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AN INVESTIGATION INTO THE STATE OF ENVIRONMENTAL EDUCATION AND THE USE OF TECHNOLOGY IN ENVIRONMENTAL EDUCATION IN GAUTENG, SOUTH AFRICA

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ABSTRACT

Since the Industrial Revolution, humankind has consumed and used the earth's resources for its own gain, but at the expense of the earth's biosphere (Maluleke, 2005; Govender, 2011). Such impacts did not go unnoticed within the realms of education. With the roots of Environmental Education can be traced back to the 18th century when Jean-Jacques Rousseau identified the importance of Environmental Education in that it is a learning area that focuses on the environment (Eneji *et al.*, 2017). EE gained a significant boost in the 1960s and 1970s and gained a global platform in 1972. In 1972, Stockholm, hosted the United Nations Conference on the Human Environment, from which emanated a declaration to the effect that EE should be imperative as a tool to 'address global environmental problems' (Eneji *et al.*, 2017). Since the 1970s, there have been significant advances in technology: from advances in automation to the use of mobile cellular devices and computers that have become exponentially more efficient and mobile. In fact, the list of types of technologies which have been developed since the 1970s is endless (Blažek *et al.*, 2017). They have had an impact on almost every economