their collective experiences and in this way, are discouraged from simply memorizing what they have learned, and stimulates them to build structural

connections between one event and another. People learn in many different ways (Brooks & Brooks, 1993) and as described in the previous sections, (2.2.1; 2.2.2 and 2.2.3) learning based on different theories such as constructivism, social constructivism and experiential learning, all contribute to prior knowledge. Prior knowledge has been described and defined by many authors such as Cummins (2007); Roschelle(1995); Reutzel & Morgan (1990).

Kujawa and Huske (1995, p.1) consider prior knowledge a combination of the learner's pre-existing attitudes, experiences and knowledge. Attitudes are beliefs held about ourselves, awareness of our personal strengths, weaknesses and desires, and motivation to learn. Experiences are everyday activities, events that provide background understanding and shared family and community values. Knowledge is content and personality related and involves knowledge of reading, mathematics, concepts, fables, stories, personal goals, strengths, weaknesses and many more (ibid). Prior knowledge is considered by the writer as conceptual, personal and content knowledge acquired in everyday life as well as in a more formal situation such as school.

Hedegaardt (1996) notes that prior knowledge is assimilated from a cultural and language environment that takes place from the time of birth. She explains that beginning from the moment of birth, knowledge is transferred from parents, siblings, extended family and other community members. Furthermore she says language is absorbed by the infant in a particular way by copying or mimicking family members. Experiences to which an individual is exposed in **both the educational and social context** shape prior knowledge. Though these experiences are exclusively personal, they are nevertheless experienced within the prevailing social parameters and are often bound by what is expressed as culture.

Bernstein (1971, 1977) as cited by Taylor, Muller and Vinjevold (2003), studied the language of children observed at school. Bernstein explained it as 'community code and school code'. The difference between the two codes are that children master community code at home and school code in a more formal setting such as school. However in his studies he pointed out that 'middle-class' learners appeared to learn the basics of school code at home and would thus have prior knowledge of both codes at school in comparison to 'working-class learners' who appear to be at a disadvantage, having to learn a new code, 'school code' at school. Bernstein (1999) indicated that

these codes are often referred to as everyday common-sense knowledge and school(ed) knowledge within the educational field.

The common or horizontal discourse is usually typified according to Bernstein (1999) by everyday knowledge or common knowledge as everybody potentially has access to it and it applies to all within a specific context. It is also considered as common "because it has a common history in the sense of arising out of common problems of living and dying" (Bernstein, 1999, p.159). He defines horizontal discourse as "a set of strategies which are local, segmentally organised, context specific and dependent, for maximising encounters with persons and habitats" (ibid). The example Bernstein uses for explaining segmental development is that "learning how to tie ones shoes has no relation to learning how to use the lavatory correctly" (ibid, p. 160). These developments can happen at the same time "but are related not by integration of their meanings by some co-ordinating principle, but through the functional relations of segments …and the everyday life" (ibid). He further says that horizontal discourse is a set of strategies of operational knowledge activated in contexts.

The school(ed) or vertical discourse Bernstein (1999, p.159) "takes the form of coherent, explicit and systematically principled structure which is hierarchically organised as in the sciences or it takes the form of specialised languages with specialised modes of interrogation …". Vertical discourse is thus dependent on the integration at the level of meanings. "Vertical discourse consists not of culturally specialised segments, but of symbolic structures of explicit knowledge" (ibid p. 161). The development of language in a vertical discourse leads to the "speaker of each language become[ing] as specialised and as excluding as the language [itself]" (ibid, p.163).

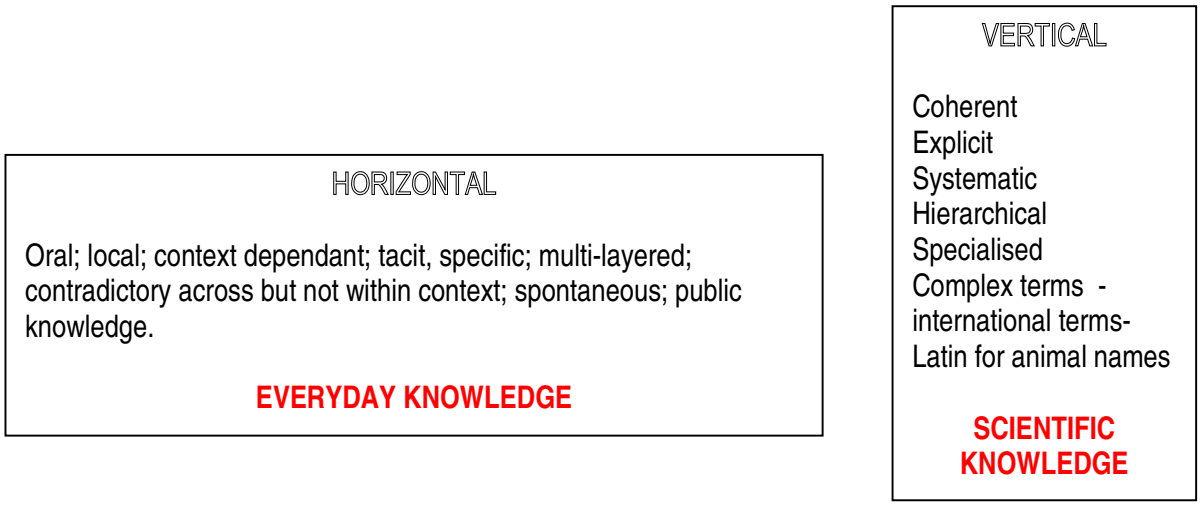


Figure 2.1 Prior knowledge in a horizontal and vertical discourse as adapted from Bernstein's Model (1999, p. 162)

Prior knowledge will be viewed in context of everyday and scientific knowledge. Bernstein's model of the horizontal and vertical discourse can be helpful in understanding the distinction between the everyday and scientific knowledge. Making use of Bernstein's model of horizontal and vertical discourse, and adapting it to everyday and scientific knowledge will assist the writer to understand and distinguish between what learners and educators know about amphibians within these two discourses.

The differences between everyday and scientific knowledge was recognised in the past by other authors such as Piaget and by Vygotsky as cited in Daniels (2001) as well as Hedegaardt, Fosnot, Driver, Rochelle and Littledyke. Some of their opinions are highlighted.

Hedegaardt (1996, p. 175) explains everyday knowledge as:

> The child is born into a society in which knowledge is available as the standard procedure for dealing with persons and things. … In a specific society the standard procedures for solving societal problems can be seen as culturally developed skills acquired and developed in each generation. Knowledge is accessible through different media, for example, language and

pictures and is the result of culturally and societal developed procedures for solving societal problems.

Fosnot (1996, p.18) describes spontaneous concepts as pseudo-concepts that the child develops naturally in the process of construction. In other words, the concepts formed by the child on reflection on everyday experiences. Vygotsky differentiates this from scientific concepts, which exist in structured activities of classroom instruction and these activities are formalised abstractions and more logically defined concepts than those constructed spontaneously. As an example, one might talk about 'it hops'; 'it is slimy' as spontaneous concepts when observing frogs, but when learning about amphibians, language used changes to their mode of movement and their body-coverings in the science learning session.

Driver, Asoko, Leach, Mortimer & Scott (1994, p.5) regard scientific knowledge as "not the phenomena of nature but the constructs that are advanced by the scientific community". They elaborate by saying that constructs have been invented by the scientific community and then imposed upon phenomena to interpret and explain them. "Once such knowledge has been constructed and agreed upon, within the scientific community, it becomes part of the 'taken-for-granted' way" (Driver et al., 1994, p.6). This 'taken-for-granted' scientific knowledge is not readily available as public knowledge as it is communicated through the culture of scientific institutions. They further stated that people, who want to learn about science, need to be introduced to scientific concepts, which is the role of the science educator. Rochelle (1995, p.4) mentioned the commonly held belief that scientific knowledge is different from everyday knowledge, which the researcher agrees with.

Vygotsky was of the opinion that scientific knowledge does not come to the learner in a ready-made form. A child has to undergo substantial development which depends on the existing level of ability to understand an adult's concepts (Fosnot, 1996, p.19). The same interpretation of the work of Vygotsky is held by Daniels (2001, p. 50) where he quotes Vygotsky as saying that scientific concepts are "characterised by a high degree of generality and their relationship to objects as mediated through other concepts". Daniels (2001, p. 50) interpreted this as "those concepts

introduced by a teacher in a school, and spontaneous concepts were those that were acquired by the child outside contexts in which explicit instructions were in place".

In summary, these authors, as does the writer, distinguish between everyday knowledge and scientific knowledge. This thesis argues that horizontal discourse is representative of everyday knowledge and that the vertical discourse is representative of science knowledge. This thesis also accepts that it is not necessary to be limited to a school class situation to learn scientific knowledge as according to Bernstein (see figure 2.1) scientific knowledge is not defined by where it takes place but by other characteristics such as hierarchical, systematic, specialised and others as listed in the diagram.

2.4 ASSESSING PRIOR KNOWLEDGE

White and Siegel (as quoted by Darvin, 2006, p.399) point out that:

> A school, like a train, is a social convenience that allows for a number of people to move from different points of origin to unique destinations. One does not ordinarily think of people on a train as going through a standardized travel experience. It is a mistake to think of children as going through a standardized sequence of cognitive development.

Assessment of prior knowledge is a way in which teachers can evaluate what learners already know. "School for every child is a confrontation between what he 'knows' already and what the school offers; this is true both of social learning and of the kinds of learning which constitute the manifest curriculum" (Barnes, as cited by O'Donoghue, 2006, p.2). If assessment of prior knowledge is neglected, it may result in learners learning something that in reality, conflicts with the educator's intentions, no matter how well those intentions are executed in an exhibit, book or lecture. "Prior knowledge determines what we learn from experience" (ibid). The importance of prior knowledge in a horizontal as well as in a vertical discourse was discussed in Section 2.3. Should educators fail to assess' prior knowledge in learners; they may not be able to identify learners' understanding of scientific concepts. Educators need to listen to what learners say as well as what they do not communicate to assess their personal or prior knowledge.

The South African Revised National Curriculum Statement (RNCS) (South Africa, Department of Education, 2002) recommends that various types of assessments be implemented to assess prior understandings or knowledge and the progress of continued learning. The RNCS discusses assessment and its value as a component of educator teaching strategy. Different types of assessments are discussed but for the purpose of this research, the baseline assessment is important as it assesses the learners' prior knowledge. "Baseline assessment usually takes place at the beginning of the grade or phase to establish what learners already know. It assists teachers to plan learning programmes and learning activities" (Cherub & Rossouw, 2006, p.24). In the textbooks for Natural Sciences facilitators and educators (Cherub & Rossouw, 2006; Moodie, Keogh & De Wet, 2005) assessment is emphasized and different activities are suggested for educators to determine the prior knowledge of the learners before the start of the lesson (baseline assessment) as well as activities to assess the progress during each lesson: diagnostic and formative assessments are carried out during classroom activity. The rationale behind this type of assessment is to provide the opportunity of establishing what the learners already know about the topic of discussion as well as giving the educator the opportunity to classify learners according to their strengths and weaknesses for later participation in group work (ibid).

To produce observable results, educators are advised to use different techniques such as questions, brainstorming, discussing a problem, giving a project as a conversation starting point and creating a fun atmosphere where learners can "play" and be observed by the educator. These activities provide opportunities for both educator and learner to seek a connection to provide areas of comfort so that new learning can be built onto prior knowledge. Apart from seeking connection points of prior experiences, assessment will also enable educators to recognise misconceptions or alternative conceptions. Not only do educators need to continually assess learners but also their own understanding of concepts to make sure that they themselves have not formed misconceptions.

2.5 THE EXPECTATIONS OF THE REVISED NATIONAL CURRICULUM STATEMENT AND OUTCOMES-BASED EDUCATION

The RNCS (2002, p.1) states that one of the aims of Outcomes-based Education (OBE) is to "demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation". Educators should thus strive to link classroom teaching to real life experiences so that learners are able to understand the relevance of what they are being taught and what they are learning. The RNCS (2002) further states that the kind of learner envisaged would be a learner who is a life-long learner with respect to the environment, with the ability to participate in society as a critical and active participant.

Regarding the Natural Sciences learning area the RNCS expects learners to develop a scientific literacy that would prepare them for active participation in a society that promotes environmental responsibility. The Natural Sciences Learning area is divided into four main content areas of which *Life and Learning* is one. "*Life and Learning* focuses on healthy living, on understanding balance and change in environments, and on the importance of biodiversity" (RNCS, 2002, p.5).

It is clear that the expectations of OBE and the RNCS are to develop learners who have an understanding and appreciation of the environment in which they live. A strong link should therefore exist between what learners learn in class and the environment in which they live in. Amphibians are animals found in our everyday life and are commonly used in children' stories. They are used in teaching young children to mimic the sound and movement of frogs and together with other animals are often referred to in witchcraft, myths and as a food source. These links between classroom learning and everyday life should be a natural choice for educators to explore the concepts of ecology and conservation.

Roschelle (1995) stated that museums are potentially well suited as sites for conceptual change. Zoos are a similar type of institution in which opportunities exist to acquire everyday and scientific knowledge. Everyday knowledge may be activities such as singing animal songs whilst travelling to the institution and scientific knowledge would consist of investigating the actual animal as displayed in the zoo or the concept of animal classes.

2.6 SCIENTIFIC CONCEPTS, MISCONCEPTIONS AND ALTERNATIVE CONCEPTIONS

Roschelle (1995, p.1) believes that "Educators often focus on the ideas that they want their audience to have. But research has shown that a learner's prior knowledge often confounds an educator's best efforts to deliver ideas accurately". He further says that research also shows that learning proceeds primarily from prior knowledge and only secondarily from the presented materials. A learner's prior knowledge may be at odds with the presented materials and consequently he/she will be unable to learn what the educator intended. Roschelle (1995, p.16) says "prior knowledge is implicated in both failure and success, and is best seen as raw material to be refined. He says (p.2) that the prior knowledge of learners is often seen by educators as conflicting with the concepts they teach and educators try and suppress or eradicate these prior concepts formed by learners.

The term 'concept' is derived from the Latin *conceptum* (original) meaning to conceive, to understand, to comprehend, etc. as described in the Collegiate Dictionary (2003) as cited by Sichombe (2007). The concepts pertaining to amphibians are described in the RNCS Natural Sciences *Life and Living curriculum.* The relevant concepts are 'amphibian', 'classification', 'ecology' and 'endangered'. Educators need to assess learners' understanding of these concepts in order to address/correct misconceptions or alternative conceptions.

Some authors regard misconceptions and alternative conceptions as synonymous (Taber, 2000). According to Blosser (1987) there are differences between misconceptions and alternative conceptions. Misconceptions refer to "wrong ideas or incorrectly assimilated formal model or theory" (ibid, p2). "Alternative ideas are those scientific ideas, held by individuals, that do not match expert scientific views" (Pardhan and Bano, 2001,p. 301). This concept is also known as an alternative framework or alternative conception.

The writer agrees with Blosser and accepts misconceptions as mis-learned facts or mistakes due to incorrect language translations or concepts incorrectly interpreted by the learners or educators and even lack of sufficient knowledge. Misconceptions are often formed, in the opinion of the writer, by superficial understandings of scientific concepts. This may be the result of scientific concepts often used in everyday language where the original meaning of the concept is changed or lost as a result

of the incorrect interpretation and transfer of the concepts. An example is the term 'cold-blooded' often associated with crime.

Driver (1983, p.25) refers to studies conducted to list a catalogue of errors or common misconceptions in Natural Sciences. She says these catalogues are useful pointers "but may trivialize the nature of the problem by giving the impression that the source of the errors is mis-learned facts". She agrees that some errors may be superficial in nature and teaching can easily rectify these, but says that certain of the misconceptions or alternative conceptions stem from learners having very different knowledge frameworks than those of the scientific community (ibid, p.26). The researcher classifies this description of Driver as alternative conceptions and accepts the definition provided by Pardhan and Bono (2001, p.301). Folklore and myths are considered as alternative conceptions in this thesis.

The phenomenon of alternative conceptions according to Pardhan and Bono (2001) not only pertains to learners but also to educators. They state that programmes designed to address these alternative conceptions are vital to educators in preventing them from experiencing embarrassing moments when their understanding of concepts is incorrect. It also assists educators in presenting clearer concepts when teaching and avoids passing on these alternative conceptions to their pupils (ibid). The researcher accepts that it is not just alternative conceptions but also misconceptions that occur both within the prior knowledge of educators and learners.

2.7 LEARNING SUPPORT MATERIALS IN SCIENCE TEACHING

The RNCS calls for effective teachers who can guide learners to apply ideas to new situations, to think about what they have learned and how it is connected to their everyday life. The RNCS envisages educators that are qualified, competent, dedicated and caring. Educators are expected to fulfil the role of "mediator of learning, interpreters and designers of learning programmes and materials, … researchers and lifelong learners" (South Africa, Department of Education, 2002, p.3). According to the report on Curriculum 2005 (Chisholm, Volmink, Ndhlovu, Potenza, Mahomed, Muller, et al; 2000) educators are quick to point out that although they are eager to implement

Curriculum 2005 (C2005), they have a severe lack of learning support materials (LSM's). In the same report (ibid; p.62), a concern was raised describing the new textbooks as 'woolly and superficial'. This is detrimental to science education if these are the resources upon which educators depend.

It was reported in a review of the South African Curriculum that the Department of Education (DOE) regarded adequate LSM's as "essential to the effective running of an education system … and a means of promoting both good teaching and learning" (Chisholm et al; 2000, p.62). In implementing C2005 effectively, one of the demands was to have well-resourced classrooms consisting of textbooks, atlases, dictionaries, maps, resource materials developed by educators or other institutions and equipment suitable to the needs of the educators. In the report it was mentioned that this particular vision was undermined by the management of LSMs and the training adopted in C2005 (ibid).

The investigation into LSMs focused on quality and availability of LSMs. When the report was written, the textbooks were described by respondents of this particular research as "essentially a re-use of old textbooks' (Chisholm et al; 2000, p.62). The respondents felt that the authors of the books did not develop links between learning areas, and due to the new demands of C2005, most of the textbooks were written in an effort to represent portions of each learning area. The curriculum support materials for Grade Seven were produced by a consortium of Non Governmental Organisations (NGOs) under the auspices of the Teacher Trust in 1999 (ibid). When materials were developed for Grades Four and Eight in 2000, it was felt that poor planning compromised quality as notifications of workshops were late and good writers were not available which resulted in using writers that did not have the required skills (ibid). LSMs were not adequately available in schools according to the same report, and five main elements were reported as being critical factors affecting this lack of availability. These were budget, the provisioning process and the evaluation and selection of materials, the language of teaching and learning and historical inequalities.

Resources supplied by NGOs could assist in filling these gaps of quality and accessibility. Vinjevold (1999) stated that Reeves and Long in their research found that in classes where NGOs provided materials, there were high levels of usage of these materials. They also found that these materials increased the pupil participation in the classroom as did other evaluations of NGO programmes.

Reeves and Long cautioned that even though the LSMs did increase participation, these resources did very little in improving the educator's knowledge and understanding of conceptual goals.

2.8 CONCLUSION

The acquirement of knowledge according to the different learning theories such as constructivism, social constructivism or experiential learning, was not the intention of this study. The intention was to investigate prior knowledge and its links to these learning theories. These learning theories have however, also given an insight into how people learn and how prior knowledge can be formed according to these different theories.

Prior knowledge is evident in all people at all levels from children to adults, from those with a formal education to those without formal education. Prior knowledge is informed by everyday activities, by science learning, as an individual or as part of a social group. There is a distinction between the horizontal discourse and the vertical discourse as illustrated by Bernstein. The researcher used this model provided by Bernstein to investigate everyday knowledge as part of the horizontal discourse and scientific knowledge as the vertical discourse. In investigating prior knowledge of learners and educators, this model of vertical and horizontal discourse can be employed to analyse the type of prior knowledge and its possible origin.

The phenomena of misconceptions and alternative conceptions formed particularly in sciences, via horizontal or vertical discourse were investigated as this could assist in understanding why certain concepts are formed. It would also assist in guiding the educator through activities as suggested in the amphibian resource pack to identify certain misconceptions and alternative conceptions.

Understanding the role that educators play in teaching science and the challenge they face regarding their own levels of knowledge, the possible gaps within their own vertical discourse and use of available resources, in Natural Sciences, would provide useful knowledge for the design of a resource pack. It was the intention of this research project to establish prior knowledge of learners and educators to inform the design of a potentially useful resource pack with regards to Amphibian conservation. The amphibian resource pack would be aimed at assisting educators to improve their

science knowledge within a vertical discourse, to identify or recognise misconceptions and to make use of their own and their learners' everyday knowledge.

In Chapter 3 the methodology of the research process and the methods used to assess prior knowledge in Grade 7 learners and educators, is discussed.

CHAPTER THREE

METHODOLOGY

"Education is knowing where to go to find out what you need to know; and it's knowing how to use the information you get"

William Feather

3.1 INTRODUCTION

In this chapter the methodological framework that underpins the research is discussed including the research style, sampling and selected methods of data generation. Ethics, data analysis, validity and an evaluation of the research process are included.

3.2 RESEARCH METHODOLOGIES

The aim of methodology is described by Cohen, Manion and Morrison (2000, p.45) as "to help us to understand in the broadest possible terms, not the products of scientific inquiry, but the process itself". Methods refer to the techniques and procedures used for the purposes of gathering data (ibid).

This study was designed within an interpretive research approach. Methodologically it engaged the interpretative paradigm, focussing on the meaning-making of learners and educators with regards to amphibians. Cohen et al. (2000, p.22) state that the interpretive paradigm aims to understand the subjective world of human experiences. They further argue that an interpretive approach is "characterized by concern with the individual". Connole (1993, p.13) says that, "from this perspective we no longer speak of human behaviour but rather of human action", and she elaborates by saying "from an interpretive perspective human actions have reasons … actions are preceded by intentions and may be accompanied by reflection". Glaser and Strauss as cited in Cohen et al. (2000, p. 23) further argue that the "[theory] must be grounded on data generated by

the research act". Theory should follow research and not precede it as investigators work directly with experiences and understandings to build their theory (Cohen et al., 2000, p. 23).

Interpretive studies are not concerned with the testing of a theory - is it right or wrong - but rather with the meaning that people attach to certain issues. Such studies are concerned with the views of people relevant to a particular issue. People's views are more than simply right or wrong and in understanding that views are influenced by prior knowledge and experience within the context of their everyday lives, sharing and teaching of concepts can become easier and more appropriate to specific communities. "Thus the theory becomes a set of meanings which yield insight and understanding of people's behaviour" (Cohen et al., 2000, p.23) and, one might add their values and knowledge. Janse van Rensburg (2000) takes this further describing the interpretive approach as an interest in contextual meaning-making rather than generalized rules.

The attitudes, perceptions and prior knowledge of each person are subjective in nature and influence how they make meaning of knowledge obtained or experienced. Terre Blanche and Durrheim (1999, p.123) support this position, noting that researchers accepts that since people's subjective experiences are real, they should be taken seriously. One can understand another's experiences only through interacting with them and listening to what they tell us. The intention of this study was to explore the different meanings that learners and educators attached to amphibians, to listen to their interpretations and experiences of amphibians, in particular frogs, and to eventually address these in the intended resource pack.

An inductive approach rather than posing of a hypothesis was used. Gray (2004, p.6) describes inductive research as an approach "where plans are made for data collection, after which the data is analysed to see if any patterns emerge that suggest relationships between variables". This does not exclude observations regarding any pre-existing theories or ideas, since the inductive process does not set out to prove or refute a theory. The intention of this research was not to test if prior knowledge of amphibians did exist, but to investigate aspects of the knowledge and conceptions held by learners and educators.

3.3 THE SURVEY AS A METHOD

The specific methodology employed was a descriptive survey. Gray (2004, p.100) defined a descriptive survey as "designed to measure the characteristics of a particular population, either at a fixed point in time or comparatively over time". Surveys are seen as a methodology by Gray (2004).

Gray (2004) distinguished between epistemology, theoretical perspectives, methodology and methods. In this regard he sees constructivism as an epistemology; interpretivism as a theoretical approach; survey as a methodology and questionnaires; interviews and content analysis as methods used to generate data.

For the purposes of this study, surveys were regarded as the methodology and questionnaires, interviews and a survey of the contents of amphibian related documents, the methods used to obtain data. The RNCS (2002) document was analysed to ascertain what concepts are expected of educators in teaching Natural Sciences *Life and Living curriculum* as well as assessing prior knowledge in learners.

The choice of a survey seemed the most efficient research methodology to determine the existing amphibian knowledge of Grade 7 learners and their educators. According to Gray (2004), descriptive surveys are undertaken to ascertain attitudes and knowledge. The aim of this survey was to investigate attitudes that educators and learners held with regards to frogs as well as their knowledge of this particular class of vertebrate.

"Surveys gather data at a particular point in time with the intention of describing the nature of existing conditions, or identifying standards against which existing conditions can be compared, or determining the relationships that exist between specific events" (Cohen et al. 2000, p.169).

Some of the characteristics of surveys according to Morrison (1993) as cited in Cohen et al. (2000) which make them so useful are that gathering data at a particular point in time makes it economical and efficient and representative of a wide target population. This type of research is typically cross-

sectional as it has a 'snap-shot approach' where data is collected at one point in time (Gray, 2004). It gives an indication what these learners and their educators know about frogs at the particular time of research.

Irwin (2006a) mentions use of a wide variety of survey methods which include questionnaires, interviews, document analysis, observations, site visits, electronic searches, workshops, focus groups and many more. The choices of methods are dependent on the specific aims of the survey.

This study employed a survey format delivered via questionnaires which can be considered as written documentation, interviews and a survey examining the contents of amphibian documents. Qualitative research techniques were best suited to this task. According to Patton (2002) qualitative findings grow out of three kinds of data collection: written documentation, direct observation and in-depth interviews. Questionnaires formed a large part of the data collection methods. Patton does not mention questionnaires as a qualitative research technique but it was applied in qualitative research, indicated as appropriate by Irwin (2006a), in both qualitative and quantitative data collection.

In this survey questionnaires and interviews were used to determine prior knowledge in educators and learners. Amphibian related documents were analysed to determine the general content and availability.

3.4 THE SELECTION OF EDUCATORS AND LEARNERS

The decision to conduct a survey was influenced by geographical distribution, accessibility to learners, the number of Grade Seven learners, time and cost. The methods designed to conduct the survey with learners and educators were administered questionnaires and semi-structured interviews.

The survey was conducted in schools within the Gauteng Province of South Africa. The learners and educators targeted for the survey were in close proximity to the Johannesburg Zoo, and the survey was planned to take place over a period of three months. The travelling involved would not

incur huge expenses nor be overly demanding in time as the study was by definition on a small scale. Schools were located within a 100 kilometre radius of the Johannesburg Zoo in Gauteng Province. Figure 1.3 indicates the geographical location of the schools. In the past, all these schools have had various forms of contact with the zoo, either visiting the zoo itself or having been visited by the zoo's mobile animal unit.

The schools were located predominantly in underprivileged areas and included learners who lived in informal settlements (educators described the socio-economic character of their schools and mentioned that learners did not have resources as some of them were from informal settlements). Only one school of the eight participating in this research was located in a privileged area, though learners there were from varied socio-economic groups. School locations do not necessarily indicate the socio-economic living circumstances of all the learners or the educators but it does give a good indication of the majority.

Details of the eight schools, learners and educators who participated in the research are summarised in Appendix A. Learners from three schools participated in answering questionnaires as well as two educators from two of these schools. The same two educators were also interviewed. The other seven educators interviewed were from five different schools. There was no contact with any of their learners.

The schools were selected by convenience sampling. Convenience sampling is described as "choosing the nearest individuals to serve as respondents and continuing that process until the required sample size has been obtained" (Cohen, et al; 2000, p.102). They further elaborate, pointing out that captive students often serve as respondents in this type of sampling.

According to Patton, (2002, p.244) "there are no rules for sample size." He further argues that "sample size depends on what you want to know, the purpose of the enquiry, what is at stake, what will be useful, what will have credibility, and what can be done with available time and resources".

3.5 THE PHASES OF THE RESEARCH PROCESS

The sequence and phases in which the research was conducted are shown in Table 3.1, the duration being three months.

Table 3.1 The research process followed

Phase	Method	Sample	Response	Socio/economic area
One	Document survey	9 Bookstores 4 Public libraries 1 Zoo library	18 books; 10 websites no CD's or DVD's	Privileged and under-privileged areas
Two	Questionnaire 1	12 Grade 7 Educators from 12 schools	3 Grade 7 educators from 3 schools	Middle to under-privileged
Three	Pilot Test of Questionnaire 2	70 learners and 2 educators from 2 schools	70 learners and 1 educator	One privileged and one under-privileged
Four	Questionnaire 2 administered	3 schools 203 learners 3 educators	203 learners, 2 educators	One privileged and two underprivileged schools
Five	Pilot Test of interview schedule	2 schools	2 educators	One independent and one privileged school
Six	Interviews and Questionnaire 3 administered	8 schools	9 educators interviewed, 11 responses to Questionnaire 3	Underprivileged schools
Seven	Questionnaire 4	3 schools	3 educators	Underprivileged schools

Phase one: The document survey

A survey was done on available amphibian books and general amphibian information. The selected libraries and bookstores included the Johannesburg Main Library, Parkview Library, Linden Library, Alberton Library and Johannesburg Zoo Library. Bookstores included Exclusive books in Killarney, Bedfordview and Hyde Park, the Central News Agencies in Bedfordview, Killarney and Alberton. Other bookstores were the Public News Agency, Executive Books and Hettie's Stationery in Alberton. Grade 4-7 learners' books written according to the RNCS as well as Educators' guides were included in the survey as were as websites, Digital Video Disks and Compact Disks. A cursory analysis of the contents of the documents was conducted.
See Appendix B for a summary of the recorded contents of these documents.

Phase Two: Questionnaire 1

A two-minute survey (Questionnaire 1) was faxed to 12 schools to be answered by Grade 7 educators only to confirm that frogs were included in lessons on classification.
See Appendix C.

Phase Three: Pilot testing of Questionnaire 2

Two schools were selected in close proximity to the zoo to pilot test Questionnaire 2. Minimal changes were made to the questionnaire as a result of the pilot.

Phase Four: Questionnaire 2 administered

Three schools were selected in close proximity to the zoo to answer Questionnaire 2 which determined existing prior knowledge of frogs in Grade 7 learners and their educators.
See appendix D.

Phase Five: Pilot testing of Interviews

Two educators at schools in close proximity to the zoo were selected to pilot test the interview schedules planned for educators. One of the educators taught at an independent school. This educator was selected out of necessity as the educators in most schools were participating in a labour strike at this time and were not at school.
See appendix E: Interview schedule.

Phase Six: Interviews

Nine educators from eight schools in underprivileged areas were selected to be interviewed and to answer Questionnaire 3. These educators were known to a work colleague of the researcher. This colleague escorted the researcher to these schools due to language barriers, the unknown locations of these schools and the possibility of danger. To expand the scope of Questionnaire 3 and to prevent boredom suffered by the work colleague during the interview process, he was asked to administer Questionnaire 3 to additional educators not being interviewed. This resulted in two extra responses. In total: nine educators were interviewed and 11 responses for Questionnaire 3 were received.

See Appendix F.

Phase Seven: Questionnaire 4

The addition of Questionnaire 4 was designed to clarify how educators acquired their animal knowledge. The work colleague was asked to administer this questionnaire to additional educators whilst the researcher was busy with the planned interviews. It was initially intended for five educators but the work colleague managed to administer the questionnaire to only three additional educators as he was unable to accompany the researcher to the last two schools.

See appendix G.

When deciding on the number of appropriate educator interviews, Greef suggests that one look at sufficiency – are there sufficient numbers to reflect the range of participants and sites that make up the population and saturation of information if the same answers are being repeated (Greef, 2006). Ten interviews were initially planned, but in the end only nine were interviewed as one educator was unavailable due to family loss. The nine interviews were considered adequate for the purposes of the small scale research project.

3.6 QUESTIONNAIRES

Cohen et al. (2000) suggests that the aims and objectives of a questionnaire need to be determined as part of the planning of the research process to answer the research question. The primary aims of the questionnaires in this research project were to determine knowledge of

amphibians including the definition, place in the food chain and life cycle, their value to humans and the attitudes of learners and educators towards them.

The secondary aims of the questionnaires were:

- to clarify if learners and educators knew what the term 'endangered' meant,
- which animals were endangered and what the consequences might be if animals became extinct. Some of the questions relating to conservation issues were general and others focused only on amphibians,
- to evaluate the responses received from the questionnaires for the purpose of further investigating how learners and educators acquired this knowledge by probing these issues in the interviews for educators

3.6.1 The design, pilot testing and administration of questionnaires

Table 3.2 provides a summary of the number and type of questions asked in each questionnaire

Table 3.2 Questionnaires

Questionnaire	Pilot tested	Administered	Number of questionnaires administered	Number of responses	Number of questions per questionnaire
Q 1: Appendix C	No	Faxed	12	3	3
Q 2: Appendix D	Yes	Researcher	206	205	19
Q 3: Appendix F	No	Researcher	12	12	14
Q 4: Appendix G	No	Colleague of researcher	3	3	5

Davidson, (1970) as cited in Cohen et al. (2000, p.250), explains that "[A questionnaire] is clear, unambiguous and uniformly workable. Its **design** must minimize potential errors from respondents … and coders. And since people's participation in surveys is voluntary, a questionnaire has to help in engaging their interest, encourage their co-operation, and elicit answers as close as possible to the truth."

Guidelines as suggested by Cohen et al. (2000) and Delport (2006) were observed in the design of the questionnaire. These included appropriate question formats such as open-ended and close-ended, unambiguous and relevant questions.

Since Questionnaire 2 was aimed at learners with English as their second language in most cases, more than usual space on the form was allowed for answers. Language was simplified to suit the age group. Delport (2006, p.171) advises that "Sentences should be brief and clear, and the vocabulary and style of the questions should be familiar to the respondents".

Questionnaire 3 was the only questionnaire **pilot tested**. This questionnaire was pilot tested on two Grade Seven classes, with 79 learners and one educator, to assess and correct issues that might arise. "Often a pilot …study will use a relatively unstructured approach in preparation for a more structured approach to be taken in the main study" (Terre Blanche & Durrheim, 1999, p.394). Delport (2006, p.171-172) suggests that it is "essential that newly-constructed questionnaires, those in their semi-final form, be thoroughly pilot-tested before being utilized in the main investigation." This enables the researcher to correct any errors and to replace leading questions with non-leading questions as this may result in biased answers, and to replace vague questions with specific questions. Alterations to the original questionnaire were minor.

Even though not all questions were answered, time constraint was obviously not the issue as the questionnaires were decorated with drawings of flowers, animals and various coloured squiggles and lines.

Questionnaires 1, 3 and 4 were not pilot tested. Questionnaire 1 was intended to provide clarity on an assumption before the research commenced that educators used frogs only as part of their classification lessons. See section 1.3.1. Questionnaires 3 and 4 evolved after the completion of Questionnaire 2 and were an abbreviation of that questionnaire. It was considered unnecessary to pilot test these two questionnaires as similar questions to those in Questionnaire 2 were asked.

With regards to administration of questionnaires, 12 copies of Questionnaire 1 were faxed to schools by pre-arrangement. There were only three responses despite reminders. Based on the experience and advice of Gray (2004) and the research supervisors, Questionnaires 2, 3 and 4 were administered directly to the respondents and resulted in a 100% response rate from the learners for Questionnaire 2 and educators for Questionnaires 3 and 4.

Initially it was anticipated that more educators would be available to complete Questionnaires 2. However, each school had only one educator responsible for Grade 7 Natural Sciences. The sample size was increased by administering Questionnaires 3 to each educator who was subsequently interviewed and Questionnaire 4 to three additional educators.

3.7. INTERVIEWS

Rubin and Rubin (1995) as cited in Arksey and Knight (1999, p.32) note that "qualitative interviewing is a way of uncovering and exploring the meanings that underpin people's lives, routines, behaviours, feelings, …".

Cohen et al. (2000) discuss the purposes of interviews. In interviewing respondents, their attitudes, values, preferences and knowledge can be investigated in-depth as opposed to questionnaires. They elaborate and say that interviews can also be used in conjunction with research techniques such as surveys to follow up on issues. In questionnaires, respondents may be brief in answering the questions but in interviews, the answers can be probed for a better understanding.

Greef (2006, p.286) says that “Interviewing is the predominant mode of data or information collection in qualitative research”. Interviewing is further described as a conversation between two parties by Gray, (2004, p.213) where, the one person plays the role of the researcher and the other party the respondent.

Interviews were intended to probe the knowledge and attitudes of the educators with regards to amphibians and their conservation to obtain meaningful information on which to base the design of the resource pack. Important issues such as how they assessed a learner’s prior knowledge before the commencement of a lesson plan were probed as well as how educators saw the process of knowledge acquisition by both themselves and their learners. Their personal attitudes towards frogs were ascertained as well as an indication of whether they would teach and understand the plight of animals that may be unpopular due to associated fears and myths.

A large amount of data can be generated within a single interview and the researcher may have problems in dealing with the data, especially if the researcher is inexperienced. Gray (2004) suggests that the interviewer should keep control of the interview process by minimizing long-winded responses and digressions. In this research process interviews lasted an average of 22 minutes and transcriptions resulted in an average of five single spaced typed pages. The data was manageable. A copy of a transcript is attached as Appendix E.

The type of interview was semi-structured as indicated in Appendix E. Greef as cited in De Vos et al. *(* 2000) notes that semi-structured interviews allow for more flexibility for both the researcher and participant and are aimed at forming a general picture of the participant’s beliefs, perceptions or accounts of a particular topic. It was intended to probe the knowledge and attitudes of educators towards frogs.

“Semi-structured interviews are defined as interviews that “allow for probing of views and opinions where it is desirable for respondents to expand on their answers” (Gray, 2004, p.217). The questions focused on a particular area of interest yet allowed the researcher some freedom to explore attitudes and beliefs as well as facilitating unexpected insights from educators.

In semi-structured interviews the researcher is free to modify the sequence of questions and change the wording according to the respondent's answers (Cohen et al., 2000). The sequence of questions is often determined by these answers. This did occur as educators responses led to different follow-up questions. Despite a pre-determined set of questions it was considered that the flow of conservation was of a higher priority, than the question sequence.

Interviews were pilot tested with two educators from very different schools. The inexperience of the researcher became apparent in listening to the recorded pilot tests as the researcher spoke more than the respondents and tended to explain and share too much information. This was rectified in the actual interviews.

The actual interviews took place at the educators' schools. This was deliberately pre-planned as it gave the researcher an opportunity to experience the school environment and to ensure a 100% response rate, as personal appointments were made with each educator. Complications that arose during interviews were unforeseen. The researcher assumed that since appointments had been set in advance, educators would have made the necessary arrangements for the interviews to take place in privacy and that they would not allow for any interruptions. Coping with interruptions during the interview proved to be a challenge and occurred in schools where there was a lack of space to conduct the interview. In some of the schools the principal's office was used and the principal had to collect papers, make telephone calls or have meetings during the research process. Notes were made during each interview as a back-up in case recordings were not audible due to interruptions. In most of the schools there simply was no suitable space such as an empty class room.

The recording and transcribing of all interviews were included in the planning phase. An MP3 player was used to record all interviews. This was small, unobtrusive, easy to manage and equipped with a large memory capacity. The sound track was downloaded onto a computer to assist with the transcribing of interviews.

According to Cohen et al. (2000) transcribing of an interview could result in merely a record of the data collected and that the social characteristics of the interview may be lost, for example, the body language of the respondent. The researcher made notes during each interview and added certain

observations to the notes during the time that the educator completed Questionnaire 3 post-interview. Significant body movements, interruptions, the environment in which the interview took place and questions asked by the educator were added to the notes.

Interviews were transcribed as soon as they were completed. This highlighted some answers that needed further exploration. In recording and transcribing interviews, the researcher became familiar with the data collected and often found richer data than was immediately apparent the original encounter with the educator. After transcribing each interview, the researcher became more alert as to what might have been misunderstood and what questions would need more clarification. These questions were addressed in the next interviews.

Interviews need to be practised to make the researcher more comfortable with the interview process as well as to iron out any problems that might be experienced with questions being vague or misinterpreted.

In discussions with supervisors, a number of changes were made in the interview schedules and Questionnaire 3 was added to investigate prior knowledge of amphibians.

3.8 DOCUMENT SURVEY AND ANALYSIS

The Documents surveyed and contents analysed consisted of Amphibian related books, websites, CDs and DVDs
See section 3.5 and Table 3.1 for details of documents.

A list was compiled of all available documents after completing a survey in libraries, bookstores and websites to ascertain what was available. The contents of each document was then analysed to determine what information was available with regards to pre-determined categories, similar to questions asked in the questionnaires and interviews regarding frogs. A short description of content was provided (See appendix B). Categories included conservation, characteristics and mythology.

One of the aims was to determine a baseline for concepts such as the definition or understanding of amphibians, conservation categories, biodiversity and environmental education to determine if an additional resource pack would be necessary and secondly, to what extent information on amphibians was readily available. Literature surveys are intended to find out what is written about a certain topic and usually involves compiling some sort of list (Irwin, 2006a).

Strydom and Delport as cited in De Vos et al. (2005, p.315) divide documents into different categories: personal, official and archival documents and mass media. Mass media is defined as any material available to the public such as books, newspapers and audio-visual media and this was the focus of the analysis of contents.

A non-amphibian related document was analysed, the Revised National Curriculum Statement (RNCS) for Natural Sciences: Life and Living, Intermediate and Senior Phase. The authenticity of the document was established as this particular copy was obtained from the Gauteng Department of Education as an official document. The content is well known as it is a guideline used by all schools and institutions involved with education programmes for learners.

The RNCS was analysed to determine what was expected of educators in key concepts in Natural Sciences, as well as assessing prior knowledge in learners. The expectations as to what learners should know in the field of Natural Sciences in completion of their senior phase were determined.

3.9 VALIDITY AND RELIABILITY

Validity and reliability are multi-faceted concepts according to Cohen et. al. (2000, p.105).
In qualitative data, validity may be addressed through various factors such as the honesty, depth, scope and richness of the data achieved including the level of objectivity displayed by the researcher (Cohen et al., 2000). In essence, validity refers to the question of how valid a piece of research is and if it is not valid, it is considered worthless. The measurement of validity is variable and can consist of the evaluation of content, internal, external and generalisability validity as long as it reflects the truth within the research paradigm used.

Gray (2004) explains that validity is ensured if the research instrument measures what it intended to measure. In this study the intention was to investigate aspects of the knowledge and concepts held by learners and educators. The survey conducted did exactly that within the sample used and resulted in highlighting the concepts of amphibians, misconceptions and alternative concepts held by the educators and learners surveyed as well as the lack of understanding of certain concepts. In other words, the study did what it intended to do.

This research was done within an interpretive paradigm. Janse van Rensburg (2001) explains that validity through the lens of an interpretivist can be established by using a smaller sample size as the intention is not to generalise but to rather establish transferability, credibility, dependability and confirmability. These criteria indicate interests in closely exploring the meaning-making within smaller groups and not establishing laws or norms within a wider population. She further suggests a list of general criteria when judging the integrity of a study which includes clarity, consistency, coherence, completeness, and creativity, consciousness of the impact of the research, context sensitivity, authenticity, honesty and reflexivity of the methods used.

Morse, Barret, Mayan, Olson and Spiers (2002) advocate a similar set of criteria to ensure reliability and validity during the research process , and argues that strategies of verification should be used throughout the process instead of relying on the judgement of an external reviewer/s. They further state that the verification strategies consist of the responsiveness of the investigator, methodological coherence, theoretical sampling, sampling adequacy, an active analytical stance and saturation: in other words the research process should be a rigorous process consistently analysed and questioned by the researcher. As Creswell (1997) and Kvale (1989) say these verification strategies should enable the researcher to "identify and correct errors before they are built into the developing model and before they subvert the analysis" (as cited in Morse et. al., 2002, p.9). To ensure validity of the research, the researcher carefully planned and pilot tested the tools used to collect data. Questionnaires and interview schedules were tested and discussed and additional data was collected to check and verify certain results.

In the process of this research thesis, the researcher added Questionnaires 3 and 4 after investigating the data obtained from the pilot interviews and in finding some inadequacies. The

researcher was responsive to the data obtained; investigating different insights from different points of view (testing the data obtained against the knowledge of colleagues, study advisors and acquaintances) even though these points of view may have contradicted original expectations. Answers from educators and learners were discussed with colleagues in the Zoo and within a wider Zoo community to form a better understanding of data received. An example was the eating of bullfrogs, and the way in which they were prepared. This was explained in greater detail by work colleagues as the researcher was hesitant to explore the concept with the two educators who had mentioned this practice with some hesitation.

The sampling was considered adequate for the scope of the study. It was not always possible to prove saturation of data obtained as learners were not interviewed in this study and interviews may have given more insight into the horizontal discourse of the learners. An analytical stance was taken by the researcher during the research process. Kvale (1989) (as cited in Morse et.al., 2002, p.14) emphasises that to "validate, is to investigate, to check, to question and to theorize". The researcher feels that this study of prior knowledge of amphibians was validated by constant investigation, checking, questioning and theorizing throughout the process.

Reliability is suggested as a measure of consistency over time and over similar samples. Thus the research process should produce similar data from similar respondents over a period of time (Cohen et. al., 2000, p. 117). The researcher believes that this would not be the case in this particular study as similar results can not be expected in other learners or educators as the sample was not large enough to be representative of both groups.

3.10 DATA ANALYSIS

For this study inductive analysis was applied described by Danermark, Ekstrom, Jakobsen and Karlson (2002) as seeing similarities in a number of observations. Patton (2002, p.41) describes inductive analysis as the investigation of data to discover patterns and themes resulting in a creative synthesis.

The sample of 203 responses from learners was randomly divided into two sections for data analysis. The 101 answers were considered adequate. The sample of two educators was not considered adequate and Questionnaire 3, a shortened version of Questionnaire 2, were administered to educators being interviewed. The educator responses from Questionnaires 2, 3 and 4 were collated and summarised in one document to reduce the amount of data collected. Summaries of data obtained from learner questionnaires reduced the amount of data considerably and these summaries were most helpful in identifying themes for discussion and presentation of data.

Relevant topics, for example, frog conservation issues or assessment of prior knowledge in learners, were highlighted in all interview transcripts to reduce this amount of data into manageable batches.

Following Arksey and Knight (1999, p.155) "Data analysis is determined by the research design and in turn the design ought to be guided by thoughts on data analysis". In qualitative analysis, themes are identified and coding becomes imperative. Coding was not used in identifying themes but summaries of answers were compiled to indicate major themes. Some themes were pre-determined as the research design probed certain pre-determined concepts.

3.11 ETHICS

"A consideration of ethics is fundamental to all research" (Murray, 2006). Cohen et. al. (2000, p.246) describes the respondents as subjects and not objects of research that needed to be respected as having given informed consent to the research, having the right to withdraw at any given time and guaranteed that the research will not harm them in any way.

Permission was sought from the Gauteng Department of Education (GDE), principals of schools and interviewees, as well as the chief executive officer of the Johannesburg Zoo to ensure that none of the institutions or people involved in the research would be compromised. The project has

been accepted by the Africa Association of Zoos and Aquaria. (See Appendix H for the consent from GDE).

The teachers had given their consent for interviews and consent for the learners to answer the questionnaires. (See Appendix I for letters requesting permission from schools to conduct the research on their premises).

In the research regarding prior knowledge of amphibians, there appeared to be little threat of harming the respondents as the topic was not personal in nature, yet the researcher had ethical concerns regarding probing attitudes and beliefs of educators as it was not the intention to disrespect any beliefs held by them. In the actual interviews the matter did not pose a problem as discussions were superficial and educators did not share any cultural secrets attached to the myths or fears in their personal experiences with the researcher. Their discussions about myths and fears were removed from themselves as they said in some instances, "we believe that some people do associate witchcraft with frogs or that some people do eat frogs" (educators interviewed, personal communications, 2006). In the instances where educators spoke about beliefs or practices held by them, they volunteered the information without appearing uncomfortable.

The researcher was concerned that educators might feel they were being tested and judged on their level of science knowledge. The educators involved were the Heads of Departments or educators nominated by their Heads of Departments. The process was carefully explained to clarify that the research was not intended to evaluate knowledge, but to investigate attitudes towards understanding of animals and concepts. The educators agreed to be recorded, and not only was the purpose of the research fully explained, but also why it was necessary to record the interview. Greef (2006) suggests that consent can be obtained when setting up the appointment. In this study, it proved far easier to obtain consent immediately prior to the interview as educators were more at ease after seeing the recording equipment and when they were face to face with the researcher.

Mutual respect and confidentiality was observed at all times. The findings of the data collected were discussed with some respondents to ensure correct interpretation.

The identity of the educators and learners were not mentioned in the discussion but the identity of each school had been included to sketch the context in which the research was conducted.

3.12 A CRITICAL EVALUATION OF THE RESEARCH PROCESS

In evaluating the research process it became clear to the researcher that the process could have benefited from greater urgency and better planning. The timeline set for the research process was not followed and unexpected delays caused stress and unplanned additions to the data gathering process.

The extended educators' strike, 2007, was unexpected. The educators were not available for two months due to the strike and the school holidays that followed. The pilot testing of interviews were done in a very quick and hurried fashion, giving the researcher little time to reflect on the questions asked or to carefully consider marrying the data from interviews with the data obtained from Questionnaire 2. This necessitated additional questionnaires, 3 and 4, without a means to explain the research process in a clear and meaningful way. The data obtained was very useful, but the additional questionnaires, in certain aspects made the process appear superficial and disorganised as the original planned interviews could have made provision for questions asked later in additional questionnaires.

In reflecting on the process followed in all the questionnaires, despite the intentions to clarify the questions, it appeared to be an untidy process which could have been rectified by more exploration during interviews had the researcher been able to identify the issues requiring clarification. These additional questionnaires did however, demonstrate the rigour of the researcher to ensure validity in the process followed and resulted in useful data. The additional data obtained enabled the researcher to form a clearer picture of the misconceptions and lack of knowledge of certain concepts held by the group of educators.

Some challenges that face a researcher when using qualitative research as described by Gray (2004, p.213) include establishing a rapport with participants to gain information while

simultaneously asking the questions, making notes and observing body language. Initially, generating a rapport did not appear to be a problem, as educators freely shared their experiences and their knowledge about animals. In assessing their attitudes and beliefs about frogs during analysis of the data, as well as in discussions with the colleague who had accompanied the researcher, the impression was formed by the researcher that educators may not have been as open and eager in these discussions as originally thought. This may have been due to fear of being misunderstood, a language and culture difference, and very possibly the fact that both parties met for the very fist time during the interview and did not know each other at all.

Language may have been a challenge. Some answers could have been skewed due to language barriers such as the understanding of conservation terminology.

Interviewing learners might have added more insight to their attitudes and interest levels in frogs and conservation since it was difficult to determine body language and other frog information that was not specifically mentioned in the questionnaire. It was decided to forego interviewing learners as the researcher felt that sufficient data had been obtained through the questionnaires and partly because the planned timelines were disrupted. In retrospect further interviews could have provided richer data.

The research design of the survey was suitable in providing answers that determined prior knowledge of amphibians among both educators and learners. Surveying the amphibian literature was most useful in establishing a concept baseline, as well as indicating content for the intended resource pack.

CHAPTER FOUR

EDUCATORS' PRIOR KNOWLEDGE ABOUT FROGS, CONSERVATION AND BIODIVERSITY

"Do not teach too many subjects and what you teach, teach thoroughly".

Alfred North Whitehead

4.1 INTRODUCTION

This chapter reviews the reactions and responses of eleven educators to the questionnaires and nine educators interviewed – see Table 3.1 in Section 3.5. The intention of the interviews was to investigate the attitudes of educators towards amphibians as well as their teaching practice with regards to assessment of prior knowledge in their learners. The questionnaires were intended to ascertain their knowledge of amphibians in a horizontal and vertical discourse and to examine any alternative conceptions and misconceptions potentially held by educators, as described in Chapter 2.

The responses were collated and represented in tables with short descriptions where appropriate. It was not always possible to indicate how many of the educators held the same viewpoint as questions were open-ended and invited more than one response. In some instances where a certain trend was observed it was deemed appropriate to indicate the number of educators following the same trend as this gave an indication of a shared concept, alternative conception or misconception.

The presentation of the results (sections 4.2- 4.6) is followed by discussion (section 4.7) which focuses around two main points:

a. Prior knowledge in a horizontal discourse. Educators had their own everyday prior knowledge and experience of amphibians. Their attitudes and beliefs as well as myths were taken into consideration.

b. Prior knowledge in a vertical discourse. Knowledge such as classification of animals, principles of ecology and conservation is accepted as vertical discourse. The Revised National Curriculum Statement – Natural Sciences (RNCS) requires that educators ensure that learners will understand, will be able to interpret and apply scientific, technological and environmental knowledge such as classification, ecology and 'endangered'. The extent of this knowledge as well as the application of using the knowledge in, for example, identifying amphibians was investigated.

4.2 THE CONCEPT OF AMPHIBIANS AND FROGS

Knowledge of the concepts of amphibians and frogs were investigated in both Questionnaires 2 and 3 (Appendix D & F) as well as in interviews (Appendix E). The data gathering methods dealt with different ideas which are: the definition of amphibians; selecting correct examples of amphibian species; ability and knowledge base of educators in identification of different frog species as well as frog habitats. Their attitude towards frogs was probed to ascertain how they viewed these animals and if they were aware of any myths, fears or cultural beliefs. Each idea is addressed in a subsection.

4.2.1 The concept of an amphibian

Educators were asked to explain what an amphibian is? ***(Questionnaire 2)*** This was to determine their understanding of the concept.

Two educators responded:

- Animal that lives on land and in water and has a rough skin.
- Animal that lives inside water and outside water.
- Animals both aquatic and terrestrial.

After explaining what they understood an amphibian to be, they were asked to identify the correct examples from a given list. ***(Questionnaire 2).***The list consisted of the following animals: platannas, bullfrogs, rain spiders, chameleons, lizards and snakes. The responses were:

Table 4.1 Amphibians as indicated from a given list by two educators (n=2).

Correct examples of amphibians	**Incorrect examples of amphibians**
Giant bullfrog x 2	Snakes x 1
	Rain spider x 1
	Chameleon x 1

In ***Questionnaire 3***, eleven educators were presented with pictures of a frog, lizard, spider and snake. The use of pictures elicited considerably more correct responses as listed in Table 4.2. Only one educator identified the snake as an amphibian.

Table 4.2 Identifying examples of amphibians from pictures (n=11).

The request did not limit the number of responses.

Correct examples of amphibians	**Frequency**
Frog	11
Incorrect examples of amphibians	
Snakes	1

Educators were asked to list any other kind of amphibian apart from a frog. ***(Questionnaire 3)*** This was to determine the extent of their general knowledge of examples of Amphibians.

Table 4.3: Additional amphibians listed (n=11).

Correct examples	**Incorrect examples**
Toads	Crab
Salamanders	Turtle
Newt	Snake
	Crocodile x 2
	Hippo
No response	2

To determine the extent of the educators' knowledge about frog species, they were asked if they could identify a frog if they saw it. ***(Questionnaire 3)***

Knowledge about different species of frogs was further investigated and educators were asked if they could identify different frogs and give examples. The responses are illustrated in Table 4.4.

Table 4.4: An indication of educators' knowledge in identifying different frog species and examples given. (n= 11).

Negative responses	**Positive responses**	**Examples**
5 out of 11 said no, they could not identify any frog species	4 out of 11 said yes	Toads x 2
		Bullfrogs x 2
		Ordinary pond frogs
		Lektlametlu – black frog, lives mostly in water
		Green ones
		Brown ones
No response - 2		

4.2.2 Classification of amphibians

Educators were asked to give three characteristics of a frog to differentiate between frogs and mammals, and they were given a further clarification by rephrasing the question: '***how are frogs different from mammals' (Questionnaire 3)***. The intention was to investigate their scientific knowledge as prescribed by the RNCS, classifying vertebrates by different characteristics as discussed in Appendix J. The following responses were listed:

Table 4.5 Characteristics used by educators to differentiate a frog from a mammal (n= 11).

Correct responses	**Frequency**
Lay eggs (in water).	5
Male fertilizes eggs outside (external fertilization).	3
Covered in moist, damp or slippery skin.	2
Mammary glands absent (they do not breast feed).	2
Stages of growth; Tadpole stage – growth changes in stages. Lungs that develop later.	1
No fur.	1
Cold-blooded.	1
No parental care (which is why they lay so many eggs).	1
Breathe through skin and lungs.	1
Live in water and outside water	1
Incorrect or inadequate responses:	
Webbed feet.	2
4 legged (do not move like mammals).	2
Scales.	1
Body divided into three parts - head, body and thorax.	1
Mammary glands present.	1
No horns.	1
Rough skin.	1
Soft skin.	1

4.2.3 Habitats and when and where frogs were last seen.

Educators were asked to list three different frog habitats, excluding water ***(Questionnaire 2 & 3).*** In response educators answered:

Table 4.6 Habitats of frogs as listed by educators (n= 11).

Habitats	**Frequency**
On land, under stones, grass, mountains, forests	11
In water, rivers and muddy areas	5
Trees	2
Schoolyard	1
Swimming pool at home	1
Areas surrounding home	1
Books	1

Responding to the question: '***When last did you see or hear a frog?***'**(Questionnaires 2 & 3),** educators responded with a variety of time frames that showed no specific trend. Responses did include answers that indicated seasonal habits of frogs. Four educators answering the questionnaires said frogs were seen after it rained. Three referred to seeing frogs after it rained in their interviews although they were not specifically questioned about this during these interviews.

Answers regarding the time when they last saw a frogs, varied from two to seven years, to the previous week and recently in a book.

4.3 CONSERVATION OF AMPHIBIANS AND THEIR ROLE IN ECOLOGY

4.3.1 The concept of 'endangered'

Educators were asked to explain what the word endangered meant to them. ***(*Questionnaires 2 & 4)**

Table 4.7 Educators' understanding of 'endangered' (n=5).

Reduction in the number of a species, which could lead to extinction
To put things into a dangerous position
Animals of which there are a few left
Means extinction, the animals lives are threatened and they are facing destruction
Animals that are scarce and that are killed for certain parts used for personal gain

The rest of the educators were not questioned about their understanding of the concept.

To expand on their understanding of the concept, educators were asked to list as many endangered animals as they knew. (**Questionnaire 2)**

Table 4.8 Educators' examples of endangered animals (n=2).

Water animals like frogs x 2
Snakes
Frogs
Rats
Birds
Fish
Lizards
Sea-lion
Penguin

During **interviews** the question was phrased differently and the educators were asked about the examples of animals used when teaching about conservation.

Table 4.9 Educators' examples of animals used in teaching about conservation (n =9).

Their responses were not limited to a specific number

Gorillas
Baboons
Tortoises
Animals kept in zoos that we would not see if they were not in the Zoo
Animals portrayed on the Coat of Arms
Different animals in an eco-system like a pond
Salamanders
Water animals x 3
Dogs and domestic animals that the children know about

Three educators said they did not teach about conservation with regards to animals but used natural resources such as water or energy when teaching about conservation.

The educators' knowledge regarding the conservation status of frogs was investigated.
The question asked them to choose the statement that best described the conservation status of amphibians. **(Questionnaire 3).**

Table 4.10 The conservation status of frogs as indicated by educators (n= 11).

Choice of answer	**Frequency**
Half of all amphibians are extinct	4
There are plenty of frogs and tadpoles around	3
A third of amphibians are critically endangered	3
No choice indicated	1

The correct choice is that a third of all amphibian species are critically endangered.

4.3.2 Ecology: the role of frogs in a food chain

The role of frogs in food chains was investigated.
A list of animals was given and the educators had to place them in the correct sequence of a food chain. Animals: frog, snake, mongoose and mosquito**.** The instruction was that each animal can only be used once. **(Questionnaire 2) (n=2).**

Both educators completed this task, one of whom incorrectly sequenced the order of what eats what. Despite the one mistake, their ecological knowledge was evident as far as it related to the contents in school text books as discussed in Appendix B.

To ascertain whether educators understood the connections between the loss of biodiversity and the effect on ecology (food chains), they were asked what would happen if frogs became extinct. **(Questionnaire 2 & 3).**

Table 4.11 The effects if frogs became extinct according to educators (n=11).

Effects	**Frequency**
More mosquitoes and more insects such as flies	4
The balance of nature will be affected	3
Prey would be short of food	2
Mosquitoes would need more food and will eventually not be able to survive and they will eventually become endangered	1
Imbalance in nature, the food web will be disturbed; the ecosystem will be out of balance	1
Negative effects because people love animals	1
People will miss them and become worried	1
Peacefulness will cease	1
I am not sure.	1

A second question more focused on the effect on humans if frogs became extinct, was asked. **(Questionnaire 3).**

Tale 4.12 The effects on people if frogs became extinct according to the educators (n =11).

Effect	Frequency
Increase of insects, flies, mosquitoes and an increase in diseases such as malaria	2
Increase in use of insecticides leading to increase in pollution that will affect the ozone layer	1
Plants will be affected by the presence of too many insects and this could lead to poverty	1
Those who are aware of their advantages would worry and those who are scared of them would not. Frogs prey on small animals that scare people	1
We won't be happy. Our children must learn about frogs and know them	1
Cloning would occur	1
No effect on humans	1
There would be more snakes all over the place	1
No response	3

4.3.3 Educators' perceptions of how to save endangered animals

Educators were asked to list the actions they would take if frogs were endangered. **(Questionnaire 3)**

Table 4.13 Actions suggested saving frogs (n =11).

Actions	Frequency
Remove from that particular habitat to a safe environment	3
Have a safe place for frogs at institutions such as zoos and they should be asked to help to remove frogs from any danger. This educator said prey species of frogs should be reduced in numbers	2
Educate people and teach them about frogs	2
Watch children carefully and teach them to be careful of frogs	1
Recycle	1
Take frogs back to the stream and make sure they were not killed. (This response came form the educator who ate bullfrogs)	1
Supply ponds in parks and at 'our respective places' and put frogs back into the water and make a place for them	1
Let frogs free. Protect frogs from being killed	1
Cloning	1
I really cannot help them, because of the myth I know about frogs	1
No response	2

4.4 THREATS TO AMPHIBIANS

A list of threats to frogs was requested. **(Questionnaire 2)**

Interviews: Responses during interviews (n – 9) elicited fairly general and indirect references to threats of frogs or their habitats. This question in Questionnaire 2 and during the interviews was aimed at finding out if educators knew about threats specifically applicable to frogs because of their characteristics as a class.

Table 4.14 Perceived threats to frogs (n=-11).

Threats	Frequency
People that do not care about animals and the environment – e.g. children can be cruel to animals	2
People kill animals for different uses like medicines, foods and clothes	2
Pollution: chemicals; oil leakages; poisonous substances; insecticides from farming; littering	1
Lack of knowledge about interdependence between species	1
Other water animals that eat frogs	1
Threats to water habitats	1
People kill animals because they fear them	1
No responses (interviews)	2

One educator spoke about eating bullfrogs himself and said he did not wish to consider the conservation status of bullfrogs, as this would deter him from eating them.

4.5 ATTITUDES TOWARDS FROGS

The attitude of educators towards frogs was investigated mainly through interviews (see Appendix E) and also Questionnaire 2 and 3 (see Table 3.1 in Section 3.5 and Appendix D and F).

In **Questionnaire 2**, different questions were asked to determine the attitude of educators towards frogs. Questions were: ***'would you hold a frog?'****(1 = yes; 1 =No),* ***'keep it as a pet?' (****1=yes; 1=no****) and 'do you like frogs?' (****yes) (****n =2).***
As to the housing of a pet, the educator who had expressed a phobia of animals responded positively and said she would keep a frog as a pet as it would control the number of insects at her house but she would never touch it.

Educators were then queried about their familiarity with the sounds of frogs and if they enjoyed the sounds they heard. **(Questionnaire 3).**

Table 4.15 Educators responses to frog sounds (n =11).

Un-familiar with noise	Familiar with noise	Enjoy the frog noise	Do not enjoy frog noise	No comment
4	7	5	4	2

Four educators said that they had never heard the sounds of frogs whilst five indicated that they had heard frogs. Only three indicated that they liked the sounds that frogs made and one associated it with peacefulness.

The same question was asked during interviews. **Interviews (Appendix E):** Varied responses were received but the majority of educators to whom the question was posed in the interview process (six out of nine) had negative feelings. One educator explained her phobia for all animals and said it did not really matter if it was a frog or a snake or a mouse. Six educators described frogs as ugly, noisy, scary and smelly. During their interviews, their responses were accompanied by body-language which in the writer's Zoo experience was an indication of dislike such as the pulling of their faces to shrinking and moving their shoulders, displaying discomfort by simply the thought of a frog.

Stories and myths accounted for a significant part of the educators' fear of frogs.
The question was posed as: do you know of any stories, myths or folklore of frogs?
(Questionnaire 2 and Interviews)

The responses to Questionnaire 2 were mixed- one said she was terrified of frogs, whilst the other said, no—no fear of frogs. They did not elaborate on any myths but one of the educators indicated that frogs were used for medicinal purposes.

Seven out of nine educators responded during the interviews with various interpretations, such as frogs were seen as messengers of bad omens or feelings. Educators described how frogs would

be chased out of their houses and gardens and often killed. One educator said that in her culture, they habitually killed animals that they did not like or perceived as a threat. One educator described how he would be branded as practising witchcraft if he attempted to save frogs from his garden and return them to the river in his area. His perception was that frogs would increase in numbers in his garden and he would eventually spend the majority of his time returning frogs to the river and thus be regarded as unstable by his neighbours. These are examples of fear associated with frogs.

Eating frogs was referred to by two of the three educators who had no fear or 'problem' with frogs. Methods of cooking frogs were discussed and one educator indicated that he and his family ate frogs. They knew exactly where and when to catch them and compared the taste of a frog to that of a chicken.

Three educators referred to warts, sores or skin reactions if frogs urinated on a person or if frogs were touched. This reason caused people to fear frogs and to kill them.

None of the educators referred to children's stories such as fairy tales, poems or frog games played with young children. One educator, when queried about this, said that she had known the stories when teaching younger children but could not remember them now.

4.6 THE ACQUISITION OF PRIOR KNOWLEDGE OF EDUCATORS

4.6.1 Prior knowledge of educators

Knowledge and its acquisition were investigated to discover how and where educators sourced their own personal/prior knowledge as well as scientific knowledge necessary for teaching the subject.

Educators were questioned as to how they obtained their knowledge of animals.
(Questionnaire 4 and interviews).

Five educators were questioned during interviews about their animal knowledge before embarking on their teaching professions and how they acquired this knowledge.
Three educators were questioned in **Questionnaire 4** with regards to acquiring their animal knowledge. Responses were thus obtained from 8 educators.

Table 4.16 Acquisition of prior knowledge by educators (n=8).

Educators could indicate more than one choice

Means of knowledge acquisition	**No. of educators**
Tertiary education	4
Books other than text books	2
Personal experience, growing up with animals	2
Television programmes such as 50/50, SABC 3	2
From Zoos	1

Educators were asked to list the resources used if they needed more facts on frogs**.**
(Questionnaire 2 and Interviews)

Table 4.17 Resources for educators to find more information (n= 9).

Resources	Frequency
Textbooks in the class	4
References in libraries	4
Television programmes	2
Zoos	2
Magazines and newspapers	2
Internet	2
Books other than textbooks	1
Museums	1
Jungles	1
From people that work with animals	1
Kruger National Park	1

Educators were asked to list the resources learners would use if they needed to do research.

(Questionnaires 2, 4 and Interviews)

Table 4.18 Resources learners would use for research purposes according to educators. (n= 12).

Resources	Frequency
Television programmes	7
Zoos	4
Libraries	3
Newspapers	2
Magazines	2
Textbooks	2
Encyclopaedias	1
Internet	1

Television programmes seem to be a well-recommended resource. Most of the schools had computer laboratories but they were not in use due to lack of skills, broken equipment or educators saying there was no time for a computer class as it was not part of the curriculum.

4.6.2 The assessment of prior knowledge in learners by educators

Educators were questioned on how they knew what learners knew before they began a specific lesson. This question was explored only during **interviews** with educators. Nine educators responded to this question.

They responded in very similar fashion saying that they questioned learners and wrote their answers on the board or asked learners to do a project first, which they marked, and this gave them an indication of what learners knew and at which level they were at. Some educators mentioned that they told stories to the learners but could not remember an example of such a story.

Learners' attitudes towards frogs, according to their educators were investigated in **Questionnaire 3.**

Table 4.19 Learners' attitudes towards frogs according to their educators (n=11).

Comments	**No. of educators**
They love frogs and play with them and don't react as wildly as they do with snakes, love frog sounds	4
Scared because of their damp and soft skin; scared and like killing frogs	3
Mixed – friendly & scared, theoretically excited but practically they are scared	2
Not sure- I have not spoken to them about frogs	2

During the interviews, educators mentioned that what learners knew or liked about frogs would be difficult to assess as they did not really come into contact with frogs and hardly ever saw them, and probably did not know frogs well at all. When questioned about which animals they thought learners would like or be most familiar with, they mentioned animals such as lions, elephants, snakes and domestic animals. They also suggested that learners playing with frogs just saw them as everyday things and not as fascinating or fearful animals.

4.7 DISCUSSION OF RESULTS IN TERMS OF PRIOR KNOWLEDGE WITHIN THE HORIZONTAL AND VERTICAL DISCOURSE.

4.7.1 The Concept of amphibians, habitat and classification

The discussions in this section refer to Tables 4.1- 4.6.

The teaching of Natural Sciences in the core knowledge of 'Life and Living' falls within the vertical discourse. Overlaps within a horizontal discourse are expected as certain concepts often appear in the media and become everyday language. There is however, a danger of concepts being used in a superficial application, often leading to misconceptions or partial understanding with the incorrect applications of such concepts. There is some data presented in the tables mentioned that shows such evidence and will be highlighted in the discussions.

The educators had to have scientific knowledge (prior knowledge within the vertical discourse) to distinguish between animals such as frogs, snakes, salamanders, newts, hippos and the other animals mentioned. To distinguish between these animals or to classify them in classes or groups, the educators had to make use of a set of characteristics or definitions as criteria. Such criteria are within the vertical discourse. In this instance educators were guided by the questions posed by the writer and the criterion used was a definition or understanding of the concept of an amphibian.

The concept amphibian was explained by the educators as 'an animal that lives on land and in water' which is partially correct. By using this concept at its superficial level educators incorrectly identified some of the examples listed by them. A hippo, crab, crocodile and snake are all correct examples of animals that can live in water and on land but these animals are not amphibians. By

using the superficial understanding of this concept, educators formed misconceptions concerning the correct classification of an amphibian and in applying this knowledge to identifying amphibians correctly.

To understand the concept of an amphibian, educators had to apply the additional characteristics within the vertical discourse as discussed in Appendix J. Educators did show some evidence of acknowledging these characteristics, especially in Table 4.5 and listed criteria such as reproduction, parental care, metamorphosis, body-coverings, respiration and thermoregulation. As discussed in Chapter 2, the language characteristic of the vertical discourse is complex and internationally understood. Despite using terminology found more commonly in a horizontal discourse such as fur and laying of eggs, instead of using animal pelt or oviparous for example, the use was applicable to the level or age of learners taught in the Intermediate and Senior phase as well as bearing in mind that English was the second language for most of the educators and learners surveyed. Cold-blooded is an example of a scientific concept that has been used in a horizontal discourse for different meanings such as a cold-blooded killer. In a vertical discourse it refers to the thermoregulatory aspects of the animal classes: Pisces; Amphibians and Reptilia. These classes of animals are often thought by humans not to suffer from pain and to be devoid of expression hence, the connection to cold-blooded killers.

The understanding of these terms or concepts of amphibian and the classification criteria were superficial and did not enable educators to make use of the criteria suggested by them in Table 4.5 to correctly identify amphibians. Some examples submitted by them as amphibians included hippos, crabs, crocodiles and more. By correctly using and understanding the characteristics of an amphibian, it is clear that a hippo, for instance, does not lay eggs or have a similar life cycle like frogs.

The confusion between amphibians and reptiles appear often in educator responses – see Tables 4.1; 4.2 and 4.3. The criteria in classifying an animal as an amphibian or as a reptile have some similarities but show more dissimilarity such as respiration, metamorphosis, body covering and reproduction. Once educators understand these dissimilarities, they would find it much easier to distinguish between an amphibian and a reptile.

Educators also included characteristics still within the vertical discourse that could not be used for classifying or identifying amphibians, such as horns and 'head, thorax and body' divisions. Using the criterion, 'horns', is applicable to classification but only in an order like the Artiodactyla. Educators showed a lack of knowledge in the vertical discourse with regards to the morphology of horns and how they grow and thus formed a misconception thinking that this criterion could be used to distinguish between amphibians and mammals. The same applies to the body divisions as these divisions are used in the classification of invertebrates and are not applicable in vertebrate classification.

Two educators suggested using colour as a criterion for classification. This is not a significant number to base an analysis on, but in the opinion of the writer, is a common criterion used by people to distinguish between animal species, although incorrect. Classification is based on many criteria such as adaptations, dental formulae suggesting different feeding habits, the shape of beaks, claws and many more. Colour is very rarely used in a vertical discourse for classification purposes as frog larvae, sub-adults and adult frogs of the same species may differ in colour. Another example is tawny, Barbary and white lions displaying different colours but considered the same species by geneticists. In a horizontal discourse, it would be acceptable to use colour to distinguish between items such as crayons, clothes, hair of people, cars, etc. This would serve as a casual distinction and not based on any scientific knowledge.

Some of the examples of amphibians as suggested by the educators can be considered as being within the horizontal discourse. Animals such as bullfrogs have been highlighted in the published and electronic media and in the experience of the writer, are most commonly used in general conversation. Many visitors to the Zoo often mention that they have bullfrogs in their gardens based on the sounds they hear at night only to find that they most probably have a guttural toad or a red toad. The word 'bullfrog' is commonly found within the public domain as well as the words 'frogs' and 'toads'.

In a vertical discourse, a distinction is made between frogs and toads, and even though educators did mention them as two different species of frogs, it is evidence of another misconception. The terms frog and toad do not refer to two different species nor to two suborders as both are classified

as frogs, in the order Anura. In previous years frogs and toads were distinguished from each other in the United Kingdom based on the few species of frogs found there. This criterion is no longer valid.

The responses from educators in Table 4.4 show a lack in understanding the concept 'species' within the vertical discourse. Different looking animals do not constitute different species nor is the terminology used in the horizontal discourse. Toads, bullfrogs and ordinary pond frogs do not indicate different species. In fact, all of these commonly used terms may refer to the same species of frog as it is difficult to determine which species is being referred to.

Table 4.6 reflects data within the horizontal discourse. The habitats of frogs are described in layman terms. A popular misconception based on the understanding of the concept of an amphibian, is that frogs have to be found near water and many children's stories (Mills, 2004) describe frogs in dams sitting on lily pads, as do illustrations and the popular song sung by Paul McCartney: 'We all live together'. The habitats suggested by educators such as mud, under stones and in forests, gardens and swimming pools show an understanding that frogs inhabit many areas in nature and in one's own environment. The educators expressed their responses within a horizontal discourse yet showed some understanding of frogs inhabiting varied ecological niches, concepts found within the vertical discourse. These concepts are still superficial in that educators did not mention specialised habitats. By expressing themselves within the horizontal discourse could be an indication of prior experience where they have seen frogs before.

The number of responses in each table indicates that the majority of educators operate within a vertical discourse but at a superficial level with limited understanding of concepts and the application of such concepts. There is an overlap between the horizontal and vertical discourse which is acceptable for teaching the intermediate and senior level but of concern is the superficial understanding of concepts and application of said concepts within the vertical discourse. The superficial understandings of such concepts lead to misconceptions formed by the educators which in turn lead to educators transferring such misconceptions to their learners.

4.7.2 Conservation, ecology and threats to frogs

The discussions in this section refer to the data compiled in Tables 4.7 – 4.14.

The concept of 'endangered' falls with the vertical discourse. The majority of the responses were correct in describing 'endangered' as a concept where the numbers of the animals were threatened. Statements such as 'a few left', 'reduction in number of species' and 'animals that are scarce' as well as later connecting it to actions such as 'having a safe place for frogs' are examples. However when all the data relating to conservation is examined, the understanding of the overall concept of 'endangered animals' is superficial and the examples of endangered animals and some threats listed, show limited understanding.

The term 'endangered' is used when describing the conservation status of a species (See Appendix K) and is not linked to general groups of animals such as fish, snakes, birds, frogs, lizards, in Table 4.8 as the educators indicated. These responses to the question of providing examples of endangered animals indicate a limited understanding of the concept, 'species'. If educators specified their responses by saying 'some fish' or 'some frogs' it would have indicated a better understanding of the concept even though specific species would not have been mentioned. A blanket response indicates that all fish for example, are endangered, which is not true.

The same applies to the animals listed as examples used when teaching about conservation. One example, 'gorilla', out of nine responses is correct. The rest of the examples are incorrect and vague such as 'animals kept in zoos'. A percentage of animals in zoos are threatened but the majority are not, indicating a misconception about zoos as well as the animals portrayed on the Coat of Arms. Similarly with domestic animals – an inappropriate response which may point to a misconception of the concept of 'endangered' being the same as 'dangerous', although this is purely speculative. It is not clear why one educator out of nine would use domestic animals in a conversation about conservation.

The majority of responses were inappropriate in terms of questions relating to 'endangered'. In analyzing the responses as to possible effects on an ecosystem or on people, should frogs become extinct, shows limited understanding of the role of frogs in an ecosystem or the effect they

have on the balance of an ecosystem. Some responses were correct indicating more insects, the possibility of an increase in diseases such as malaria and an increase in the use of insecticides. Other responses such as 'people will be unhappy, peacefulness will cease and no effect on people' makes no sense and are situated in a horizontal discourse. 'Mosquitoes will eventually become extinct' is incorrect and a misconception of the interdependence of species.

The conservation actions and threats to frogs listed in Tables 4.13 and 4.14 as responses by the educators, illustrated a number of misconceptions. Threats and actions are situated in the vertical discourse as the solutions are often more complicated. Frogs are extremely sensitive to their particular habitats, substrates they live on and food sources. They cannot simply be collected and put in a different environment whether it is in another dam/river/forest or in captivity. Removing 'prey' (educator confused predator and prey) species that frogs rely on for survival indicate that to save one species, it is o.k to remove another. If the educator did mean 'prey' it causes even more confusion as prey equals the food source of frogs and this most certainly would not save frogs. It also indicates the misconception that predator species are to be blamed for the demise of prey species. This only occurs when the ecosystem is entirely unbalanced, and the removal of certain species by man has had mixed results. The saving actions suggested by educators were situated in a vertical discourse but with limited understanding as to the implications and effects of such suggestions.

Threats were blamed as cruelty in children. This, cruelty, in general, applies to lucrative commercial animal related business such as farming with wildlife or domestic stock with no concerns for animal welfare and not individual children. Other threats listed were vague in nature such as other water animals eating frogs, again indicating the misconception of predators being blamed for the demise of frogs. Two educators said that frogs were threatened for the products they supplied, which is partially correct but they also mentioned clothes. This shows a generalization of threats, 'one threat fits all endangered animals' as it is impossible to produce clothes from frog skin.

Some actions suggested and threats were correct. Educating people and adding ponds in parks could assist in saving frog species in certain instances. Recycling is an indirect solution not

specifically related to saving frogs but to saving natural resources. So are threats such as pollution, litter and habitat destruction vaguely indicated as threats to water habitats. Even though stated in the beginning of the discussion that threats and actions are situated within a vertical discourse, one can argue that educators are exposed to some of these threats in their everyday lives depending where the school is situated or where they live. Such threats would then be situated within their horizontal discourse where actions could include the removal of litter and securing of dust bins.

The ecological knowledge in designing a food chain with a given list of specific animals, by the two participating educators, despite one mistake, showed adequate prior knowledge within a vertical discourse concerning the principle of food chains. The educator, who made one mistake in the sequence of what eats what, may have been unfamiliar with some of the animals in the list given.

These responses indicate that educators are operating mainly in a vertical discourse with limited or superficial understanding, leading to incorrect application and a number of misconceptions. The number of misconceptions is of concern and indicative of the lack of scientific knowledge amongst the educators surveyed.

4.7.3 Attitudes towards frogs

The discussions in this section refer to Table 4.15 and Section 4.5.

The attitudes or feelings of humans towards animals, or in fact any feelings, fall within a horizontal discourse. In the opinion of the writer there appears to be no hierarchy or systematic learning that contributes towards attitudes, nor is it mediated by the Natural Science educator. It can be argued that the aim of teaching Natural Sciences is to instil an appreciation for wildlife, as is the aim of many wildlife institutions such as zoos, and were in fact mentioned by five educators when asked why they taught the subject of Natural Sciences. However, to progress from a low level of knowledge toward attitude or feelings to more advanced levels seems inappropriate in a vertical discourse. It is difficult to measure and is often more dependent on context, is spontaneous and can be developed within the public domain.

Educators were asked about their feelings towards frogs, their likes and dislikes about the sounds frogs make and any stories or myths that would bring to light their fears or dislike of frogs.

The majority of educators indicated that frogs were not animals they particularly liked or appreciated. Some educators said frogs were killed if found inside their homes and others described them as ugly, noisy, scary and smelly. These responses are within the horizontal discourse but indicative of generalizations towards all frogs. Not all frogs are scary as some of them are very small and some are beautifully coloured. Not all frogs are smelly and it seems doubtful that educators would get close enough to actually smell a frog. The physical appearance of frogs with their specialized adaptations to survive such as moist skin, contributes to their unpopularity, as in the zoo experience of the writer it deters many people from touching a frog. It is more appealing to stroke fur than a 'slimy' frog. The physical appearance of many frogs, used as a criterion to classify frogs – moist skin- can lead to a misconception that all frogs have a slimy skin. Some frogs have a dry 'rough' skin and are known as toads.

The feelings expressed by the majority of educators highlights ambiguities within their responses. During the interviews some of them said that all creatures should be protected. Noting responses in Table 4.11 of people missing them, people feeling negative if frogs became extinct as people love animals, points to more contrasts within their responses. One educator expressed her phobia of all small animals but indicated that she would keep frogs as pets to eat mosquitoes at her house. These ambiguities were noted in the educators' responses about how their learners would feel about frogs in Table 4.19. Extreme responses from one end of the spectrum to the other end were that all their learners loved frogs or all were scared of them. The mixed results appeared the most likely response as adults are likely to believe that some learners would like frogs and others would not. These responses makes the writer wonder if the educators actually do know what learners feel about animals, which is in contrast to some of their statements about wanting to teach Natural Sciences because learners must love animals. These contrasts or ambiguities are inconsistent responses that may be the results of a standard reply – 'we should protect and appreciate all animals' yet when educators are forced to think about the actual animal, which they possibly fear, it becomes incomprehensible. It may also indicate that some responses are simply inappropriate

(Table 4.11) because educators do not know enough about conservation and the effects of animals becoming extinct.

Attitudes and fears may result from alternative conceptions**.** Some people do fear that their skins may react when in contact with a frog. One educator said that 'you get sores when a frog urinates on you'. A skin reaction may develop if say, an exotic poison arrow frog comes into contact with human skin but the belief that one gets warts or sores may be more related to misconceptions about frogs which have contributed to the alternative conceptions. Frogs were regarded as messengers of bad omens and part of witchcraft. The resource pack should incorporate such alternative conceptions to shed more light on these beliefs and to highlight the importance that frogs have played in folklore and mythology, and to address some of these misconceptions in context.

Not all the responses were negative in nature. Close to 50% of educators indicated that they enjoyed the sounds that frogs make, notwithstanding that approximately 40% said they were unfamiliar with such sounds. The appreciation of frog sounds fall within the horizontal discourse but it should be noted that if educators had been able to identify frogs from their sounds, this would have been considered as knowledge within the vertical discourse.

It was notable that some educators claimed that they used stories when introducing a new topic but were mostly unable to think of any stories at the time of the survey.

4.7.4 The acquisition of prior knowledge of educators and assessment of prior knowledge in learners.

Discussions In this section refer to Tables 4.16 – 4.19.

To assess whether educators and their learners made use of other resources and would make use of the intended amphibian resource pack, the survey investigated resources used by both groups.

Educators claimed that their prior knowledge of animals was obtained mainly from within a vertical discourse – their tertiary education and books. They mentioned alternative resources such as television programmes and visits to zoos. Very few indicated that their prior knowledge about animals originated from within a horizontal discourse (growing up with animals). This cannot imply that educators have no actual contact with animals or no familiarity with animals. In the experience of the writer, being familiar with animals may indicate an interest in wildlife which often leads to educators wanting to know more about the Natural Sciences they are teaching and a need to share their passion with learners. The responses in this survey suggest that the majority of educators are not particularly familiar with animals in their everyday experiences.

The most popular educator research resources were libraries, television programmes and text books. Educators indicated television programmes, zoos and libraries as the resources most used by learners in Table 4.18. Notably absent is the suggestion of practical investigations. These are Natural Sciences educators and one out of eleven said she sometimes sent learners to the river close by and one other said they have live tadpoles in a tank in their class. There was no other indication of any attempts to involve learners in investigating animals or displaying animals at their schools. Visits to zoos would account for a practical experience but as in the majority of cases, schools can afford one visit per year, which can have mixed results if not planned properly to involve experts from the zoos.

In assessing the prior knowledge of their learners, educators indicated that they asked their learners questions or gave them a project to do at home. Educators were not sure how their learners felt about frogs and as discussed in Section 4.6.2, gave some blanket responses, or said they did not know how learners felt. Only two educators said there would be mixed responses, indicating to the writer that these two educators appeared to be more knowledgeable about their learners. The writer did not form the impression that the majority of educators actually assessed prior knowledge of their learners based on an inappropriate example supplied by an educator to illustrate this assessment, as well as the limited knowledge of Natural Sciences within a vertical discourse of the educators as highlighted during the survey in this study.

4.8 CONCLUSION

Some educators do have prior knowledge within the horizontal and within the vertical discourse. The knowledge within the horizontal discourse appears limited and educators do not appear to use this knowledge base as a potential connection for discussions such as whether frogs should become a sustainable food resource.

The knowledge in the vertical discourse is superficial and in applying this knowledge, for instance in identifying amphibians, misconceptions are formed.

Alternative conceptions are present and may influence attitudes towards frogs but it appears that educators do not discuss these frameworks as an interest point with their learners.

CHAPTER FIVE

LEARNERS' PRIOR KNOLWEDGE OF FROGS, CONSERVATION AND BIODIVERSITY

"Our task must be to free ourselves... by widening our circle of compassion to embrace all living creatures and the whole of nature and its beauty".

Albert Einstein

5.1 INTRODUCTION

This chapter discusses the responses of learners with regards to **Questionnaire 2 (Appendix D)** on amphibians. The intention of the questionnaire was to investigate learners' prior knowledge of amphibians, specifically frogs. Evidence of prior knowledge was investigated according to Bernstein's model of horizontal and vertical discourse as discussed in Chapter 2.

The responses from various questions were collated and represented in tables and short descriptions where appropriate to summarize what learners said about amphibians and frogs. It was not always possible or appropriate to indicate how many of the learners had the same viewpoint as questions were open-ended and invited more than one response. In some instances where a certain trend was observed it was deemed appropriate to indicate how many learners followed the same trend as it gave an indication of a correct concepts, misconceptions or alternate concepts shared by a group of learners.

The presentation of the results (section 5.2 to 5.5) is followed by the discussion (section 5.6) which focuses around two main points:

a. Prior knowledge in a horizontal discourse. Learners had their own everyday prior knowledge and experience of amphibians. Their attitudes and beliefs as well as myths were taken into consideration.
b. Prior knowledge in a vertical discourse. Knowledge such as classification of animals, principles of ecology and conservation is accepted as vertical discourse as taught by the

educators in Natural Sciences. The Revised National Curriculum Statement – Natural Sciences (RNCS) requires that learners understand, be able to interpret and apply scientific, technological and environmental knowledge such as classification, ecology and 'endangered'. This knowledge, as well as the application of using the knowledge, in for example, identifying amphibians, was investigated.

5.2 THE CONCEPTS OF AMPHIBIANS AND FROGS

Knowledge of the concepts of amphibians and frogs were investigated in Questionnaire 2 (Appendix D).The questionnaire dealt with different ideas which are: the definition of amphibians; selecting correct examples of amphibian species; the habitats of frogs, ecology, conservation and learners' attitudes towards frogs. The attitudes of learners were further investigated by questioning them on keeping frogs as pets, and if they would touch them. Feeding habits of frogs were not questioned directly but explored though the use of a food chain. The awareness of learners of myths and fears was investigated indirectly by asking them to share stories or poems of frogs. Each idea is addressed in a subsection.

5.2.1 The concept of an amphibian.

Learners were asked to explain what an amphibian is. The word amphibian was deliberately used instead of frog, to determine if the learners were familiar with the scientific terminology.

Table 5.1 The concept of amphibians according to Grade Seven Learners (n= 102).

Correct but incomplete answers (contains some criteria)	Frequency
No definitions but examples of animals both correct and incorrect	25
Animal that lives both on land and in water (1 learner said land and sea)	24
Incorrect answers such as meat-eaters, dangerous animals, warm-blooded, scaly animals	23
Cold-blooded animals (3 learners added invertebrate)	12
Mainly correct definitions with a combination of characteristics	7
No response	10

Learners were then asked to identify correct examples of amphibians from a list of animals given in the questionnaire. The list consisted of bullfrog, mongoose, chameleon, snake, Platanna, Rain spider.

Table 5.2 Examples of amphibians as selected by learners (n=102).

Responses were not limited in number

Examples of amphibians	Frequency
Correct examples chosen: Bullfrog and Platanna	95 indicated the bullfrog 31 indicated the Platanna
Incorrect examples chosen: rain spider, mongoose, chameleons and snakes	48 indicated a snake 43 the chameleon 39 the rain spider 14 the mongoose

5.2.2 Habitats of amphibians

These issues were investigated through two different questions and answered by the majority of learners.

a. Can you briefly describe in what kind of home or place frogs will be the happiest to live in
b. Where did you see a frog?

The intended difference between these two questions was – where did learners think frogs should live and where did they observe frogs in their everyday experiences. In some cases the answers are the same.

Table 5.3 Habitats of frogs as indicated by learners (n=102).

Habitats	Frequency
Water areas	51
Dams	18
Ponds	17
Swamps	16
Rivers	14
Land areas	12
Grass areas	7
Jungle/forest	3
Lakes	3
Mountain	1
No response	5

Table 5.4 The areas where learners saw frogs (n=102).

Areas	Frequency
Anywhere at their home areas inclusive of swimming pools	36
Dams/rivers/lakes	34
Zoos and similar institutions	25
Ponds	16
School	7
Holiday destination	6
Pile of bricks (not specified where)	2
Television	1
Cat's mouth	1
No responses	1

In response to when last they had seen frogs, no trend could be observed and answers varied from day to month to year and some answers were connected to events such as weddings. One of the learner's answers indicated seeing frogs after it rained.

5.3 CONSERVATION OF AMPHIBIANS AND THEIR ROLE IN ECOLOGY

5.3.1 The concept of 'endangered'

Learners were asked to explain what the word 'endangered' meant to them.

Table 5.5 Learners' understanding of the word 'endangered' (n=102).

Correct understanding	Frequency
Animals that can become extinct, few left, numbers declining, nearly all gone, not quite extinct but close to it	54

These learners gave correct examples of endangered animals as seen in Table 5.7

Table 5.6 Incorrect answers (n = 102).

Incorrect understanding	Frequency
Animals that are dangerous	17
Incorrect understandings such as, animals that are not dangerous, being female, a meat eater, different reasons about frogs, animals getting together, etc.	14
Animals that we kill ourselves for eating or as pest animals	11
No response	6

These learners gave examples of animals according to their understanding of the concept. An example: Meat eaters – examples of carnivores; not dangerous animals – examples of domestic stock.

Learners were asked to demonstrate their knowledge of 'endangered' and to list as many as possible animals they consider to be endangered.

Table 5.7 Endangered animals according to the learners (n = 102).

Correct examples	Frequency
Lions – white	34
Tigers	29
Polar bears	29
Domestic animals	25
Frogs	19
White rhino	18
Cheetah	14
Leopard	13
Black rhino	12
Elephant	12
Panda	12
Rat	11
Chimpanzee	8
Wild dog	7
Crocodile	7
Koala	6
Gorilla	5
Buffalo	2

5.3.2 Ecology: The role frogs play in a food chain

Learners were given a list of animals: frog; snake; mongoose and mosquito and asked to place them in the correct sequence of what eats what. They were further instructed that each animal could only be used once in the food chain.

Table 5.8 Frequency of correct and incorrect response in terms of the food chains according to the learners (n = 102).

Application	**Frequency**
Correct sequence	39
Incorrect sequence	29
No response	34

Learners had to complete a sentence: Frogs eat …. and …. eats frogs, to investigate their knowledge on prey and predators of frogs. Their responses were not limited.

Table 5.9 Learners identifying prey and predators of frogs (n = 102).

Correct prey	**Frequency**
Insects	74
Incorrectly identified prey/food	
Plants	6
Mud	1
Correct predators	**Frequency**
snakes	75
Mongoose	12
Incorrect predators	
Mosquitoes	4
Sharks, sea lions	2
No response	9

The connection between the loss of biodiversity and ecology was investigated. Learners had to explain what would happen if frogs became extinct. The question was asked within the context of the food chain.

Table 5.10 The effect if frogs became extinct according to learners (n =102).

Effects	Frequency
Inappropriate responses: mosquitoes would be happy, people would be happy, snakes would have to eat mosquitoes	33
More mosquitoes	24
Food chain out of balance	3
No effect	3
No responses	39

Learners then had to explain what the effects on humans would be if frogs became extinct.

Table 5.11 The effects on people if frogs became extinct according to learners (n = 102).

Effects	Frequency
More mosquitoes, more malaria, more deaths in human population	44
Inappropriate responses: people will cry, be happy, no toys to play with	16
No effect	10
It would be smelly	4
Need more insecticide	1
Less food for people	1
Food chain would be interrupted	1
No responses	25

Learners were asked to list actions that would save frogs from becoming endangered.

Table 5.12 Actions suggested in saving frogs (n = 102).

Actions	Frequency
Implement sanctuaries, frog farms, shelters, S.P.C.A and zoos	29
Inappropriate answers – keeping frogs as pets, catch flies for them to eat	11
Start breeding programmes	9
Remove threats – stop pollution, stop Chinese people eating frogs, stop lab experiments on frogs or use smaller numbers of frogs	4
I won't help them	3
Create an awareness of the plight of frogs	1
Make killing frogs illegal	1
Call the police	1
No response	43

Learners listed what they thought threats to the survival of frogs were. They could offer more than one response.

Table 5.13 Perceived threats to frogs according to learners (n=102).

Threats	Frequency
Pollution	39
Predators	21
Mechanical factors	1
No response	51

The potential ecological values of frogs as perceived by people were investigated. When asked what learners thought frogs could be used for by humans, they responded as follows:

Table 5.14 Uses of frogs (n = 102).

Uses	Frequency
Pets	24
Food for people	13
For experiments	7
To catch insects	6
Bait for fishing	4
Decoration, art, pictures	4
In zoos	4
Poison	3
Food for other animals	2
Skins for clothes	2
Entertainment - animal fights	1
No response	32

5.4 ATTITUDES TOWARDS FROGS

The attitudes of learners were investigated by using a variety of questions such as would they hold a frog, keep it as a pet and any known stories about frogs.

Table 5.15 Learners willing to hold / touch frogs (n = 102).

	Yes	No
Frequency	40	51
No response		11

Table 5.16 Keeping frogs as pets (n =102).

	Yes	No
Frequency	28	66
No response		8

All learners were asked to say what they would do with their frog as a pet, once they no longer wanted it. Some learners, who did not want frogs as pets, did not respond.

Table 5.17 Ways and means of disposing of unwanted frog pets (n=102).

Action	Frequency
Zoo	25
Pond- release	15
Give it to a friend	10
Euthanasia	2
No response	50

Learners were asked to write a summary of a short story, poem or song they knew about frogs. This was to determine if they were aware of any myths, folklore or stories they heard when they were younger.

Table 5.18 Stories listed or written by learners (n =102).

Stories	Frequency
Own creations	31
Television programmes: Kermit, Jeremy, Shrek, 50/50	15
Princess and the frog	7
Mentioning of warts	7
No response	42

5.5 THE USE OF RESOURCES FOR ADDITIONAL INFORMATION

Learners were asked to list the resources they would use if they had to find out more about frogs

Table 5.19 Resources suggested by learners (n = 102).

Resources	Frequency
Zoo	44
Internet	44
Library	22
Books and encyclopedias	8
Television programmes	4
Pet shop	2
Educator	2
Museum	1
Experts	1
Live frogs	1
Habitat of frogs	1
Animal hospital	1
No response	22

5.6 DISCUSSION OF RESULTS IN TERMS OF PRIOR KNOWLEDGE WITHIN THE HORIZONTAL AND VERTICAL DISCOURSE.

5.6.1 The Concept of amphibians, habitat and classification

The discussion refers to Tables 5.1 – 5.4.

Learning about classifications, amphibians, ecology and 'endangered' concepts in the core knowledge: 'Life and Living' within Natural Sciences, falls within the vertical discourse. As with educators as discussed in Chapter 4, certain overlaps between the vertical and horizontal discourse are expected, as certain concepts often appear in the media and becomes everyday language. Misconceptions are potentially formed because of the danger of concepts being used in a superficial application as explained in Chapter 4, Section 4.7. The data presented in the tables mentioned, shows evidence of such misconceptions.

The learners had to have scientific knowledge (prior knowledge within the vertical discourse) to distinguish amongst animals such as bullfrogs, platannas, snakes, chameleons, rain spiders and mongoose. The list of animals were given to them and to distinguish between these animals or to classify them in classes or groups, the learners had to make use of a set of characteristics or a definition as criteria. Such criteria are within the vertical discourse. In this instance, as with the educators, learners were guided by the questions posed by the writer and the criterion used was a definition or understanding of the concept of an amphibian. Some of the examples of amphibians selected by learners can be considered as knowledge obtained within the horizontal discourse and not necessarily within the vertical discourse such as bullfrogs, as these animals are often mentioned in mass media, as discussed in section 4.7.1.

The concept amphibian was explained by a number of descriptions supplied by the majority of learners. The criteria used, such as animals living both in water and on land and cold-blooded as seen in table 5.1 are situated within the vertical discourse. These descriptions are not complete, as discussed in Appendix J, as the definition of an amphibian consists of not just one but a number of criteria (Halliday & Adler, 1986). The language used for scientific concepts by learners such as cold-blooded instead of poikilothermic, appears to be more characteristic of the horizontal discourse. The language used in a vertical discourse as discussed in Chapter 2, consists of complex terms and is understood internationally such as scientific names of animals expressed in Latin. Terms such as cold-blooded originated in the vertical discourse but as discussed in Section 4.7.1, is often used in a different context in the horizontal discourse. These kinds of terms are expected to be used at the level of Grade 7 when bearing in mind that English is the second language for two thirds of learners surveyed.

Table 5.1 lists the responses of learners. Twenty five learners did not explain their understanding of what an amphibian is, but listed examples of animals such as frogs and toads, and some incorrect examples such as rain spiders. It appears that some of these learners knew that frogs and toads are amphibians but they are incapable of providing a definition of an amphibian. The learners providing incorrect animal examples can be considered as ignorant of the concept of an amphibian.

It needs to be stated that some learners providing correct although incomplete definitions or characteristics of amphibians, did mix their correct with some incorrect characteristics. With regards to the mixing of correct and incorrect characteristics, one mentioned sea instead of water, and three listed invertebrate with cold-blooded. The learner mentioning the sea may not be aware that the majority of amphibians are found in fresh water. The learners appeared to be confused with what a vertebrate or invertebrate was. It is likely that learners did not learn the difference between the two concepts correctly or they may have associated all creatures considered likable as a mammal, and those unlikable as an invertebrate.

Twenty three learners supplied incorrect descriptions such as a dangerous animal or a meat eater. This may have led them to identify incorrect examples of amphibians although the numbers of wrong choices as seen in Table 5.2 is not consistent with the application of incorrect understandings of the concept of an amphibian. These choices of amphibians appear to have been made without using the criteria in Table 5.1, as supplied by the learners themselves. Another consideration is that the animals were unknown to the learners. They may not have known what a rain spider, a mongoose or chameleon is, as listed in Questionnaire 2. If pictures were supplied, it may have yielded a different response from some of the learners.

Reptiles were confused with amphibians as was expected by the writer. Snakes were indicated as amphibians by 48 learners and chameleons by 43 learners. These misconceptions may be due to learners looking at physical similarities or by being taught incorrectly by educators (could be parents or other learners) as educators showed the same confusion about these two classes (see Tables 4.1; 4.2 and 4.3). Learners may have misunderstood or only partially understood the criteria for identifying amphibians. The criteria to classify an animal as an amphibian or as a reptile have some similarities but show a greater degree of dissimilarity such as respiration, metamorphosis, body covering and reproduction. Once learners understand these dissimilarities, they would find it much easier to distinguish between an amphibian and a reptile, but not necessarily from pictures, as these characteristics are abstract and not recognised as physical attributes.

Tables 5.3 and 5.4 reflect data within the horizontal discourse. The habitats of frogs are described in layman terms. The same misconception is apparent in the responses of learners that frogs are found near water as discussed in Section 4.7.1. The habitats suggested by learners show much more variety such as swamps, jungles, lakes, ponds, rivers and dams as well as mountains. What is of more interest is the number of learners who have observed frogs in their immediate environment such as at their homes, at schools and holiday destinations. This indicates that learners are aware of frogs in their environment and points to knowledge within the horizontal discourse which educators could assess during their lessons to make the connections for learners between what they see in their everyday life and what they are learning at school. Frogs could be collected, shown in class as part of their observations and then released when the lesson was completed. Another significant observation is the number of learners indicating that they had seen frogs at the Zoo as seen in Table 5.4. A visit to the Zoo or similar institution appears to have an impact on what some learners observe and remember.

5.6.2 Conservation, ecology and threats to frogs

The discussions refer to Tables 5.5 – 5.14.

The concept of 'endangered' falls with the vertical discourse. The majority of the responses (54 out of 102, see Table 5.5) were correct in describing 'endangered' as a concept where the number of animals were under threat and other statements such as 'a few left', 'animals getting less and less' and 'animals that are scarce' or 'animals that are close to extinction but not yet there'. The learners who gave an acceptable definition of 'endangered' listed animals that showed they understood the concept. They listed animals such as white lions, tigers, wild dogs, dolphins, whales, pandas, and many more. The learners were able to provide an extensive list of endangered or perceived to be endangered animals which is in sharp contrast to what educators could manage in Section 4.7.2.

An interesting comparison between incorrect definitions of 'endangered' and correct examples of their misconception of endangered animals was observed. Learners indicated that 'endangered' meant that these were animals killed by people because we needed them for food or they were harming people, and some examples given were domestic animals, cockroaches, mosquitoes,

snakes and rats. ‘Endangered’ was also explained as being a dangerous animal and examples were lions, leopards, tigers, elephants and buffalo. Where ‘endangered’ was considered to be an animal that was not inherently dangerous, examples were domestic animals such as cats and dogs. This illustrates the implications of not recognizing misconceptions within learners and how the misconceptions appear to grow in the minds of learners.

The types of misconceptions of the concept of ‘endangered’ are noteworthy. Learners are confused with the word danger but also seem to have completely different understandings such as animals that are not dangerous, animals that people kill for products, animals with poison – possibly connected to dangerous animals and animals that eat meat. The concept should certainly be included in the amphibian resource pack as will be discussed in Chapter 6, with appropriate examples so that learners may form a better understanding through the mediation of their educators.

Regarding food chains within the field of ecology, a concept within the vertical discourse, the results were mixed, as seen in Table 5.8. Animals were not always placed in the correct sequence. It may be that learners were unfamiliar with a mongoose. A large number of learners did not respond to the question. This could be that they had at the time of the survey, not been introduced to ecology lessons or that they could not remember what they had learned earlier.

Learners had more success with recognizing the correct prey and predators of frogs although it can be argued that they used the information supplied in the actual questionnaire. Some of the examples of prey/food used by learners (Table 5.9) such as plants could have been related to tadpoles and not frogs. It is unclear why they chose plants. Their choice of prey and predator may have been observed in their everyday experiences if one looks at the number of learners that have seen frogs. This knowledge could then be seen as prior knowledge within a horizontal discourse.

In the discussion about what the effect would be if frogs became extinct, it appeared that some learners (24 out of 102, Table 5.10) gave the correct answer that mosquitoes would increase in numbers and become hazardous to the health of humans. The majority of learners did not understand the effect or implication in ecology or the effect on mosquitoes if frogs became extinct.

The misconception may be that learners find it difficult to visualize the effect on mosquitoes because mosquitoes are eaten by frogs, so they should be 'happy' if frogs become extinct. Learners were surer about the effect that the extinction of frogs would have on humans (Table 5.11). They spoke about more mosquitoes, leading to more bites and to diseases. There is evidence of knowledge within both a horizontal as well as a vertical discourse. Being bitten by mosquitoes is a common occurrence in their everyday lives as is the use of insecticides. The disease aspect and mention of malaria is situated within the vertical discourse although the concepts may appear within the public domain. The understanding of what causes diseases, the connection between the mosquitoes and the disease, are within the vertical discourse.

The number of responses to threats of amphibians and the possible solutions were low (Table 5.13). The prior knowledge should be situated within a vertical discourse but learners seemed to be guessing about some threats as the connections between the concepts of what makes an amphibian an amphibian, the ecological threats and physical threats to frogs did not appear to be well understood. The number of 'no response' (51 out of 102) support this observation. The responses from the learners showed some scientific knowledge with regards to pollution and predators. This is expected, as the conservation of frog species and the threats to frogs are complex and needs expertise as well as an investigation of complex scientific information not always understood at this age group. The majority of learners spoke about pollution which is correct as it has a long term effect on water quality and frog populations. The mention of predators is expected but not always applicable in a discussion about conservation. When ecosystems are not in balance one of the aspects that influences populations may be the increased activity of predators on a certain prey species. Solutions (Table 5.12) that were suggested were not informed by the specialised information required. "Taking frog species to safety" be it at the S.P.C.A or zoos or safe environments could, in fact, be more hazardous than saving the species and the knowledge of what kind of substrate, water quality, food requirements and the danger of frogs contracting diseases were not known. This is an aspect that should be included in the amphibian resource pack to ensure a more comprehensive understanding of the complexities surrounding the conservation of animals. Learners may have a 'misconception' related more to humans being in danger. Humans do get removed from dangerous situations, rescued by rescue workers,

helicopters, ambulance, etc. and this information is a common feature on television programmes, printed media as well as in our everyday life situations.

Learners' responses showed that they were aware that other animals ate animals and predators would be a threat to the existence of animals. Prior knowledge in a horizontal discourse was evident from the learners who referred to boats and the damage that the propellers of boats caused to wildlife as well as using frogs as bait.

Groups of people, in this case the Chinese people, were identified as eating frogs. This may have been seen on television programmes or in printed media. None of the classes observed had oriental learners at the school, which could have accounted for these statements made by learners. The French are more known in western societies as eating frogs and they were not mentioned at all. Some African communities do eat frogs but this was not mentioned as a threat as the Chinese were. Prior knowledge with regards to people eating frogs appeared to have no connection with the cultural habits of these specific learners.

Some interesting responses were received from learners as to what they thought frogs were used for by people, in other words, the material value of frogs. Some results were informed by scientific information such as using frogs for experiments as well as 'catching insects'. The knowledge of 'catching insects' could have been acquired at school as part of ecology lessons or the concept of amphibians but also in their everyday experiences. In the experience of the writer, justifications surrounding the existence of animals feared and killed by people often hinge on 'what can the animal do for us' for example snakes kill rats and frogs catch insects. Responses within a horizontal discourse include using frogs for bait, food for other animals, food for people and pets. The number of responses of pets can be argued as informed by the questionnaire as it was a specific question asked. Some misconceptions were evident such as the use of frog skins – a clear indication that learners did not think about the actual frog skin and assumed it could be used like the skins of other animals. The mention of art, decoration and animal fights are indicative of generalizations of uses of other animals such as dog or cock fights, the use of ostrich feathers, cattle skins, etc. The thought of decorations may also refer to artifacts in the shape of frogs.

5.6.3 Attitudes towards frogs

The discussions refer to Tables 5.15 - 5.18.

As stated in Section 4.7.3 it is the opinion of the writer that attitudes or feelings fall within a horizontal discourse. Learners were asked about their feelings towards frogs through a variety of questions. Learners were asked if they would hold a frog. The question seemed appropriate as learners are often more willing to engage physically with their environment than adults (Huyn, 2005). The responses (Table 5. 15) showed that the majority would not hold a frog and reasons stated varied from being afraid, to it may be poisonous, make bad sounds to being slimy, disgusting and can give you warts (See appendix N). Some learners increased the font of their responses to more than twice the size of their general handwriting and added exclamation marks to emphasize their viewpoint. Seven learners said that they did not want to get warts. There was an indication from some of them that they were told they would get warts from frogs by 'a lady or a woman'. Warts are a misconception as a few frogs do cause skin reaction but people believe all frogs will give you warts. This misconception has formed part of an alternative framework as to why frogs should be feared. Frogs are often associated with witches, and witches are very often portrayed as creatures covered in warts.

The number of learners who said they would like to hold a frog was only slightly lower than the 'no' responses. These learners said they would like to feel what it feels like. Some said they were not scared of frogs as they are harmless. This indicates a positive attitude towards frogs and a curiosity to explore the Natural Sciences. Learners' answers were qualified with positive statements such as: "frogs are cool", "I love frogs", "I love their slimy skin", and "they are friendly except the bullfrog" and "I have my own pet frogs".

In the responses regarding touching frogs, learners displayed prior knowledge of what a frog would feel like by providing a description of what they expected or knew a frog to feel like. The fact that they mentioned warts indicated that they had previously learned by word of mouth, or in stories about this myth. It is often associated with a frog urinating on the skin of a person or the slimy substance affecting the skin.

The ‘keeping of pets’ shows a positive and caring feeling about animals as pets involve feeding, cleaning and veterinary care. It indicates a close involvement with other creatures, assuming that the learners look after their own pets. How would they dispose of frogs should they no longer care for them was asked to determine if they would form emotional bonds or simply get rid of the frogs. The survey did not show any particular findings in this regard. Learners did indicate to some extent that they would give their frogs to the Zoo or a friend or find an alternative home for them. Other indications were that they would release them back into the ponds where they had collected them from or give it back to the pet shop. It appears that amongst the learners there are mixed attitudes towards frogs.

The responses to stories were interesting in that they showed the creative aspect of learners (See appendix M). They wrote their own stories, poems and songs about frogs and decorated their creations with colour drawings, lines and frames. It indicated an experience of stories and creativity in both a horizontal and vertical discourse as writing of poems, stories and art could be enjoyed at home or they could participate in such subjects, art and language studies, at school.

Some learners did remember children stories such as the *Princess and the frog*. They also remembered films, television programmes and puppet characters. There were seven references to ’Kermit’, a puppet popular on American television programmes. These responses refer to experiences within their everyday situations. This could possibly be a good introduction point in class to get learners to focus on frogs, what they look like and where learners have ‘met’ the concept of a frog before.

5. 6.4 Resources used by learners.

The discussion refers to Table 5.19.

The responses from learners were quite different from that of educators indicated in Table 4.18. Learners certainly make more use of the internet than their educators (Table 4.17) and more use than their educators think they do (Table 4.18). It could also indicate more accessibility at their homes and learners are in general more competent and familiar with electronic equipment. Learners did indicate zoos as a resource. It could be a result of the writer being from the Zoo

although there are a number of calls received at the Zoo throughout the year enquiring about information required for projects. The bulk of these calls are from parents.

The library was indicated by 22 out of 102 learners as a resource used by them. Television programmes appeared not to be considered as a resource for more information by many learners. Some unusual resources were mentioned such as the pet shop (not unusual for the learner who has his own frogs but an unusual resource for educators and other learners), live frogs, animal hospital, experts and the museum.

5.7 CONCLUSION

A portion of learners do have prior knowledge of amphibians within the horizontal and within the vertical discourse. The knowledge within both discourses appears to be more comprehensive than that of their educators considering the number of animals listed as endangered, the habitats described, where they had seen frogs, resources they consult for more information and their creativity.

Learners did display serious misconceptions in need of addressing such as their understanding of 'endangered' the understanding of the criteria used for classification and ecology.

Alternative conceptions were not evident. Learners do talk about warts but this is considered as a misconception. Learners also talk about eating of frogs but it appears to be an accepted practice within their experience.

Amphibians are animals found in close proximity to schools either in the gardens or displayed at animal institutions. It is an animal class easily accessible to be used for teaching principles of classification, ecology and conservation. It is recommended that educators take note of resources such as animals found in their own gardens to teach Natural Sciences concepts.

CHAPTER SIX

TOWARDS A RESOURCE PACK

"The uncreative mind can spot wrong answers, but it takes a creative mind to spot a wrong question".

Anthony Jay

6.1 INTRODUCTION

Chapters 4 and 5 presented data from educators and learners regarding their prior knowledge of amphibians within both a vertical and horizontal discourse. Chapter 6 aims to examine the potential content of the amphibian resource pack in terms of the concepts identified in the data. The primary aim of the resource pack is to provide a base of information and in doing so, to strengthen and build on the concepts, correct the misconceptions and recognise some alternative conceptions. A secondary aim is to encourage educators to see themselves as scientists and to treat their learners as learner scientists. Natural Sciences - Life and Learning curriculum should inspire educators and learners to investigate, be curious, interpret and apply their acquired knowledge. It is not intended to be a learning area with only textbook knowledge. Underlying these aims is the potential to design the pack in such a way that it can be adaptable in other countries in Africa within their educational context.

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The pack will focus on a holistic approach to teaching about amphibians. As explained in Chapter 1, they are threatened worldwide, but found in the immediate environment of most learners and educators, making them a perfect choice for teaching concepts of classification, ecology and conservation. Since the data collected indicates that there are gaps in the knowledge requirements within the vertical discourse as discussed in Chapter 2 (Section 2.5), it seems logical to conclude that educators do not necessarily see the connections between these concepts and teaching about them.

Further the educators do not perceive that the natural world functions holistically and is interrelated and thus they separate the topics of ecology, classification and conservation as if these concepts are unrelated. This serves the purpose of making the study of the natural world easier and more understandable but educators need to understand the reasons for structuring the topics as separate units with an underlying understanding that all is in fact related. It is as if an animal is sliced up into bits of classification, bits of conservation and bits of ecology and in the end never reassembled as one animal. It would be quite difficult for a learner to achieve a complete picture of the amphibian in the natural world without the intervention of a knowledgeable educator. The knowledge within the horizontal discourse of educators and learners needs to be recognised as a connection and springboard for further learning as, according to Cummins (2007) "… activating prior knowledge is like preparing the soil before sowing the seeds of knowledge". The everyday knowledge can be a useful indicator of the understanding of concepts, misconceptions and alternative concepts.

A survey of mass media resources in Chapter 3, (see Appendix B) was undertaken to determine whether a resource pack would necessarily add to the amphibian knowledge base and serve as an additional teaching resource to material already in existence. It was found that while these mass media resources did supply copious amounts of information about all aspects of amphibians they did not specifically address the issues of how to cope with the problematic concepts with which educators and learners are struggling, as apparent in the data presented in Chapters 4 and 5. The development of the resource pack is essential to assist educators and learners in understanding of concepts and in the application of their acquired knowledge.

6.2 CONCEPTS IDENTIFIED FOR INCLUSION IN THE RESOURCE PACK

The data collected and analysed highlighted certain problematic concepts for both educators and learners. Three main themes were identified: classification, ecology and conservation. Embedded in these three themes were myths and alternative concepts (Section 6.2.4).

Each concept will be dealt with, highlighting comparisons between educators and learners with regards to the problems experienced by each group. Ways in which concepts might be addressed

in the resource pack are discussed. All the identified concepts are problematic as they are not fully understood and are used in a superficial or in an incorrect manner.

6.2.1 Classification of amphibians in the broader aspects of animals

The concept of classification includes the criteria used to differentiate the five vertebrate classes with emphasis on amphibians, the concept of an amphibian and the correct identification of examples of amphibian species when applying the criteria. These concepts are seen as prior knowledge within a vertical discourse as discussed in Chapter 2 (Section 2.3).

The survey did not specifically enquire about classification as a concept. The differentiation between the levels of classification such as the differences between classes and species is required to answer questions about the concept of an amphibian as a class, and the concepts of conservation status, as status addresses species and not general groupings as explained in Section 4.7.2. Educators and learners did not appear to have much knowledge about the differentiation as seen in the examples they provided to answers in the questionnaires and interviews in Chapters 4 and 5.

6.2.1.1 Criteria for classification

The data, in Chapters 4 and 5 (Sections 4.2.2 and 5.2.1) showed evidence that this was a challenging concept as it deals with abstract entities not easily observed by educators or learners, for example the thermoregulation of frogs. The educators did respond with more knowledge within the vertical discourse about criteria used for classification than learners although it should be noted that educators were asked in a more direct way to supply these criteria: both educators and learners were asked to explain what an amphibian is whereas educators were asked to differentiate between frogs and mammals in an additional question. The educators were able to explain differences between frogs and mammals but they were unable to use these characteristics in selecting correct examples of amphibians as seen in Tables 4.1; 4.2 and 4.3 in Section 4.2. Educators also gave incorrect criteria for classification such as colouration, horns, etc. as seen in

Table 4.5. Learners did supply some correct criteria for classification but showed confusion between criteria applicable to amphibians and other classes as seen in Table 5.1.

Criteria such as respiration, reproduction, metamorphosis, body coverings and temperature regulation, typically within a vertical discourse, were supplied by educators and learners. The understanding of each concept was lacking which was only determined by looking at the examples of amphibians chosen. To regard animals such as rain spiders, mongoose, snakes, chameleons, hippos, crabs and crocodiles as examples of amphibians as shown in Tables 4.1; 4.2; 4.3 and 5.2, clearly indicates a limited understanding of these concepts. It is possibly an indication that classification criteria are simply 'book knowledge' and that the animals mentioned are not actually known to the respondents.

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Learners displayed limited knowledge in a vertical discourse (Section 2.3) about what makes an amphibian an amphibian. Approximately 36%, (n=36) gave a partial explanation of the concept. Their answers were mainly that amphibians are cold-blooded animals, living in water and on land. Only three learners, (fewer than 10% of the 36%) had a combination of partially correct definitions using the correct examples of amphibians. The rest of the 36% learners had a mixture of correct and incorrect examples with chameleons and snakes mentioned as the highest number of incorrect examples. The conclusion drawn is that the majority of learners, 64% (n=64), did not understand or recognise the concept or examples of amphibians, except for the bullfrog which was mentioned by 95% (n=95) of learners. The question is that if a learner can identify the correct example without the correct definition, does this knowledge fall within the horizontal discourse as discussed in Chapter 2, is it guesswork or are learners unable to define an amphibian but know the examples? There is no clear answer from this data.

Educators used a superficial definition of amphibians despite mentioning criteria for classification such as laying of eggs, external fertilization, stages of growth, cold-blooded, no fur, no mammary glands and lack of parental care. These criteria did not enable the educators to choose correct examples of amphibians as they still mentioned animals such as hippos, crocodiles, snakes and crabs. It indicates limited understanding of the criteria and it indicates that educators are not making the connections between the criteria and examples (lack of knowledge within a vertical

discourse, Section 2.3). Educators are not applying their book knowledge to enable them to classify animals. It is however possible that those educators with limited animal knowledge would be confused with the physical appearances of animals. It is possible too, that a hippo skin appears to be the same as a frog skin and both are found in and out of water. If the classification criteria were applied one would know that hippos do not lay eggs, have external fertilization, no gills nor a metamorphosis. The lack in animal knowledge points to limited everyday experiences (see horizontal discourse, Section 2.3) as well as an inability to apply scientific knowledge.

In this instance both groups seemed to be unaware of the purpose of classification (to differentiate between animals groups) and the criteria used, as they are unable to apply it in identifying animals.

With regards to classification terminology such as the concept of 'species' it became apparent in the responses from both the educators and learners, (see Table 4.8, Section 4.3.1and Table 5.7,Section 5.3.1) that there was some confusion as to what the term species meant as the replies consisted of general groupings such as fish, snakes, birds, frogs and lizards. Learners did mention a larger variety of animals although it is unclear if learners recognized these animals as individual species.

6.2.1.2 Amphibian as a concept

What makes an amphibian an amphibian? Educators (n=2) responded in Section 4.2.2 with correct but incomplete definitions and so did learners (55 out of 102, approximately 55%) as indicated in Table 5.1.

This is not a simple question as the definition depends on a number of criteria as seen in Appendix J (Mattison,1998). All amphibians are not alike and there are always exceptions to all the rules. The most generally accepted rules are that the amphibian class consists of animals that live both on land and in water, with a moist skin allowing respiration through the skin, fertilization is external, eggs are deposited in a moist environment, from where larvae hatches and passes through

different developmental stages, finally emerging as frog. A completely new set of criteria applies to larvae. The skin has no scales or any other features such as fur or feathers. There are no mammary glands present and if parental care is given it is mainly in the form of protection and not feeding of young.

None of the educators or learners were able to offer a comprehensive definition of an amphibian.

6.2.1.3 Correct examples of amphibians

In this study, five out of nine educators and 64 learners from 102 (approximately 64%) chose reptiles as an example of amphibians. The reptiles confused as examples of amphibians were snakes, chameleons, turtle and crocodiles.

The reasons why reptiles are confused as amphibians in Section 5.6.1 may be due to the physical appearance of the animals as well as the general attitudes of people to both classes. Similarities, although in some instances superficial, are that both classes are cold-blooded, lay eggs and in most cases parental care is absent or minimal; with no mammary glands present and no fur or feathers as a body-covering. Some may perceive them to look alike in that they appear to have 'cold' eyes without expressions (in the writer's experience in the Zoo) and similar 'skin' colours as many reptiles and amphibians feature grey, browns, dull greens and dark shades. Should educators and learners study these animals more closely, they would be surprised by the array of colours displayed by the different species.

In the experience of the writer within the Zoo context, people tend to fear or dislike animals that are not as expressive as mammals and birds. People also relate better to animals such as mammals as we are one of the mammal species and are guilty of anthropomorphism. Reptiles, amphibians and fish are also regarded by many people as incapable of pain. The reasoning seems to be because they are cold-blooded. In fact cold-blooded has to do with temperature regulation and has no connection to nerve system or pain centres located in the brain. It is a perception based on human attitude and a misconception (see Section 2.5) found in both educator and learner groups.

The survey was unable to determine whether this confusion was learned within a horizontal or vertical discourse. It is possible that it was learned in both considering the number of educators who shared this misconception with the learners. It should also be noted that the educators in this survey appeared to have limited knowledge about animals in general, and in the lack of variety mentioned by them when asked for more examples of reptiles and for examples of endangered animals. It appears, p*rima facia,* that learners are aware of a larger number of species, possibly gained through the use of internet, visits to the Zoo and books, and as such learned within their everyday experiences. In the experience of the writer learning about the different animals, and the richness of biodiversity within South Africa, is normally learned within the realm of experiences in everyday life and at home, especially if parents/guardians show a keen interest. The acquisition of this knowledge is very limited at school.

Regardless of where it was learned, these misconceptions can be detected by educators when assessing learners' prior knowledge (Section 2.4) and should be addressed within a vertical discourse. The resource pack would be able to assist educators in their preparations and assessment to address such misconceptions within their own knowledge base as well as those of learners.

6.2.1.4 Problem identification and dealing with it in the resource pack

The main problem identified with these concepts is that neither group, educators nor learners, have adequate knowledge of classification. As stated in Chapter 2 (see Section 2.3), prior knowledge in both the horizontal and vertical discourse can be acquired in many different ways. In this survey it is evident that limited knowledge has been acquired in both levels of discourses, but especially within the vertical discourse leading to misconceptions that have not been identified by the educators. From the writer's interaction with them, educators appear to be unaware of their own misconceptions.

Educators (four out of nine) stated in Section 4.5 that they relied on the information obtained during their tertiary qualifications, school textbooks and books in the library. The low responses indicate that educators do not spend enough time and effort in acquiring information and it is possible that

learners are not encouraged either to read, or learn more. Learners stated in Table 5.19 that their main resources are the zoo, internet and library. The writer suspects that these resources are employed for home projects but that the projects are not formulated in such a way as to encourage more understanding or the acquisition of extra facts.

A second problem is that educators do not assess prior knowledge of learners (see Section 2.4 and 4.6.2) and neither do they investigate their own prior knowledge. By not being aware of their own misconceptions and in failing to assess prior knowledge in learners, misconceptions are often undetected, not dealt with and passed on to the learners.

The points outlined suggest that the resource pack deal with the limited knowledge base by supplying factual information about amphibians in a way that will provide a thorough understanding of the concept of classification, class and species and how to use the concepts correctly. Appropriate examples will be included and areas of difficulty will be highlighted, with opportunities for participants to practice their new knowledge. Activities included will encourage both educators and learner groups to source additional information and not just what is required by school syllabuses. The approach will be holistic, as stated in the introduction. The perception that the classes Pisces, Amphibia and Reptilia do not feel pain will be addressed through explanations of nervous systems with examples of reactions shown by these animals to discomfort.

Educators will be assisted with assessment activities for themselves and for learners. It may possibly be in the format of a self-assessment questionnaire for educators and a story activity or card game for learners.

6.2.2 Ecology

The concept of ecology includes an understanding of food chains, the relationship between predator and prey, habitats and seasonal occurrences of amphibians as well as the value of frogs as perceived by people (as discussed in Appendixes J& L).

6.2.2.1 Food chains

Learners did not respond well to this question. Out of 102 learners, 68 responded, (67%) with 39 (57%) of the 68 in the correct sequence as seen in Table 5.8. Only two educators were queried on the food chain: one responded correctly and the other incorrectly as seen in Section 4.3.2. The knowledge base within the vertical discourse was poor in quality. The responses did not indicate what ate what very well: while the sequences of animals were correct from 39 learners, the arrows used were confusing. The arrows could either show what ate what (in this case with only nine correct responses – approximately 4%) or they could indicate what came next in the flow of energy and not what ate what. It was the impression of the researcher that the majority of learners who got the sequence correct did not understand what the placements of arrow directions meant.

It appears that scientific knowledge is limited in this regard. Food chains would generally appear to be just book knowledge and not addressed with any logic. To ask 'what eats what' would possibly simplify food chains for learners and for educators. It is also possible that neither learners nor educators knew all of the animals suggested in the food chain in Questionnaire 2 (See appendix D).

6.2.2.2 The concept of predator and prey

Learners (74%, n= 102) responded well (Section 5.3.2 and Table 5.9) in identifying both the prey and the predators of frogs although it may have been as a result of information supplied in Questionnaire 2 (see Appendix D). However, in later discussions involving threats to frogs, 21 learners out of 102 (21%) responded that predators were responsible for the endangered conservation status of frogs (Table 5.13). Educators showed some confusion in the use of these two concepts in Table 4.11 indicating that if frogs became extinct, prey would not have food. This may be due to language difficulties, failure to differentiate between predator and prey or simply indicate limited scientific knowledge.

According to Storer, Usinger, Stebbins and Nybakken (1971) there is an interaction between predator and prey species. If prey species increase in number, a larger predator group can be

supported. If predators increase in number, prey would decline more quickly, this would then have an effect on the number of predators that can be supported. In this case the frog could be seen as a predator so prey would increase if frogs became extinct as the predator was removed. On the other hand if the frog played the role of prey, the predator would have to find an alternative food source or become extinct as well. It is not clear how educators concluded that prey would have no food if frogs became extinct. As indicated previously, it may be due to confusion between what a prey and what a predator is, or a lack of understanding the interaction between the two groups.

6.2.2.3 Habitats and seasonal occurrences of frogs

Both educator and learner groups mentioned a variety of habitats within the horizontal discourse (see Tables 4.6; 5.3 and 5.4). Frogs were associated with water bodies, mountains, grassy areas, garden areas and swimming pools. The choices made by both educators and learners were expected by the researcher as most people would tend to indicate a water body when describing the habitat of frogs as it relates back to their definition as seen in Section 4.2.2 and Table 5.1. Although the habitats are correct, they show little evidence of knowledge within a vertical discourse (consult Figure 2.1). Frogs live in such a diversity of habitats and are not limited to water bodies (described in books surveyed in Appendix B and amphibians described in Appendix J, see Chapters 2, 4 and 5). The implications of this lack of knowledge in a vertical discourse suggest that there is limited understanding of the ecological niches filled by frogs, the impact of their possible extinction in the variety of habitats, and the richness of the biodiversity within South Africa. Currently in this group of educators and learners surveyed, frogs are associated mostly with water and even with swimming pools. If there is no water, then logically there should be no frogs, regardless of the fact that frogs are found quite some distance from water bodies (see Appendix L).

Bullfrogs as an example hibernate underground and one of the main reasons why they become threatened is that in areas such as Midrand, Gauteng, building and development takes place in areas where there is no water, and a lack of knowledge of the habitat and behavioural needs of these frogs. This lack of knowledge and even misconception (Section 2.5) could be addressed by educators and learners by investigating frogs more closely, and suggestions will be included in the resource pack.

One educator mentioned a swimming pool as a habitat. Frogs fall into pools by accident or may choose to go into pools as it may be the only source of water in some gardens. If they are not assisted in getting out of pools they may die as most swimming pools are either chlorinated or saline, both harmful to the existence of frogs due to the permeability of their skins. If educators believe that frogs are naturally found in pools, they will see no reason to take them out of pools and this misconception could be detrimental to large numbers of garden frogs such as the guttural toad. A possible solution would be to prevent frogs from entering a swimming pool by having barriers around the pools and by providing alternate ponds for them to inhabit. The misconception again points to a limited understanding of the skin of a frog.

Seasonal occurrences of frogs were referred to by four educators (n= 11) and one learner in Section 4.2.3 and 5.2.2. This indicated that these educators were more aware than learners of the occurrence of frogs after it rained, referring to everyday knowledge. The sample in this research is however, too small to make a general assumption that it would be true of most educators and learners. It is possibly an indication of the lost or non-existing connection between urban people and the seasonal changes of our natural world, since so few are aware of the changes in behaviour of animals around them. In observing the lifestyles of urban people by the writer, preferred accommodation seems to be more towards a 'lock-up-and-go' style, where the inhabitants spend none or very little time in small gardens. It seems a logical assumption that most urban people are oblivious to seasonal changes with regards to animals but are more aware of it regarding personal lifestyle choices – to go swimming, wear winter clothes or the inconvenience of rain, cold or hot temperature changes.

Educators can integrate information from different subject fields to teach learners about weather and seasonal animal movements around urban areas as this has the potential to make school subjects and learning relevant to learners. Johannesburg is said to be the largest man-made forest in the world with a variety of bird, insect and frog species within our immediate environment. To focus learners on such seasonal changes could have the potential of using one's environment as one's own laboratory and learning would be more experiential (see Section 2.2.3). Bearing in mind that the aim of teaching natural sciences as was stated by educators in Chapter 4 (Section 4.7.3) is to teach learners to appreciate animals and nature, this could be an opportunity to fulfill it. The

requirements for such an approach would be for educators to acknowledge the everyday experiences of learners and to incorporate school learning and projects within the everyday experiences: in fact make scientists of learners from an early age. This would also require educators to consider themselves as scientists, fulfilling the broader aims of Natural Sciences: investigating the living world we share and not just learning from a book.

6.2.2.4 Ecological values of frogs as perceived by people

As discussed in Section 5.3.2 and indicated in Table 5.14, the question of the possible value of frogs to people elicited interesting responses especially from the learners, of whom 69% (n=102) responded. Two educators (N=11) referred to the value of frogs in their discussions of threats to frogs (Table 4.15). The values of frogs are seen mainly as commercial, medicinal and ecological. The question was asked to determine if learners and educators knew of any economic benefit and traditional uses of frogs. Pets (24 out of 69 responses) and food (15 out o 69) were the most common responses.

The concern was that learners mentioned generalised uses of other animals. The purported use of frog skins point to both a lack of scientific knowledge and the inability to use scientific knowledge within their everyday experiences. Skins of animals are used for clothes, furniture or floor coverings but not the skin of frogs. Other animals are used for animal fights and decorations but again this is not applicable to frogs. There is nothing attractive about dried frogs and they cannot be treated by taxidermists. It may be lack of knowledge or guesswork that prompted these responses. Some of the suggested uses such as bait for fishing, poison stemming from poison arrow frogs, and food for other animals such as snakes in captivity are either from personal experiences or from information from books, internet or television programmes. Learners (7 out of 102) mentioned using frogs in experiments and it is true that many frogs are bred at universities for dissections and other experiments. The Platanna breeds well in captivity and has been used for many years as an experimental animal (Zippel, 2006).

6.2.2.5 Problem identification and dealing with it in the resource pack

The main problem identified is lack of knowledge. The majority of learners do not know how to construct a food chain and the using of arrows to indicate 'what eats what'. Some animal species common to Greater Johannesburg, such as the mongoose, appears to be unknown to them. Terminology can be confusing, indicating either a lack of knowledge or a language difficulty.

The resource pack will supply factual knowledge with regards to food chains with photos of animals and primary food sources. Special attention will be paid to highlight the ecological value of frogs, both to the ecosystem and to humans as environmental indicators, and to terminology to ensure understanding. The intention is to clarify the terminology and use of concepts such as predators and prey. In the experience of the writer within zoos, lions and tigers and other big cats are more easily associated with predators than, for example, frogs. Animals such as frogs are seldom perceived as carnivores or predators.

Commercial uses will be expanded on within the pack with examples such as breeding of frogs for food and medicinal purposes. Information about ethical aspects of farming and animal welfare will be supplied. Again the scientific knowledge of amphibians should be emphasized to ensure both educators and learners would know why the skins of frogs cannot be used.

Educators will be encouraged by interactive activities to assess the prior knowledge of learners by *inter alia* enquiring about the recreational activities of learners and where they may have encountered frogs as discussed in Section 2.4. Sharing of holiday stories may lead to discussions about boating, fishing and frogs.

6.2.3 The concept of endangered species and threats

The concept of endangered species include the concept of 'endangered', appropriate examples of endangered species; threats, possible solutions and the effects of extinction. The definitions oft these concepts are explained in Appendix K.

6.2.3.1 The notion of 'endangered'

In this survey five educators (n =5) supplied a definition of endangered of which only two could be considered as correct, (as seen in Section 4.3, Table 4.7) one incorrect and two as partially correct. Of the 102 learners, 54 supplied an acceptable definition, 46 supplied incorrect definitions and there were two no responses as seen in Section 5.3.1, Tables 5.5 and 5.6. Both groups were asked to list animals they perceived as 'endangered' as reported on in Table 4.8 and 5.7 respectively. In the case of the learners, 54% used the correct definition with appropriate examples of endangered animals. An interesting observation was made where learners combined an incorrect definition but with appropriate or correct examples to illustrate their answers, for example: 'endangered' means animals that we kill like rats, mosquitoes, etc. as seen in the discussion in Section 5.3.1. Educators on the other hand provided vague examples of endangered animals of which most were incorrect. Only one example of an endangered animal as seen in Tables 4.8 and 4.9 was correct.

'Endangered' is a concept with its origin in the vertical discourse but has been used to such an extent in the horizontal discourse that the true intention of the concept has become superficial and confusing to many of those using it. The original meaning has to be re-established within the educators' scientific language (see Section 2.3) so that they may explain it to their learners with correct examples of animals threatened. This concept raised many misconceptions as discussed in Section 2.5, originating from language issues, personal circumstances and incorrect facts.

The language confusion stems from the root 'danger' and both learners and educators confused the concept of 'endangered' with 'danger' or 'dangerous'. Learners' responses included examples of dangerous animals such as lions, elephants, tigers, crocodiles and more when asked to list animals they perceived to be endangered. Educators used examples such as fish, birds and frogs A clear understanding of the concept of 'endangered' needs to be explained as well as the application of the term to individual species of animals and not animal groupings such as fish or birds.

'Endangered' should also be explained in terms of how it differs from personally being put in danger. Some learners described it as being in a dangerous position. This may relate to a personal situation as one solution offered was to 'call the police'.

Wrong understandings included 'animals that are being killed by humans' with examples of domestic stock, cockroaches, rats, mosquitoes and ants. This understanding relates more to pest animals with a nuisance and health factor. These learners appeared to have formed the incorrect impression (misconception, Section 2.5) as some endangered animals have been hunted close to extinction and the threatened status is often blamed on people because 'we' do not look after our environment, waste resources and kill without considering sustainability.

Another meaning suggested by learners was that 'endangered' meant not dangerous animals and their examples included domestic stock, cats and dogs. This misconception has been difficult to explain and it may be attributed to language or lack of scientific knowledge.

6.2.3.2 Threats to amphibians

Educators (n=11) responded in Table 4.14 to what they perceived as threats to frogs with four responses being acceptable. Learners (50 out of 102) responded and indicated one or more threats, as seen in Table 5.13. Three main threats were identified of which pollution was elected by 39 of the respondents. Predators were indicated by 21 respondents and mechanical factors by one.

Frogs are considered as environmental indicators informing scientists of threatened ecosystems (Zippel, 2006). They are, as explained in Chapter 1, compared to the use of canaries in coal mines to detect dangerous gasses in order to protect humans. Frogs play a similar role in the ecosystems they inhabit.

Pollution as a threat was mentioned by 39% of learners and one educator. The types of pollution mentioned focused on water and litter pollution. Changes that occur in the quality of water due to chemical and human waste products are well known to scientists. The effect of polluted water on

frogs due to the permeability of their skins and the consequences such as observed genetic effects, deformed mouth parts, inability of frogs to breed, as well as some of the food sources of frogs disappearing are mentioned in papers written by scientists (Amphibian Conservation Summit, 2006, Zippel, 2006). Since learners mentioned pollution, it provides an opportunity to build on their prior knowledge in a vertical discourse and to link it with actual examples of biodiversity loss.

The increase in insecticide use was mentioned by one learner and one educator. This illustrates the links existing between everyday experiences and the scientific knowledge learned within a school environment. It presents an opportunity to explore everyday experiences of learners, the scientific field of insecticide manufacture and the effect it has on the environment. Opportunities also exist to discuss 'greener' option to control pests and the use of environmentally responsible products instead of using what are the most commonly available products in shops.

The main threats to amphibians are habitat loss or destruction, pollution in its broader sense affecting water and air quality as well as litter, diseases transmitted by touch or air-born agents, climatic changes and changes in ecosystems, including food webs and the interdependence of species (Chapter 1, Section 1.4).

There are other threats to consider such as the over-harvesting of large frogs such as the Goliath frog as a food source (Zippel, 2006), the belief by the general public that there are many frogs available, (Section 4.3, Table 4.10) and that the critically endangered status is an over-reaction especially within government policymaking departments and budget allocation for conservation projects. These threats are often not considered as we are not aware of the extent of frog harvesting in our country and many people are not concerned with budget allocations unless it has an impact on their own budgets.

6.2.3.3 Conservation solutions as suggested by educators and learners

The suggestions by educators to save frogs were reported in Table 4.13. None (N=11) of the suggestions were comprehensive enough to show that they understood why many frogs were endangered. Learners (59 of 102) shared their responses in Table 5.12. The majority of their

responses focused on one aspect such as removing threats to frogs. Out of the 52 responses from learners, twelve gave incorrect answers and three mentioned that they would not help frogs. None of the respondents mentioned frog habitat conservation that may ultimately be the only way in which to conserve frogs.

The conservation solutions mentioned in learner and educator responses seemed to result from both horizontal and vertical knowledge. The media frequently flights programmes on conservation projects and the most popular projects often depict animals such as gorillas, chimpanzees, elephants, rhinos, leopards, cheetah, lemurs, sharks, dolphins and whales. The solutions often involve sanctuaries or laws preventing hunting or poaching. Human interventions such as shark nets, tracking of animals with collars and housing animals in captivity such as zoos, are discussed as means of protecting animals as well as establishing breeding programmes. These solutions may also be discussed in class as a home project for learners to explore.

Amphibians however, present many complications which cannot be rectified by sanctuaries, zoos or tracking devices. The very nature of what makes an amphibian, an *amphibian*, as discussed in Section 6.2.1, causes these complications. The permeability of the amphibian skin makes them susceptible to pollution of all kinds – air, water, gasses, litter and chemicals. They are extremely sensitive to water quality, acidic levels in water, quality of substrates, and types of plants for egg sacs to attach to and larvae to feed on. By relocating them to a sanctuary or other form of captivity, the aim would be to prevent or lessen the effects of pollution as well as deteriorating air and water quality. Humans handling frogs, can cause certain forms of tuberculosis within frogs (M. Barrows, personal communication, September, 2008). Stress causes death by other diseases. The solutions are complicated and involve worldwide changes such as limiting carbon dioxide release, controlling waste in water areas, air pollution and many more. Frogs cannot just be saved by removing them from their habitats. The conservation of amphibian habitats is a crucial action to ultimately conserve frogs. By conserving their habitats, freeing it from pollution, human interference and diseases, one would be able to conserve frogs assuming they could adapt to potential climatic changes.

In the experience of the writer in zoos, conservation is often perceived as a noble cause with non-materialistic rewards for those involved. Many conversations with both learner and adult groups indicated the desire of these groups to become involved with saving animals such as dolphins and reaping the reward of swimming with these animals and being recognised by both humans and animals as the 'friend of such saved animals'. Conservation is in actual fact a science requiring dedication, broad-based knowledge, and continuous research and requires people with great strength of character. In essence this is not the romantic visions that people have of conservation. This is a career that needs explanation at school level, as many learners have romanticized it only to find it is not what they thought it to be. If conservation projects are better researched at school and brought into context, learners will have a clearer picture of what conservation entails.

6.2.3.4 Effects of extinction

The responses of educators were recorded in Table 4.11 and those of learners in Tables 5.10 and 5.11. Some answers indicated an increase of mosquitoes (44 out 102 learners and four out of eleven educators).

The extinction of a class of animals such as the amphibians emphasise the need for educators to teach Natural Sciences holistically and not isolated topics, depending on what is required for the term.

The overall understanding of the loss of species is complicated and creates much educated speculation within the scientific community. The loss of frogs as addressed by the Amphibian Ark as mentioned in Chapter 1 (see Section 1.4), is based on educated predictions by scientists but also by observation of what has occurred since certain species became extinct in some of the ecosystems studied. The changes in ecosystems are slow and often need multiple study projects of long duration to arrive at an acceptable explanation. Certain changes however, can be expected, such as predators having to find other food if frogs have disappeared, the effects on the populations of these alternative food sources, the loss of specialized predators feeding mainly on frogs and the increase in the prey species of frogs.

What is often neglected is a discussion of water quality; what happens to the plants in the habitat and the animals that used to feed on frog eggs and larvae. To understand, even in a superficial discussion, the possible implications, requires knowledge of the ecosystems, knowledge of frog habitats and the food webs involving all stages of the frog's metamorphosis. It involves knowledge of the implications of commercial frog farming and how the losses will affect cultural traditions and stories shared in communities.

The responses such as people will be 'sad or unhappy' is probably related to catch phrases used in the past about the loss of species and how sad it will be to show the next generation photos of animals that once roamed the earth. It is not impossible that some people would be saddened by such occurrences but the writer has yet to meet or hear about people who miss the Blue antelope, the Cape lion, the Dodo or Quagga.

6.2.3.5 Problem identification and dealing with it in the resource pack

The main problem with concept of 'endangered' is the language issues as danger and endangered becomes the same concept for educators and learners with English as their second language. In this instance the resource pack needs to unpack the terminology, mention the common misconceptions as observed by the writer, explain the intended understanding of 'endangered' in the scientific or vertical discourse with added information as to why 'endangered' is applicable to species and not vague groups or individual animals.

The main contents of the resource pack will be factual information, possibly using case studies to assist the educators to understand the complexities of conservation, threats and solutions. It is also important to mention the socio-economic factors that have an influence on conservation projects. Case studies by experts can be used to give career guidance to learners who may have an interest in conservation as a career. It is important to share what conservation careers are about as discussed in Section 6.2.3.3 without influencing learners negatively as it may appear that these careers are not as glamorous as perceived.

6.2.4 Myths and alternative conceptions

Warts and skin reactions when in contact with frogs were mentioned by both educator and learner groups. Three educators and seven learners mentioned warts specifically. One educator mentioned witchcraft and a few mentioned that frogs were seen as messengers of bad omens as discussed in Section 4.6.3.This fear and dislike evoked among educators can be attributed to their beliefs of such myths or alternative concepts as seen in Section 2.5. It is recognised by the writer that such fears cannot easily be eradicated. However educators should be empowered to answer such queries from their learners with scientific facts where applicable.

Myths and alternative concepts originate from misconceptions, folklore and stories (see Appendix J). The possible problems associated with such myths and alternative concepts are that they can affect attitudes of people towards frogs: phobias and discomfort can prevent educators and learners dealing with the concepts of amphibians and their conservation.

The resource pack can attempt to solve these issues by providing facts illustrated with graphics to explain some of the misconceptions.

Factual information such as the following will be included:
Both groups mentioned that if frogs urinate on your skin, this would cause warts or sores. The first investigation would be is to find out if frogs actually do urinate if you pick them up. According to the frog experts at Johannesburg Zoo (A. Guinsberg & S. Van Der Spuy , personal communication, February 11, 2008), it is only the Giant bullfrog which they have observed urinating when handled. Many of the garden varieties such as guttural toads do not. What can happen is that when frogs are handled, they may be in the process of shedding their skins and this leaves a residue on one's hand when picked up. Some frogs are however, known to produce a substance as part of their defensive mechanism that may cause skin irritations or swelling. Dogs or cats that catch frogs often foam at the mouth or have swollen mouths due to these substances. These conditions are normally short-lived and can be treated by washing the affected areas. What causes warts has nothing to do with frogs but it is actually caused by a human papillomavirus, *Veruccae vulgaris*

(retrieved February, 2008, from
http://www.associatedcontent.com/article/96945/warts_dont_blame_frogs_toads.html).

Educators spoke about the killing of frogs should they enter their houses as they associated frogs with fear as messengers of bad omens. Since beliefs are hard to change as they originated within the horizontal discourse, the writer thought it prudent to address ways and means of getting rid of frogs without harming or killing them. The design of a simple device such as a unit that can lift the frog and deposit it outside the house, or deterrents that will prevent frogs from entering the house in the first place such as a barrier enhanced with natural herbal deterrents are possible. Similar devices have been used to prevent other animals such as 'Parktown prawns' (a large armoured cricket) from entering a house or to remove them.

6.3 CREATIVE WAYS TO ADDRESS CONCEPTS WITHIN THE RESOURCE PACK.

The resource pack may take any format from a booklet to a compact disk to a website. There may be more than one format considered depending on the needs of those to whom it is aimed. Distribution of resources throughout Africa is problematic and electronic formats may be more applicable to this audience. The resource pack will recommend that educators in other countries use their own examples of amphibians.

6.3.1 Possible principles for an amphibian resource pack.

6.3.1.1 Factual information

There are many books, other publications and websites available as mass media described in Appendix B. The problem with these resources is that they often contain very scientific knowledge which could be intimidating for primary educators. The aim of factual knowledge in the resource pack would be to prioritize the information into easy 'bite sizes' with examples to assist educators in understanding the concepts. An easy reference guide would be added as well as a glossary to

make the resource pack user-friendly. A word game might be included to assist learners to understand the concepts within an amphibian theme, the aim being to explain the concepts and to reduce language difficulties.

Suggestions for the inclusion of factual information were discussed in Sections 6.2.1.4; 6.2.2.5; 6.2.3.5 and 6.2.4. Other examples of factual information such as the origination and possible solutions in the treatment of warts could be used to dispel or enlighten both educators and learners about certain myths such as warts for example:

> **"Frogs and Warts**
>
> Some say that you get warts from touching frogs and toads.
>
> You get warts from human viruses, not from frogs and toads!
> Frogs have slimy skin to stay moist when it is dry, and toads have bumpy skin to help camouflage them in their habitat. Some frogs and toads have paratoidal glands which secrete poisons as protection which can cause skin irritations and may be poisonous to some species of animals, but warts have nothing at all to do with the frogs themselves!" (Retrieved February, 2009 from http://allaboutfrogs.org/weird/general/myths.html)

6.3.1.2 Interactive and creative activities

It is in the experience of the writer important to make the resource pack interactive as was suggested in Section 6.2.2.3. Passively reading up on facts is certainly helpful but educators would need stimulating exercises to keep their interest levels and to provide them with challenges, experiential learning opportunities such as fact-finding expeditions and 'games' to play with their learners. Educators often need assistance with creative activities that may stimulate them to design their own.

Some ideas that could be included in the pack:

- A game in which different indigenous animals are used in a project for learners to identify with the intention of making them familiar with the animals and teaching them to differentiate between different species. The project may take the format of border control officials and those who want their animals to enter the country of South Africa. Learners

will have to supply each animal with an identity document – as an example: they have to identify this animal as a guttural toad and as an amphibian because of the reasons suggested by them. Should the reasons be valid, their animal may enter. The learners will have to design an identity book for each animal containing their classification. Some learners (see Section 5.6.3) have shown a need to be creative and this may be an exercise they would enjoy.

- The use of experts are recommended for a class outing or for a class visit. Willing/ available experts from institutions such as universities, zoos and herpetological societies will be identified by the resource pack for contacts so that the class may go on a focused outing or invite an expert to the school to share specifics of their field of expertise. Many educators may not be informed about the available resources in their areas.
- Practical observations or investigations without needing a laboratory. A number of projects can be suggested so that both educators and learners can learn to connect their 'book knowledge' to the world they live in. Learners can be equipped with inexpensive materials such as plastic gloves; scientists 'note books', magnifying glasses, etc. to create the feeling of a science expedition. Keeping of frogs (with the help of experts) in their class to demonstrate the development phases can be achieved by most educators. Add the activity of taking photos or drawing sketches of frogs seen in their immediate environment with notes on physical appearance, time of day and year thus creating a field observation log of the animals. Seasonal changes can be noted to learn about breeding behaviours of frogs such as the bullfrog that hibernates during winter. Institutions such as zoos and museums have 'biofacts' (preserved animals) for loan. Certain universities present opportunities to observe or participate in dissections of animals such as frogs.

6.3.1.3 Graphics

Illustrations, class decorations as reminders and stimulating posters are exciting and easy to use for both educators and learners. Learners enjoy colour and creative images. Posters of the ten most common frogs can adorn the walls of the classroom and learners can be encouraged to add their own pictures. The old saying 'a picture tells a thousand words' needs to be remembered and implemented as part of teaching. The resource pack can assist with providing these illustrations.

Some ideas to be used in the pack:

a. Provision of a Natural Sciences 'map' might be included to highlight the interdependences of classification, ecology, conservation and biodiversity. This will assist educators to teach holistically about amphibians.
b. A large frog template with layers may be included based on the idea of peeling each layer off to reveal what makes an amphibian, an *amphibian*. The same can be done with examples of other animal classes to differentiate amongst the characteristics of the different classes.

6.3.1.4 Audiovisual resources

If schools have the necessary equipment audiovisual resources such as DVDs and CDs can be of benefit to share sounds and visual material of frogs. It could also be used for case studies and for home projects.

Some ideas to be used in the pack:

a. Case studies and interviews with experts passionate about frogs can be included as short inserts including places visited, smallest and largest frogs observed, most dangerous species seen and why it is dangerous, most commercially useful and other interesting facts that may inspire learners about the fascinating world of frogs and naturalists.
b. Sounds of frogs are already available on discs but may be copied with permission, for the most common garden frogs only. Myths, folklore and general stories can be added to add cultural aspects surrounding frogs and other amphibians.

6.3.1.5 Assessment activities

As discussed in Section 2.4 as well as 4.6.2; 6.2.1.3 and 6.2.1.4, self-assessment for educators as well as assessment of learners of knowledge in both discourses are important, to find connections for new learning and to identify possible misconceptions and alternative concepts. Activities suggested may include 'show and tell' activities, making use of what learners experienced during

school holidays, frogs found in swimming pools, photos taken of frogs in their immediate environment or sharing of a folklore story to illicit conversations about frogs. Simple self-help tests can be included or a checklist of factual information.

6.3.2 Language aspects of the resource pack

The language of the resource pack will initially be in English. Translations into different languages are costly and time consuming. It is envisaged that the effectiveness of the resource pack will be tested and evaluated before any translations are considered. Certain concepts may be translated to ensure clarity as well as the identification of animal species should they be known in different languages as well as colloquial names. The languages considered would be isiZulu, Setswana, North Sotho and Afrikaans as the writer has contact with expertise in these particular languages and these languages are spoken in the schools that visit the Johannesburg Zoo. Translations into other languages will not be excluded but are dependant on available expertise and budget.

6.3.3 Practical aspects to consider in designing the amphibian resource pack

To encourage educators to use the resource pack, the pack needs to be introduced to educators and subject advisors to excite them about the possibilities and for them to understand the aim of such a pack. These pilot workshops would also provide an opportunity for educators to contribute their own ideas as well as to highlight certain problematic areas they may encounter. In the experience of the writer, it is often far more practical to present ideas that can be expanded upon and be critiqued than to expect educators or participants to assist in the design of such a pack from the start.

It is important to realize that the educators did not request such a resource pack and that the successful implementation of the pack is the responsibility of both institutions such as zoos that have a mandate to educate about biodiversity as well as the educators who are teaching the subject of Natural Sciences. Educators have a responsibility to teach scientific concepts and their implementation or use correctly and here again the resource pack can be of assistance. Zoos and

similar institutions have the expertise and if they want the resource pack to succeed, implementation and use must be partly their responsibility. One of the ways of implementation of the pack is to use it for schools that book for education programmes at the institution.

Available budget is a consideration as design aspects are often costly especially if done in small quantities. Staff of Johannesburg Zoo will be used to assist with design aspects as there is a display artist employed. The National Zoo could be contacted to ask for assistance as they have a similar artist as well as a graphic designer on their staff. The CDs or possible DVDs will be produced as a trade agreement between 'Enviroworld', a zoo tenant, and the Johannesburg Zoo.

6.4 CONCLUSION

Identifying problematic concepts within the Natural Sciences 'Life and Living' curriculum is not of any use if no attempt made to assist with the understanding of these concepts. The educators at institutions such as Zoos can focus on problematic concepts identified and illustrate these concepts with appropriate examples from within the Zoo. For institutions such as zoos, it is part of their mission statements and mandates to assist with education and to ensure that the youth and educators are empowered with knowledge about Natural Sciences. It is to fulfill this aim that a resource pack will be designed to assist educators with correct understanding of concepts and to assist them with resources and ideas to educate their learners.

Deleted: earning

CHAPTER SEVEN

CONCLUSION

"Amphibians are some of the most amazing animals on earth, found in our immediate environment. You do not need to travel to the ends of the earth to see them. Yet very few people know anything about them or the fight for their survival".

David Attenborough

7.1 INTRODUCTION

This study has investigated the prior knowledge of educators and learners with regards to amphibians, within the theoretical framework of Bernstein's horizontal and vertical discourse (Chapter 2). In drawing conclusions, the research constituting the thesis can be viewed at from two perspectives:

- Identification of prior knowledge within both discourses taking into account the understanding of concepts, misconceptions and alternative conceptions
- A guide to the development of an amphibian resource pack to assist in improving understanding of concepts relating to RNCS Natural Sciences- 'Living and Learning' curriculum.

7.2 EVALUATION OF THE RESEARCH

The primary goal of the research (see Section 1.2) was to investigate prior knowledge about amphibians with Grade 7 learners and their educators in order to inform the development of an amphibian resource pack. It is intended that the pack would look at a holistic approach towards amphibians to illustrate and strengthen the understanding of the interrelationship of concepts such as 'the amphibian', 'classification', 'ecology' and 'conservation'.

The primary goal was achieved in that draft contents of a resource pack have been developed from the findings of the survey (Chapter 6). The survey results indicated the level of understanding of concepts and alternate conceptions related to amphibians as well as misconceptions regarding them.

The secondary goals (Section 1.2) were achieved in that supportive links between the contents of the amphibian resource pack and the Revised National Curriculum Statement for Grades 4-7 in Natural Sciences were explored for possible inclusion in the development of the pack (see Appendix B as discussed in Chapter 3). It should be noted that the links between the RNCS and the contents of the pack has been carefully developed in such a way that other potential users in Africa will accept the pack as useful for their regions as well as for South Africa. The second part of the secondary goal in terms of investigating mass media to establish the availability of amphibian resources available has also been achieved. The summary as discussed in Chapter 3 is presented in Appendix B.

With reference to the research assumptions made in Section 1.3, it can be concluded that there is no reason to doubt the assumptions made in addressing the concept of frogs in the teaching content at schools as discussed in Section 1.3.1. It is indeed true that the concept of the amphibian or frogs is not holistically approached but merely understood and taught in a superficial manner during the classification lessons.

The assumptions made in Section 1.3.2 were correct and the writer did not experience any difficulties in obtaining permission for the research, and the selected schools were very helpful in making their learners and educators available. The assumption that educators would find the research useful was premature in that educators would only be able to comment on the usefulness of the research once the resource pack is available, although educators did comment during the interview process that they would certainly pay more attention to amphibians and did not realise their importance in ecology before the interviews took place.

With regards to the research findings being useful for the development of a resource pack in an assumption made in Section 1.3.3, it can be concluded that the findings were indeed useful for the

development of a draft pack. The other assumptions were again premature in assuming acceptance of the resource pack by zoos and similar institutions as well as within environmental education institutions. It can be said that, *prima facia*, there is no reason to doubt that other zoos, similar institutions and environmental education concerns would not find the pack useful if implemented, as in the experience of the writer, supportive learning materials are in most cases well received and adapted for the specific purposes of each institution.

7.3 EVALUATION OF METHODOLOGICAL ASPECTS

The methodological aspects were largely discussed in Chapter 3, Section 3.12, but comments here are applicable in terms of validity and generalisability of the research.

In response to whether the research process can be considered as valid, the writer is convinced that it is valid since the research achieved what it set out do in the primary and secondary goals in Section 1.2. The survey yielded results concerning the quality of prior knowledge of amphibians in both educator and learner groups, indicating that a resource pack may well assist in improving the understanding of concepts within the Natural Sciences 'Living and Living' curriculum. The data presented in Chapters 4 and 5 is a reliable presentation of the status of prior knowledge within both groups, applying Bernstein's theory of a horizontal and vertical discourse (see Chapter 2).

However, the research findings, relating to the level of understanding of the concepts within the Natural Sciences 'Life and Living curriculum', cannot be generalised to all educators and Grade 7 learners in Gauteng, or in the rest of South Africa. The sample used in the survey was not large enough to be representative of educators and learners. No generalization can be claimed beyond the schools used in this survey.

7.4 OVERVIEW OF THE KEY FINDINGS

Two major findings were identified.

- The first finding indicates that educators and learners showed severe limitations within their knowledge base of scientific concepts and related everyday knowledge base. These limitations were due partly to language difficulties as identified in certain concepts. Of more concern is that the majority of both educators and learners did display correct understandings of scientific concepts, have not read and learned enough about these concepts, nor been exposed to experiences to link with these scientific concepts. Their knowledge base appeared to be rooted in some book knowledge on a superficial level, and showed evidence of misconceptions or no knowledge at all about concepts or applicable animal examples. An example can be seen in Chapters 4 and 5 where the majority of both educator and learner groups said an amphibian lives in water and on land and identified rain spiders as amphibians. It can be tentatively concluded that in the case of the sample, the scientific knowledge base of both educators and learners expected at the senior phase of education, is of poor quality. It can further be concluded that there appears to be very little understanding that there is interconnectedness throughout these concepts and that the Life and Living core knowledge within Natural Sciences is not divided into separate study fields without links but is in fact one study field. Educators did not appear to apply a holistic approach in teaching concepts within the Natural sciences as the survey showed (see Chapter 4) for example that the links between frogs becoming extinct and the effect on food chains are poorly understood.

- The second key finding is that the amphibian resource pack envisioned as a holistic approach to amphibians, may well assist in improving the interconnectedness of the concepts; assist in forming a correct understanding of the concepts as well as in applying the concepts, for example, correctly identifying amphibians. The potential use of such a resource pack is far reaching within the intermediate and senior primary phase of schools and the writer is confident that with the appropriate introduction through workshops, educators will recognise the usefulness of the pack.

These key findings are not isolated, since in publications such as the report on Curriculum 2005 (Chisholm et al., 2000) similar results were found in evaluating the knowledge base of science educators and their understanding of concepts (see discussion in Chapter 2). It was also found that the quality of existing learning support materials (LSMs) was poor and in some cases inadequate, and that additional LSMs developed by Non-Governmental Organisations and similar institutions would be most welcome and helpful to educators.

The findings of the research have been useful for the writer in developing the draft resource pack. The research process has enabled her to come to a better understanding of the challenges faced within the Natural Sciences Life and Living curriculum and has been useful in formulating strategies to address these challenges.

The research process itself has proved to be an educational experience in analysing data and in the writing of a thesis. The writer has also become more critical in judging publications with regards to content and writing skills.

7.5 RECOMMENDATIONS

The tentative recommendation of the research findings is that the draft amphibian resource pack be completed and field tested with educators and learners to identify potential problems such as language issues and any misunderstandings of concepts and suggested activities. The field tests will possibly assist in necessary translations of concepts and examples of animals. It is also hoped that many more educators will become interested in the pack through word-of-mouth which will assist in the marketing drive of introducing the pack to schools throughout South Africa.

Future studies investigating the levels of understanding of scientific concepts by educators and learners using larger samples will possibly assist in improved tertiary education for future educators.

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Aesop's fables

Doctor, heal yourself.

A frog climbed out of the swamp and began croaking a message to all the other animals.
"If you are ill, if you have aches and pains and broken bones, come tome, "he called out.
"I know how to heal you all," he called out.
"I know how to heal you all, for I am a doctor."

The animals believed him except for the fox.

"Look at this miserable frog," said the fox to the other animals.
"His skin is covered with blotches and his voice is nothing but a croak. If he is such a good doctor, why has he not healed himself?"

Sample size and description:

Primary schools in Gauteng Department of Education

Date	Grade	Area	School	Teacher	Data generation
05/ 07 (T1a) 23/08/07	Grade 4 & 7	Tokoza	Monde	Female	2 questionnaires and 1 interview T1a, T1b, T1i
05/ 07 (T1a) 23/08/07	Grade 5-7	Tokoza	Reahile	Female	2 questionnaires and 1 interview T2a, T2b, T2i
1/08/07	Grade 4	Alexandra	Emfundisweni Primary	Female	1 questionnaire and 1 interview T3a, T3i
1/08/07	Grade 7	Alexandra	Pholoso Primary	Female	1 questionnaire and 1 interview T4a, T4i
2/08/07	Grade 6	Roodepoort	T.C. Esterhuysen	Male	1 questionnaire and 1 interview T5a, T5i
13/08/07	Grade 7	Fourways near Diepsloot	Philena Middle school	Male	1 questionnaire and 1 interview T6a, T6i
13/08/07	Grade 4	Fourways near Diepsloot	Philena middle school	Male	Knowledge questionnaire K1
13/08/07	Grade 6	Leeuwkop prison	Sefikeng Primary school	Male	1 questionnaire and 1 interview T7a, T7i
13/08/07	Grade 4 & 5	Leeuwkop Prison	Sefikeng Primary school	Female	1 questionnaire and 1 interview T8a, T8i
13/08/07	Grade 6	Leeuwkop Prison	Sefikeng Primary school	Female	1 questionnaire and knowledge questionnaire T10a, K2

13/08/07	Grade 7	Fourways near Diepsloot	Riversand Primary school	Male	1 questionnaire and 1 interview T9a, T9i
13/08/07	Grade 6	Fourways near Diepsloot	Riversand primary school	Male	1 questionnaire and knowledge questionnaire T11a, K3

Appendix B: Books and other sources with information on Amphibian available to educators and learners.

Books found in libraries and bookstores were investigated with regards to their conservation content as well as with regards to mythology. These books are available to learners, parents and teachers and can provide additional resources of information on amphibians.

Each book will be listed with a short summary of content. Conservation and mythology will be highlighted.

Predetermined categories were used in recording the contents:
(The same categories were used in exploring prior knowledge of Amphibians in educators and learners):

- Definition of an amphibian.
- Identification of amphibians.
- Ecological importance.
- Conservation issues relating to habitat.
- Conservation issues related to human interference such as pet trade, pests and fear.
- Uses of frogs by humans.
- Myths and folklore.

1. School text books:

a. Learner's book: Science for all Grade 6. . Natural Sciences. Outcomes based. RNCS edition. Moodie, P.,& Zwane, K. (2003). Science for Grade 6. Johannesburg. Macmillan.
   - Active animals survive: animals movements are discussed in the sense that they have to move to escape or get food. This is done in a context of animal s fitting into an ecosystem. Frogs are used as some of the animals living in this ecosystem.
   - Endoskeleton: is defined in contrast to an exoskeleton and a frog is used as an example of an animal with an endoskeleton.

b. RNCS. Stepping into Natural Sciences and Technology. Learner's book.
Du Plessis, Z., Koekemoer, C., Labuschagne, C., Molefi, S., Wagner, D., Reynell, L., & Sutherland, C. (2004). Roedurico.

- Classification

  Vertebrates and invertebrates are discussed (p.3). Amphibians are discussed with regards to endoskeleton, body covering, movements, body division and habitat.

c. Learner's book: Science for all Grade 7. Natural Sciences. Outcomes based. RNCS edition.
Moodie, P., Keogh, M., De Wet, H., & Trust, S. (2004). Macmillan.

- Classifying animals:

  Vertebrates and endoskeletons are discussed – frog is used as an example and reference is made to their long leg-bones and how it enables them to jump so well.
  Classification is discussed with regards to the following characteristics: fertilization, reproduction – oviparous: viviparous and ovoviviparous and body covering. Amphibians are described as one of the vertebrate classes. Definition of amphibians: "They live on land and in water but all of them lay their eggs in water. The tadpoles also live in water" (p.54). Reproduction and metamorphosis are discussed. Examples of frogs: bullfrog, forest-tree frog, toad, Cape platanna and sand rain frog (p.54).

  Question posed in textbook: What am I? Which group of vertebrates, fish or amphibians do you imagine could say this?
  'I am happy today. I have come back to my pond to lay my eggs. I will make the biggest stickiest lot of eggs you have ever seen. I will not stay around to watch them hatch. They won't even look like me' (p.55).

2. South African Amphibian books

a. Attracting wildlife to your garden.

Trendler, R., & Chadwick, P. (2005). South Africa. Struik.

- This book is intended to create gardens that will attract wildlife and gives advice on how to keep such a garden as natural as possible, with minimal use of insecticides and use of indigenous as opposed to exotic species. The second part of the book focuses on wildlife and discusses birds, mammals, reptiles, amphibians and fish as well as invertebrates. The section on amphibians focuses on differences between frogs and toads, life cycles, habitat needed for amphibians and reproduction. A useful guide is the addresses to contact for plants and animal rehabilitation centres. No mention of myths but there is some discussion on the legality of keeping wildlife in your garden.

b. A guide to Frogs of the Suikerbosrand Nature Reserve.

Carruthers, V. (1979). Transvaal. Nature Conservation Division.

- This is a booklet used on the reserve and gives a short introduction to the reserve. It discusses the frog species found on the reserve, gives a breeding season timetable and suggests appropriate readings. It is available in both English and Afrikaans. No mention of conservation or myths.

c. A River safari.

Clarke, N. (2004). South Africa. Struik.

- This is a very good adventure book that discusses various aspects of life around a river. All kinds of skills such as following tracks, seeing what animals visited an area, their activities such as feeding, nesting, mating or hunting and do they stay or go. Frogs are discussed in various sections with regards to special homes such as the foam nest frogs. Frogs are placed in a food chain. Frogging is discussed with regards to how to identify the different calls and different kinds of frogs found in different places around a river. **There is a general discussion relating to keeping the river clean, protecting nature, stopping pollution and planting indigenous plants.** No mention specifically about frog conservation or frog myths.

d. Bring Nature back into your garden.

Botha,C., & Botha, J. (1996). KwaZulu- Natal region. Wildlife and Environment Society of South Africa.

- The contents are focused on indigenous versus exotic plants, the use of herbicides and pesticides, dead trees in your garden, lawns and landscaping, bringing pests into your garden, different plants, water ponds and wild life found in your garden. Frogs and toads are mentioned, their differences are mentioned, the food they eat and role they play in garden ecology. The noise levels that frogs make are discussed with some advice as to where to put your pond. **The authors do mention that frogs do not give you warts or turn into princes if you kiss them.**

e. Frogs and frogging.

Carruthers, V. (2001). Cape Town. Struik.

The book has an audio compact disk included with the different frog calls.

- Contents: This is a very good resource to find out more about frogs including a wide variety of topics. It covers classification, description of different habitats, description of all the species found in Southern Africa, how to go about frogging, reproduction and metamorphosis, respiration, feeding, senses and frogs and human interaction such as sport, medicinal, poisonous and photography. Evolution is included. **Conservation and the so-called 6th extinction is discussed and a red data list of the threatened species are included.** The author has even included a short paragraph on frog philately. The second part of the book discusses identification in the field. It is an easy book to read and very appropriate for South Africans.

f. SASOL Eerste veldgids tot paddas van Suider-Afrika – also availbale in English.

Carruthers, V. (2001). Struik.

- Contents: Short description of what an amphibian is, its evolution and communication. The book also describes how to look for frogs and what equipment is needed. It then gives a short description of a number of species found in Southern Africa and ends off with a glossary. There is no mention of mythology nor conservation status of any of the species. It is a tiny book meant as a field guide for the absolute novice.

g. South African Frogs – A complete guide.

Passmore,N.I., & Carruthers,V. (1979). Johannesburg. Southern Book Publishers, Witwatersrand University Press.

- This is a comprehensive field guide that includes classification, frog sounds, breeding sites, localization of males and females, recording of frog sounds, photography, and equipment. It discusses reproduction, spawn, oviposition sites, number of eggs, development of tadpoles, colouration and defense, temperature, water and skin and feeding. It then gives a very good field key to genera, a distribution map, photographs of each frog, where to find it, calls it makes and its measurements. An excellent guide for a serious frogger but no mention of conservation or myths.

3. International Amphibian books:

a. A guide to a happy healthy pet: Frogs and Toads.

Grenard, S. (1998). New York. Howell Book House.

- The book is written for a pet owner and describes the differences between frogs and toads, classification, anatomy including skin, senses, communication and feeding. There is a short chapter on frogs and toads in the wild and a caution not to release your pet into the wild. Temperature regulation, hibernation and estivation, growth patterns, metamorphosis and some exceptions are included. **Frogs, toads and the law talks about regulations in the pet trade, CITES and the list of endangered and threatened species in the U.S.A**. The rest of the book is dedicated in how to choose and keep your pet involving medical care, feeding and habitat requirements. It discusses various frog species and a short

paragraph or two with regards to dangers that frogs hold for humans such as poisons, frog bites, parasites, frog TB and infectious diseases. Myths are not discussed.

b. Frogs A chorus of colors.

Behler,J., & Behler, D.A. (2005). Sterling Publishing Co.,Inc.

- The foreword includes their home surrounded by frogs and the amazing sounds in spring but they also include a short part on the frogs becoming endangered and extinct due to loss of habitat, developments, global warming and the consequences affecting the food chains where frogs play an important role. This book gives a very good and colourful description in Chapter 1 of what a frog is and includes all its characteristics, evolution, classification, finding frogs, differences between frogs and toads and some facts about frog jumping competitions. The rest of the chapters discuss various topics in depth with very good photographs as illustrations such as reproduction, feeding, movement and camouflage. They describe a number of frog families worldwide. **The last part of the book is dedicated to frogs being threatened and the various causes such as pollution, global warming, loss of habitat and disease. The pet trade, introduced predators, altering of natural environments, frogs used for dissections and the construction of hydroelectric power in certain rivers such as Tanzania. The relationship between man and frog is discussed – medicinal and food sources. The book ends of with some positive news with regards to what the reader can do to help save frogs.** Photography is discussed and the equipment needed.

c. Frogs and toads. A children's book.

Kalman, B., & Everts, T. (1994). New York. Crabtree.

- This is a fun book for younger readers but gives quite good but concise facts about differences between toads and frogs, habitat, frog food, cycle of life, frog sounds, senses, hibernation, camouflage, warning colours of frogs and weird frogs. **One page is dedicated to endangered frogs, reasons for decline, what extinction means and that the golden toad might already be extinct.** The book ends of with words young readers need to learn.

d. Frogs and Toads of the world.

Mattison, C. (1992). UK. Blandford and Cassel imprint.

- The differences between frogs and toads are discussed, including identification, origin of frogs and toads, design, shape and colour, senses, movements, reproduction, physiology, hunting and feeding, distribution and movement in different habitats and different families of frogs**. A short chapter is dedicated to frogs and man. This chapter contains folklore and legends as far back as the ancient civilizations of Egypt, China and Central America. It includes mention of frogs used in ornaments, furniture, clothing, art and crafts, witchcraft, children's stories, food source for humans, medicinal uses, pregnancy tests, secretions of frogs used for poison and dyes and frogs used as biological control in some countries. The pet trade is mentioned and in conjunction with this, conservation is mentioned and the destruction of habitat.**

e. Living amphibians of the world.

Cochran, D.M. (1961). London. Hamish Hamilton.

- The preface starts off with man and amphibians, primitive man who knew little about animals that he could not eat or find, thus primitive man did not care about secretive non-aggressive frogs, salamanders or caecilians. The author talks about the early Greek philosophers who wrote about mysteries, gods and myths, the Middle Ages where man was submerged in superstition and says that it was only in the 16th century that there was a real attempt made to describe the living world. The study of zoology and herpetology developed. The book describes the evolution of amphibians, classification, gives a description of caecilians, salamanders, newts, frogs and toads. Different frogs and toads of the world are discussed as well as their senses, reproduction, adaptations and how to keep a frog as a pet. **No mention of myths in particular or of conservation.**

f. The encyclopedia of Amphibians.

Hofrichter, R. (Ed.) (2000). Canada. Key Porter Books.

- Contents: it is a comprehensive encyclopedia that discusses evolution, biology and physiology, ecology and ethology, what frogs mean to humans, conservation and species protection. **The conservation aspects discussed focus on the accelerated rate of extinction and mention the task forces involved with species protection and monitoring such as DAPTF (The Declining Amphibian Population Task Force); ssc (Species Survival Commission) and IUCN (International Union for the Conservation of Nature). Causes of the decline of amphibians are discussed in great detail in a global sense and include habitat destruction, climatic changes, chemicals, biological changes, parasites and water acidification amongst others. CITES (The Convention on International Trade in Endangered Species of Wild Fauna and Flora) cautions against illegal trade. The book ends of with what we can do to assist in saving species.**

g. The encyclopedia of reptiles and amphibians.

Halliday, T.R., & Adler, K.(1986). London. George Alan&Unwin.

- Contents: the second part of the book focuses on reptiles which will not be discussed. The first part is on amphibians and gives a very good description on the evolution of amphibians as well as a description on their skeleton, movement, reproduction, life cycle, adaptations to different habitats, parenthood and senses. Caecilians, salamanders and newts are described. Different frogs around the world are discussed with reference to how humans use frogs for food and medicinal purposes as well as frog toxins and poisons. A short chapter is dedicated to why fogs have lost their tails and the physiology and type of frog calls. **There is no discussion on myths nor conservation but a book that discusses the amazing world of amphibians and their adaptations.**

4. Children books:

A list was not compiled as one story, 'The Frog Prince' with a few different titles such as 'The Princess and the Golden Ball' and 'The Frog and the Princess', which are all the same story, appears repeatedly in children books. The story was originally written by Grimm. One comprehensive resource was used as a reference in this research: 'The Children's Treasure Chest – Classics for children, nursery rhymes, bedtime stories, nonsense poems and much more': edited by Alice Mills. Frogs appeared in some of the poems in the same book as seen in Chapter Five.

Other resources consulted were the Frog Atlas and the Red Data book. These resources are not easily available in bookstores and public libraries. Copies of these two books are in the Zoo library.

- The Red Data book discusses species threatened with extinction and the causes if known. There is a Red Data book for all Five Vertebrate classes.
- The Frog Atlas is a comprehensive discussion of species and their habitats.

5. WEBSITES:

- Websites were investigated with regards to general frog information and myths. Many websites exists but the most useful ones found were:

Frog Information:

1. www.AmphibianArk.org

This is the website for the Amphibian Ark that keeps readers up to date with Amphibian activities in the International conservation world. Information is updated with regards to species under threat, conservation programmes and educational and awareness drives happening in zoos and other institutions.

2. http://en.wikipedia.org/wiki/frog;

Wikipedia is an electric encyclopedia that is updated on a regular basis by experts and interested people. Information about frog biology, habitats, ecology, conservation and different species are available.

3. http://www.frogs.org/froghoo...;

Froghoo is a website that displays a number of children programmes and fun activities that can be very useful in a class situation. It is an educational resource with a key listing for different children age groups to indicate appropriate levels of activities. These activities are designed for use in Zoo, Aquarium and Museum exhibits. Topics are varied and include frog anatomy, virtual frog dissection quiz, digital frog – software for students, interactive frog dissection and many more.

a. http://ice.ucdavis.edu/CANVDecliningAmphibians;

This website discusses the California/Nevada Working group. The DAPTF (Declining Amphibian Population Task Force, their aims, duties and responsibilities. It offers a species tour, educational information, threats and conservation, field methods and links to other websites. It focuses on Californian species but offers an insight in to how these conservation task forces operate.

b. http://web.uct.ac.za/depts/stats/adu/frg-an01.htm

This is a website on South African Frogs, written by the authors of the Frog Atlas. It offers insights in to research on frogs in South Africa, conservation status of indigenous species

c. http://www.open.ac.uk/daptf/froglog/FROGLOG-39-6.html

Bi-monthly newsletter of the IUCN/SSC Amphibian Specialist group- this is a web that gives information about the research done on Amphibians. It reports back on Herpetology conferences. It is an international information source.

d. http://www.globalamphibians.org/update.htm

This is the Global Amphibian Assessment webpage. It offers a data list of species worldwide with regards to their name; taxonomy; country; region; habitat type; threat type or IUCN Red list.

e. http://www.jaxzoo.org/things/biofacts/africanbullfrog.asp

This web belongs to the Jacksonville Zoo and Gardens. It gives very good information on the African Bullfrog (also available on the Endangered Wildlife web). It even gives the Afrikaans translation of the name.

Myths:

http://www.answers.com/topic/amphibians-and-humans

http://www.livingunderworld.org/folklore/

Both these websites discusses frogs in the history of humans. The myths, fantasies and fears are discussed. The uses of frogs in the human world: from medicines to art to the keeping of pets.

List compiled 2006/2007

Two minute survey

Can you please ask the **Grade 7** teachers to fill this in and fax it back to us. We are in the process of designing new material and need some input from teachers.

Date: 8 March 2007

Name of school:

Contact person:

Telephone number:

Amphibians are threatened, to the brink of extinction. We need to design education material that will be used for schools either at the Zoo or at the school, so need some input please.

1. Do you ever teach any lessons about frogs or use them in any lesson materials? Say yes or no.

2. If yes – is it about (tick the correct answer – it may be more than one)

a. Biology of frogs – eg. They are amphibians and have a moist skin, lungs, etc.
b. Conservation of frogs – they are endangered and we need to protect them
c. Stories about frogs – English literature – The princess and the frog, etc
d. Mythology – beliefs that people have about frogs
e. Any other – please specify:

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Johannesburg Zoo
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(Association Incorporated under Section 21)
Reg. No. 036-663-NPO
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Member of the World Association of Zoos and Aquariums (WAZA) and Pan-African Association of Zoological Gardens, Aquaria and Botanical Gardens (PAAZAB)

3. Where do you normally find the information for your lessons
a. Learning support materials
b. Internet
c. TV programmes
d. Library books
e. Other – plse specify

4. Which sources would your learners use to complete their projects
a. Library books
b. Internet
c. TV
d. Any other – plse specify:

Thank you very much for your participation.
For any queries please contact Louise at 011 646-2000 ext 254 or fax 011 486-0244

Louise

Louise Gordon
Manager Marketing and Education

Appendix D: Questionnaire Two
Interest Questionnaire

Some animals are becoming more and more endangered for many different reasons. We are living in a city – how can we make a difference? First of all we have to know which animals need our help and then we have to find ways in helping them.

This questionnaire wants to find out what you know about amphibians, so that an education programme can be developed to help us find ways to save them.

Thank you for answering this questionnaire.
Please answer each question as best as you can, but if you really do not know the answer, leave it blank

Please do not write your name anywhere on the questionnaire.

Question1. Do you know any animals that are endangered? Name as many as you know

Question2. Can you explain in your own words what endangered means?

Question3. What is an amphibian?

Question4. Which of these animals are amphibians? Mark the correct ones with a cross in the block next to the animals' name

Snakes	
Common platanna	
Mongoose	
Chameleon	
Giant Bullfrog	
Rain spider	

Question5. Can you briefly describe in what kind of home or place frogs will be the happiest to live in.

Question6. When last did you see a frog?

Question7. Where did you see the frog?

Question8. Place the following animals in a food chain:
frog, snake, mongoose and mosquito. Each animal can only be used once.

Question9. What will happen if the frog dies?

a. **How will this affect the mosquitoes in the food chain**

b. **How will it affect people if all the frogs died?**

Question10. What do frogs eat, and what eats frogs
a. Frogs eat …

b. Frogs are eaten by …

Question 11.a. What sort of things will kill frogs in the dam?

11.b Why would this happen?

Question 12. In what ways do people use frogs?

Question13. Would you like to hold a frog? Please explain your answer

Question14: If frogs were endangered, how do you think you would be able to help them?

Question15: Would you ever keep a frog as a pet? Say YES or NO

Question16. . If you could keep a frog as a pet, briefly describe what you would need to keep such a pet:

Question17: What would you do with your pet frog if you could no longer look after it?

Question18: If you needed to find out more about frogs, where do you think you would find the information?

Question19. Please write a short story about frogs that you know of?

Thank you very much for answering the questionnaire.

Appendix E: Interview schedule for teachers:

1. Teaching in the Natural sciences must be quite exciting. What do you hope to achieve with your pupils teaching this particular subject?
2. When teaching a particular topic in Natural sciences, how do you determine with your class where a good starting point will be for the particular lesson
3. Where do Amphibians feature in your lesson plans?
4. How do you approach the topic of conservation
5. What kind of animal examples do you use in teaching about conservation
6. How do you connect this topic to the everyday life of a learner
7. Frogs are not as popular as polar bears or lions or gorillas, if you had to use amphibians as a topic for conservation, how would you interest the learners in this particular animal class?
8. If a resource pack with regards to conservation became available at the Zoo, would you use it?
9. How?
10. For what duration in your yearly lesson plans?
11. Have you ever used resource packs before? Can you name some?
12. What would you include in such a resource pack
13. Would it be multi-curricular , making use of language, culture, history?
14. How do you personally feel about frogs?
15. Are there any myths about frogs that you now of?
16. If you had to introduce frogs as a topic with real animals, how do you think your class will react?

Interest sheet

1. How do you think your learners feel about frogs and can you explain why?

2a. When last did you see a frog and where?

2b. Have you heard frog noises anywhere in your environment

2c. Do you like their noises?

3. If you saw a frog, do you know which frog you saw? Can you name it?

4. Can you identify different frogs?

5. If yes, can you give some examples?

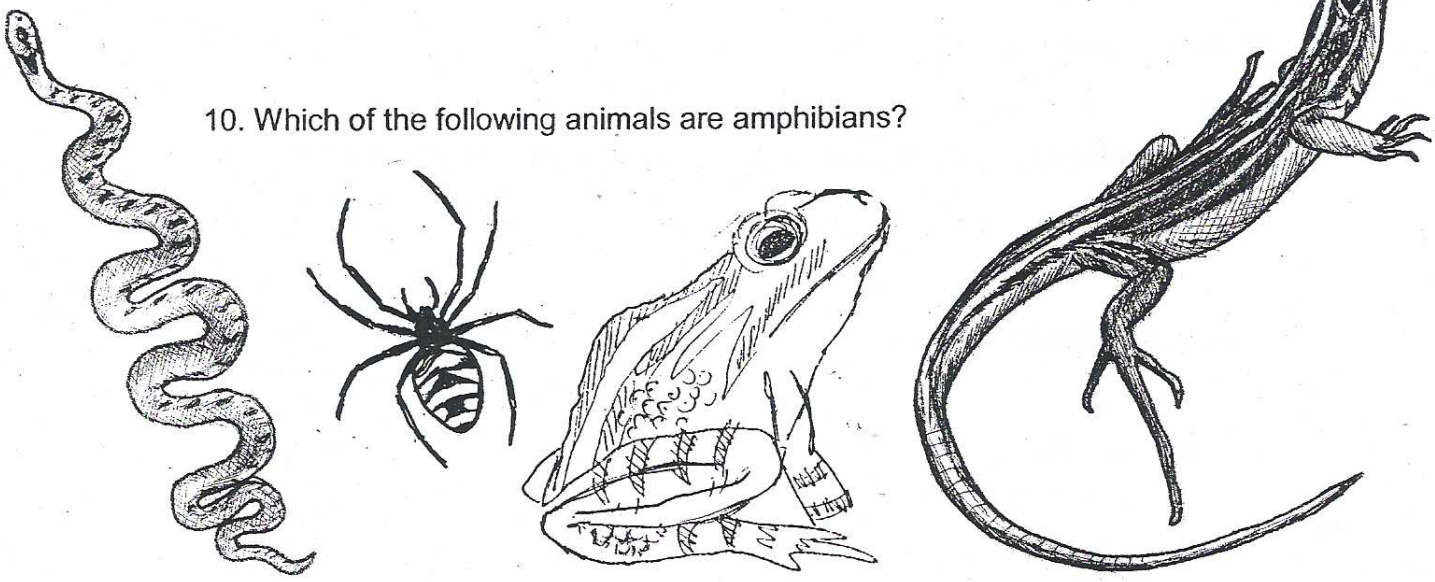
6. If these frogs were endangered, what would you do to save these frogs?

7. What do you think the effect on humans would be if frogs became extinct?

8. What would the effect in general be if frogs became extinct?

9. Can you list 3 kinds of habitats, apart from water, where you will find frogs?

10. Which of the following animals are amphibians?



11. Can you name 3 characteristics of frogs that would differentiate them from mammals? (How are frogs different from mammals?)

Appendix G: **Questionnaire 4: Educators**

Plse answer the questions to the best of your ability.

1a. Where do you get your animal knowledge from?

1b. Did you have knowledge about animals before you started teaching? Yes/No
If yes, where did you get this knowledge from?

1c. Which animals are you familiar with?

2. What does the word endangered mean to you?

Name of school:
Grade taught:
Number of learners:

DEPARTMENT OF EDUCATION

To: MRS LOUISE GORDON

Fax Number: 011 4860244

From: SHADRACK PHELE

Date: 11/04/2007

Pages: 2

Sender Phone: 011 355 0285 Fax no. 0866 400 908

If all pages are not received, or if this fax is received in error, please contact the sender of this fax immediately.

Subject: RESEARCH APPROVAL

SHADRACK PHELE
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Departement van Onderwys

Enquiries Shadrack Phele

(011) 355 0285

11 April 2007

Mrs Louise Gordon
No. 1 Samuel Road
Randhart
1449

Dear Mrs Louise Gordon

APPROVAL TO CONDUCT ACADEMIC RESEARCH

The Gauteng Department of Education hereby grants permission to conduct research in its institutions as per application.

Topic of research: "An investigation of prior knowledge about Amphibians amongst grade 7 learners and their teachers".

Degree: M.Ed. Environmental Education.

Name of university: Rhodes University.

Upon completion of the research project the researcher is obliged to furnish the Department with copy of the research report (electronic or hard copy).

Wish you success in your academic pursuit.

Sincerely,

pp Shadrack Phele

Albert Chanee
Divisional Manager
Education Financing, Planning and Monitoring.

Office of the Divisional Manager Education Financing, Planning and Monitoring
Room 1501, 111 Commissioner Street, Johannesburg, 2001 P.O.Box 7710, Johannesburg, 2000
Tel: (011) 355-0729 Fax: (011) 355-0670 E-mail: albertc@gpg.gov.za
Reference: 2005efpm

18 June 2007

Mrs Trevorte:
Blairgowri Primary School
Fax: 011 782 8463

Dear Madam

REQUEST FOR A 30 MINUTE INTERVIEW WITH GARDE 7 NATURAL SCIENCES TEACHER WITH REGARDS TO GATHERING INFORMATION TO INFORM THE DESIGN OF A RESOURCE PACK FOR CONSERVATION OF AMPHIBIANS

I am a student at Rhodes University enrolled for a master's degree in environmental education The research has been approved by the Gauteng Department of Education, letter included. I am an employee of the Johannesburg Zoo as the Executive Manager of Marketing and Education.

The Johannesburg Zoo is currently investigating its educational role in amphibian conservation. Amphibians have been in decline since 1970 and have now reached the drastic stage where a third of all amphibians all over the world are in decline and threatened with extinction. The World Association of Zoos and Aquaria (W.A.Z.A) have requested that all zoos and aquaria save at least one species of amphibians and that a strong educational programme is developed to involve communities surrounding the zoos. The educational role is my task and I have decided to use it as a theme for my thesis.

My request is that if you are in agreement, that I may conduct a verbal interview with the teacher off your grade 7 classes. The purpose of the interview is to determine whether such a resource pack will be of any use in school lesson plans and how the design can be aligned with school lesson plans to obtain maximum benefit.

No preparation is required except the time of one interview. The information acquired will inform the design of a resource pack, which will be made available to your school. The time period is quite short so I have made 2 suggestions to enable me to interview the teacher in the most convenient time as possible. The interviews need to be completed by 30 June 2007. My suggestion is that the interview takes place on Wednesday 20 June at a time convenient to the teacher at the school or during the next week 25 – 27 June at a place convenient to the teacher or at the Johannesburg Zoo. If Johannesburg Zoo is convenient I will supply vouchers for 4 people to enter the Zoo free of charge so that the teacher may visit with friends and family.

The results will be made available to the school if required and the interviews are anonymous. The school identity will also be protected and will not be used in any of the report findings.

I would very much appreciate it if I were allowed to conduct this research before 30 June 2007 as stated. It is very short notice but would require 30 -40 minutes maximum.

Thank you very much for your consideration and I look forward to hearing from you. I can be reached on e-mail at louise@jhbzoo.org.za or telephone number 011 646-2000 ext 254 or 011 646-0208 or 082 335 1177 and by fax: 011 486-0244.

If there is a more convenient suggestion, please do not hesitate to contact me.

Louise Gordon
Executive Manager Marketing and Education
Johannesburg Zoo

Appendix J

THE CONCEPT OF THE AMPHIBIANS AND FROGS, CLASSIFICATION AND CHARACTERISTICS OF AMPHIBIANS AND FROGS, MYTHS AND FOLKLORE.

The basic definition of an amphibian is that it is an animal. "The early amphibians were the first vertebrates to give up an aquatic existence and began colonization of the land about 350million years ago" (Mattison,1992, p.7). "While many of their fossil ancestors may never be known, those that we have discovered were already extremely varied in structure and habits some 230 to 280 million years ago…" (Cochran,1961, p.7). According to Carruthers, (2001, p.38) the earliest known amphibian fossil, *Ichthyostega*, is believed to be 360 million years old. The earliest southern African fossil is estimated to be 280 million years old and is known as *Rhinesuchus*. Amphibians have been around for a long time and have, up to now, survived the threats and challenges imposed by nature and man.

Though frogs are often defined as animals able to function or live on both land and in water, this definition is inadequate in describing frog morphology i.e. the term 'amphibian' is a Greek word that means 'double life' or that which is broken into two parts: amphi -(two) and bios -(life) (Halliday & Adler, 1986, p2). This refers to the two stages of amphibian reproduction. Amphibians, particularly frogs, are the only vertebrates that display metamorphosis. Eggs are laid that develop into tadpoles, which are predominantly aquatic, and these develop into a terrestrial adult amphibian.

According to Moodie et al. (2004, p.54), amphibians are animals that live on land and in the water, but all of them lay their eggs in water. The tadpoles also live in water. This description is given in a school textbook.

There are no unique structures that are diagnostic in describing all amphibians such as the feathers that identify the avian class. A combination of characteristics is necessary to classify animals as amphibians (Halliday and Adler, 1986, p.32). In the amphibian sources consulted, descriptions were given of their characteristics, which in turn were used to explain their classification. These characteristics are summarized as part of the classification discussion in 4.4.1

Amphibian Classification

Amphibians are animals that have a backbone and an internal or endoskeleton and are thus classified as belonging to the phylum Chordata and the sub-phylum Vertebrate.

The sub-phylum Vertebrate has five animal classes, normally described from the least to the most developed in terms of evolution. The classes are Pisces (fish); Amphibia (frogs, salamanders and caecilians), Reptilia (reptiles), Aves (birds) and Mammalia (mammals). These classes are identified by certain characteristics such as their mode of respiration, reproduction, thermoregulation and body-coverings.

Classification:

Kingdom	Animalia (animals)
Phylum	Chordata
Sub-phylum	Vertebrata (has a backbone/endoskeleton)
Class	Amphibia (classified according to certain characteristics)
Order (3)	• Anura – tail is absent and has four legs –frogs and toads • Caudata – salamanders and newts • Apoda – worm-like caecilians Classifications and terminologies may differ in other resources. This classification used was taken from a southern African resource, '*Frogs and frogging in southern Africa',* written by Vincent Carruthers, a recognised authority in South Africa and author of many books and articles on frogs. (Carruthers, 2002, p.7).

An animal is classified as an amphibian because it has a metamorphic reproduction cycle; its mode of respiration is through gills, lungs and skin; it is considered an ectothermic or poikilothermic (cold-blooded) animal where thermoregulation is not controlled by the hypothalamus in the brain nor raised through metabolic heat, but is completely reliant on external environmental sources of heat

to increase body temperature, and its body-covering is a permeable skin that absorbs oxygen and allows a frog to remain under water for a long period of time (Mattison, 1998, pp. 17- 44).

Frogs

"Almost everyone can recognise frogs and toads. They are those extraordinary vertebrate animals, which change from egg to adult by undergoing metamorphosis. This remarkable process played a crucial part in these animals pioneering invasion of the land. It demonstrates evolution in just a few weeks and it sparks our imagination" (Attenborough, 2008, no page no.).

Frogs are described as four-legged, tailless animals that do not have a diaphragm muscle with which to inhale air as do other animal species. Instead, a continuous movement of their throat pumps oxygen into their lungs. Their skins are kept moist by sub-cutaneous glandular secretions which allows for absorption of oxygen and in some cases, acts as a survival mechanism making the frog toxic or distasteful to swallow by predators. In South Africa the distribution of frogs is influenced by a number of factors, but because their skin is permeable or porous, they occur more in warm, damp areas (Carruthers, 2001, pp.10and 11).

In their reproduction cycle, metamorphosis occurs. This means that there is a cycle of change or a transition from one stage to another. Frogs have external fertilization. The male normally sits on the female's back to fertilize the eggs as they are laid by the female. Females may lay eggs in water bodies, under logs, in moss, and on vegetation overhanging streams or in foam nests floating on water or in vegetation overhanging water bodies or in trees (Halliday & Adler, 1986, p. 39).

In mating the male clasps his mate by attaching himself to her back. This is known as amplexus. Eggs are laid in areas where they will be protected as much as possible from predators. According to Halliday & Adler (1986, p.41) clutch sizes can vary from 2-20 000 eggs. After a period of days, variable amongst species, the eggs hatch and tadpoles emerge. Tadpoles are the juvenile stage of frogs and are aquatic, equipped with a tail and fins to propel themselves through the water. They breathe both through gills and a permeable skin. Mouthparts are so designed as to allow them to feed on algae and other organic matter found in water (Carruthers, 2001, pp.9 -10).

Hormones produced by the thyroid and pituitary glands stimulate the tadpole's transition into an adult frog. The transition is a remarkable biological process in which the mouthparts and digestive system change; transforming the tadpole's herbivorous diet to a frog's carnivorous feeding. Fins and tails disappear to be replaced by four legs and the gills are replaced by lungs to allow the frog to breathe on land (Carruthers, 2001, p.10).

Frogs and Toads

The IsiZulu word for frog and toad is 'isele' (Illman's, 2004, p.114 and 162). The common IsiZulu word for frog and toad is 'xoxo'. Many people, educators included, consider frogs and toads to be two different types of amphibians.

According to Mattison, (1998, pp.11-12) when the two terms were coined, original classification recognised only two species of anurans the 'frog', later known as the *Rana temoraria* and the 'toad', *Bufo bufo.* The main differences between these two species were their body coverings and mode of movement. The 'frog' had a slimy, moist skin and jumped and the 'toad' had a dry, warty skin and hopped.

Grenard (1998, p.9) says that the difference between frogs and toads are actually more illusory than real. Frogs are frogs and toads are frogs as well, belonging to the order Anura. Carruthers (2001, p.12) explains that more recently 'toad' has been used to describe the Bufonid family, which includes several genera.

AMPHIBIAN MYTHS AND FOLKLORE

According to Adler (2007, p. 1) "Frogs and salamanders have appeared in the legends and folklore of many cultures throughout history ".

Adler notes the following beliefs: certain beliefs; Egyptian, Zunis of New Mexico and Mayan cultures, connect frogs and toads to water, rainfall and mud which could be coincidental to the reproduction and mating calls of frogs during the rainy season. Other cultures believed that frogs

had mystical powers and shamans used their images in various rituals. Cultures such as Egypt, Greece, Turkey and Italy used images of frogs for good luck and protecting people from evil.

In ancient Egypt, the frog-headed goddess **Heqet** or **Heket** (*cf.* **Hecate**: the moon deity later associated with European magical practices) was the protector of newborns. During childbirth, women wore her amulets. An oil lamp from Roman times with a frog sculpted on it is believed, because of that, to have been used especially for times of childbirth. An image of it appears in the collection of the Glencairn Museum of Philadelphia.

Daughter of the sun-god, Heqet is called **Eye of Re** [or Ra.] That is, she is the moon which since earliest times was understood to be linked with the ebb and flow of water and of fertility. Thus, she is associated with the germination of grain.

Heqet is one of the eight deities associated with creation and she is the consort of **Khnum**, the ram-headed god. She is the one who instills the spark of life into the body that Khnum molds out of clay.

An African myth from farther south tells how frogs come back to life:

> Once, at the beginning of the dry season, a frog and gazelle had a race. When the frog lost, he asked the gazelle to give him another chance to compete. He said, "Can you come back to life? Burn down my house, and see what happens!"
>
> The gazelle proceeded to burn down the little house, with the frog and his wife still inside.
>
> Then all the neighbours wept for the couple.
>
> Six months passed. The rain began to fall and that very first night, when the gazelle went to drink at the water hole, he was amazed to see the frog and his family alive in the water!
>
> "Where have you been?" asked the gazelle.
>
> "Since the day you killed us, we were in the land of the dead," replied the frog.
>
> "So, what's it like over there?" asked the gazelle.

"Very pleasant," responded the frog. "Don't you see how healthy we are? The Lord of the Dead has truly blessed us."

Now the gazelle was not only curious, but jealous. He burned down his own house with all his family inside it. Sad to say, they never came back to life. The ignorant gazelle did not realize that frogs could "sleep" in the earth between rainy seasons.

~ Adapted from Jan Knappert's ***The Aquarian Guide to African Mythology***. 1990.

Adler says that in art and literature amphibians have been used by writers such as Shakespeare in many plays such as 'Richard III', 'Macbeth' and in 'As you like it', and in Mark Twain's first story: 'The celebrated jumping frog of Calaveras County', in Aesops famous animal fables and the stories of Grimm.

The famous tale of frogs causing warts could be connected to adverse skin reactions to some of the secretions of certain frogs. Adler says that "more than 200 psychoactive alkaloids have been extracted from the skin of frogs and toads" (2007, p. 3) causing various reactions such as the ion channels in nerve and muscle cells to fail, resulting in heart failure. Carruthers mentions that skin secretions can be toxic or distasteful and helps the frog as a defense mechanism against its predators (2001, p.11).

Frogs, especially their large muscular legs are considered a food source by many indigenous people, especially in impoverished societies, according to Adler (2007, p.3). In affluent societies it is considered a delicacy but also as a meat alternative during lent. Many countries in Southern Asia and the East Indies capture wild frogs for the food trade and this has resulted in a growing population of mosquitoes and other insects. Salamanders are rarely eaten except for the Chinese giant salamander weighing up to 65kg in weight and raised in farm ponds in China for food.

Frogs and toads are vernacular names, whereas scientific terms, consisting of a genus and species name, are a much more reliable way of identifying different frogs.

Appendix K

CONSERVATION: CONCEPTS AND TERMINOLOGY

Conservation status: terminology and categories.

Conservation terminology includes the status categories of living organisms, plants and animals. In everyday language and understanding, people talk about animals or plants being endangered and extinct. They do not specify the exact status as classified by the conservationists. The categories used in a more scientific language are specific according to data collected with regards to the species evaluated.

Categories

Categories used today in conservation follow the guidelines of IUCN criteria (CBSG Southern Africa and Endangered Wildlife Trust, 2004, pp.17 – 18). Terminology, definitions and language in this manuscript were used as per the definitions supplied in the Little Red Data Book of the Mammals of South Africa (2004). Selection criteria such as population size and reduction, habitat range and loss and actual number of mature individuals were used to evaluate the taxon and the classification of the status of a taxon. Taxon is any group or rank in classification of organisms such as a class, order, family or genus.

Table 1

Category and abbreviation	Description
Extinct (EX)	There is no reasonable doubt that the last individual of a taxon has died after extensive research and surveys over a time frame appropriate to a taxon's life cycle and life form.
Extinct in the Wild (EW)	A taxon is considered extinct in the wild if it is surviving only in cultivation, captivity or as a naturalized population well outside the past range.
Critically Endangered (CR)	A taxon that faces an extremely high risk of extinction in the wild. A number of criteria allows for this classification such as reduction in population size, habitat loss or a very small population size, less than 250 mature individuals.

Endangered (EN)	A taxon is considered endangered when it is facing a very high risk of extinction in the wild according to certain criteria such as a reduction in population size, habitat size and loss and population size of less than 2 500 mature adult individuals.
Vulnerable (VU)	A taxon is vulnerable when it faces a high risk of extinction according to criteria such as reduction in population size, habitat loss and population size of less than 10 000 mature adult individuals.
Near Threatened (NT)	A taxon that has been evaluated against the same criteria but it does not qualify for CR, EN or VU. It is close to qualifying for a threatened category in the near future.
Least Concern (LC)	A taxon that has been evaluated against the same criteria and it does not qualify for any of the threatened categories and can be widespread and abundant.
Data Deficient (DD)	Inadequate information is available for this taxon so no classification can be made for any threatened category.
Not Evaluated (NE)	A taxon that has not been evaluated against the criteria.

In everyday language the conservation categories as seen in Table 1 are not used. Animals are considered as endangered or extinct. In scientific language these distinctions are made, and with regards to amphibians, a third of the world's populations are considered to be threatened. According to the above categories in Table 4.1 it translates into 7,4% Critically Endangered, 13,3% Endangered, 11,% Vulnerable and 6,3% Near Threatened.

Concerning amphibians in South Africa, 130 species have been identified to date and four species are Critically Endangered (CR), five are Endangered (EN), two are Vulnerable (VU), ten are Near Threatened (NT) and four are Data Deficient (DD). Most of these species are not found in Gauteng except for the Cape platanna (EN) and bullfrog (NT).

Conservation terminologies in English and isiZulu

Conservation terminologies were explained according to their definition in the Collins Student's Dictionary and Survival Guide. isiZulu words were from Illman's Zulu Phrases and Dictionary. Some phrases were defined as found in school text books.

isiZulu is the language most widely understood by all the language groups since isiZulu is dominant throughout the country and the Zulu's themselves will not learn a different language, (O.N. Tlou, personal communications, 1 October 2007)

- Conservation: the protection and careful management of the environment and natural resources (Collins Student's Dictionary and Survival Guide, 2004, p.173). There is no translation for conservation in isiZulu. The word protect is vikela (Illman's English Zulu Phrases and Dictionary, 2005, p.141)
- Conservation is defined as "looking after all our natural resources so that there will be plenty left for the all people who will live here in the future (Moodie, et al, 2005, p.259)
- Extinct: an animal or plant species having died out, no longer exists. From the Latin, *exstinguire,* to extinguish. Extinguish exists in isiZulu as 'cima' (p.111).
- Extinct: an organism which is no longer found anywhere on earth (Moodie, et al., 2005, p.259).
- Endanger: to put in danger (p.270). Endangered in isiZulu is 'faka engozini'. (p.110). The word danger is known as 'ingozi'. (p.104).
- Endangered: in danger of becoming extinct (Moodie & Zwane, 2004, p. viii).
- Threatened: from threat, meaning that there is a strong possibility of something dangerous happening. To threaten, meaning to express a threat (p.820). In isiZulu threat is 'songa' and threaten is 'songela' (p.161).
- Vulnerable: able to be physically or emotionally hurt or exposed to attack (p. 947). From the Latin, *vulnus,* wound. Neither vulnerable nor wound is listed in this particular isiZulu source.

The terminologies were investigated to assist with the interpretation of data obtained through the research. It was necessary to ascertain whether relevant descriptive words existed in the African languages and if so, whether they had the same meaning as the English words. This would also give educators an opportunity to explain terminology in isiZulu if English was not that well understood.

Appendix L

CONCEPTS OF ECOLOGY

Biodiversity is a term used to describe the variety of living organisms on Earth, the richness of species, ecosystems and genetic variation (Irwin, 2001, p. vii). The word was coined in 1985 and during the 1990's has become very widely used in the popular media and in government and scientific circles. (Groombridge, 2003, no page number why?).

According to a school text book written by De Fontaine,et al, 2006, p.56, Biodiversity is short for biological diversity. It means variety of life on Earth and can be seen as the number of different species of living organisms on Earth.

The purpose of biodiversity is, according to Davies (1996, 132) a safety net against adverse environmental conditions, and McGinley, Tilman and Tilman and Pacala, as cited in Davies,1996,p.132) argues that more complex ecosystems are more stable and are less affected by outside stress. For example, drought, fire or high grazing pressure that impacts on grass lands, and the ecology is able to recover more quickly from these adverse conditions. The more variety in living organisms, the better chance ecosystems have to survive.
Ecosystems refer to natural systems on Earth, including a variety of habitats where the living (biotic) communities interact with the non-living (a-biotic) elements of an environment. (Irwin, 2001, p.5). A-biotic elements refer to soil, water, wind and heat, elements that have an influence on living organisms. Biotic refers to all living organisms, including plants, animals and micro-organisms. Ecosystems vary in size and depend on the system chosen for a specific study. An ecosystem can be the entire Earth or can be limited to a pond and the life found within it.

Ecology is described as the study of ecosystems. The word is Greek in origin, 'oikos', and refers to house, 'logos' is study. Cohen, as cited in Carruthers, (1982, p.3) defines ecology as a scientific study of the interactions that determine the distribution and abundance of organisms. He says "ecology therefore concerns itself with where organisms are found, why they are found there and how many occur there."

In a school text book written by Moodie,et al, 2005,p.7, "… ecosystem … means all the relationships between the living and nonliving things in an area".

Discussions on ecology involve the discussions of energy flow, food chains, trophic (feeding) levels, material cycling, change and limiting factors (Irwin, 2001, p.4). In the school curriculum for the Intermediate and Senior phase, ecology discussions include biotic and abiotic factors, habitats, food webs and competition for food, biodiversity and its role in an ecosystem (RNCS, 2002, p.62-65).

Frogs are used as an example of a primary or secondary consumer in a food chain. Tadpoles eat algae and water plants and are placed as a primary consumer or herbivore. Frogs eat other animals such as mosquitoes, flies, small fish and many more, and are placed as a secondary or tertiary consumer or a carnivore.

When biodiversity is threatened it has an influence on ecosystems as food chains and webs are weakened by the loss of species. Biodiversity crisis is defined as "the threat posed to the myriad life forms on Earth by a growing and ever demanding human population." (Davies,1996, p.28). If frogs become extinct, one can surmise what the impact would be on global ecosystems of which growing insect populations may be the least of our concerns.

Appendix L

CONCEPTS OF ECOLOGY

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Habitats:

Semlitsch, R., & Jensen, J.B. (2001) describe frog habitats in terms of buffer zones. The buffer zones are the critical areas around wetlands where frogs burrow in winter and emerge after the winter season. This would indicate that the wetlands plus the buffer zone would be the frog habitat, thus consisting of both aquatic and terrestrial territories. It is important to realize the size of the habitat needs of different frog species when considering the conservation of a particular habitat.

Carrthers (2001) describes a variety of habitats used by different frog species varying from wetlands, to trees to frogs living inside flowers and many more. Many people associate frogs with wetlands only.

Question19. Please write a short summary of story about frogs that you know of?
If you also know any famous frogs on television, in movies, in songs or in poems, you can write that down as well

it goes, pom pom wen the little green frog one day, pom, pom went the little green frog, pom pom went the litte green frog but we all know ~~fofg~~ frog one day but we all know frogs go ~~pom~~ pom pom ahh (it goes on but

Question13. Would you like to hold a frog? Please explain your answer

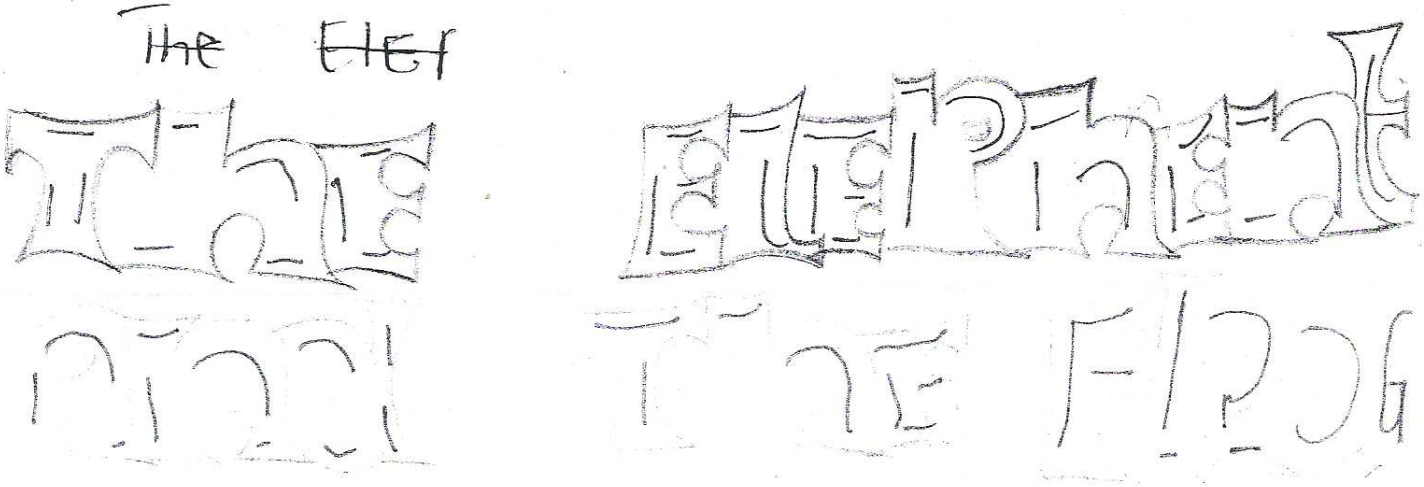
YES. Because I love ~~frog~~ frogs and I don't get out of the zoo with out seeing it I wish to have one one day at my Pre-School there were frogs in the sant we used to play with them.

Question14: If frogs were endangered, how do you think you would be able to help them?

I won't help them.

Question19. Please write a short summary or name of a story about frogs that you know of?
You can also name a poem, a song or television programme that has a frog in or any famous frog you now of.

~~The~~ ~~Ele~~



one day the lelephent. the elephant says. I can jum hiyyer that you the fleg says lets see the frog tooke the rope and tiick it on the fool then the frog jum hiyyer than the elephant. The next day the elephant came back and sad I can runn fuster than you. then the frog sad we can see. The frog went back to hes house and tooke he children then they ...t backe to the elephant. Then they ran all ...ith her children then the frog came first ...om the finished line.

Thank you very much for answering the questionnaire.

Question19. Please write a short summary or name of a story about frogs that you know of?
You can also name a poem, a song or television programme that has a frog in or any famous frog you now of.

A poem I now about frogs is that frogs never eaten people to die.

---

on tv ~~I~~ I see a ~~per~~ Garlelio he was very angre with ~~is~~ her child came with a frog in ~~her~~ his house Garlelio came and bit. ~~he~~ his child goes in her bedroom and crayed a lot after crayying he goes ~~outside~~ and pack all her clothing and go to her friend and tell her friend that he likes a frog a lot but her friend dint't under stand because he liked the frog a lot.

Thank you very much for answering the questionnaire.

Question19. Please write a short summary or name of a story about frogs that you know of?
You can also name a poem, a song or television programme that has a frog in or any famous frog you now of.

A ~~Poem~~ Story

A frog.
A frog is an animal
But you can't play with it
If I may ask is the frog a farg an
amonbian or what. well I do know that
Bye.

Thank you very much for answering the questionnaire.

Question19. Please write a short summary or name of a story about frogs that you know of?
You can also name a poem, a song or television programme that has a frog in or any famous frog you now of.

The frog hoping, hoping.

The king of the animals said to the frog, frog you are going to live on the tree with birds the frog said I want to live in water. You can't live in water We ~~wa~~ will have no fishis at all said the lion. I will if live on the water & the land the frog was happy it hopped a hopped all day long that is why the frog love hopping.

Thank you very much for answering the questionnaire.

Question19. Please write a short summary of story about frogs that you know of?
If you also know any famous frogs on television, in movies, in songs or in poems, you can write that down as well

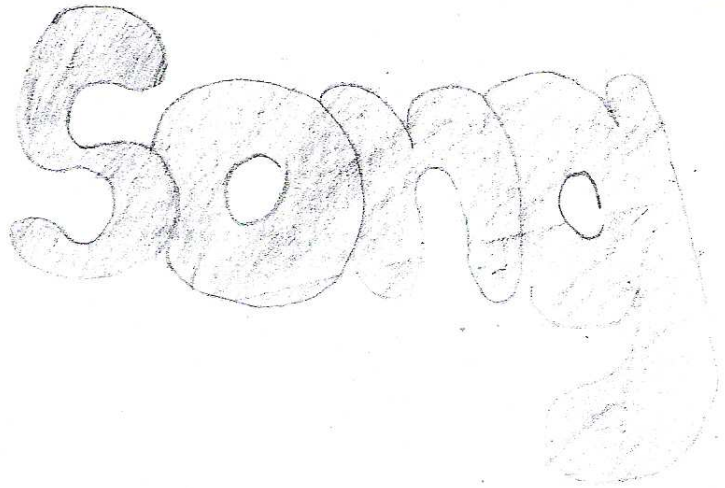
There is a Frog called Frank who has Frogpox and wants to go ice skating ~~by~~ but is not allowed to, so he paints his Face green and is mistaken For some one else and lands up in big trouble

Kermet on the muppets.

Thank you very much for answering the questionnaire.

Question19. Please write a short summary or name of a story about frogs that you know of?
You can also name a poem, a song or television programme that has a frog in or any famous frog you now of.

dont kill frog because you wont like when they kill you If you dont like go to the farm or at zoo and live it the becaus if you kill them you wont able to be a person animal. are like perso if animal kills you you will be ashemed. The end



Thank you very much for answering the questionnaire.

Question19. Please write a short summary of story about frogs that you know of?

If you also know any famous frogs on television, in movies, in songs or in poems, you can write that down as well

frogs can give you you nots if the pee on you but other wise the only things dos need is love and attention like any other animals. but frogs also need need also of water.
1) frog princess

Thank you very much for answering the questionnaire.

Question13. Would you like to hold a frog? Please explain your answer

No, I might get warts and they ~~are~~ Feel Funny.

Question14: If frogs were endangered, how do you think you would be able to help them?

Breed

Question19. Please write a short summary of story about frogs that you know of?
If you also know any famous frogs on television, in movies, in songs or in poems, you can write that down as well

That frog give you wort. a lady got wort from touching a frog and never forgave her self again. and when she touched a frog again she got more and more worts. when she touch a ~~toe~~toad the worts went away and she said thanks

Thank you very much for answering the questionnaire.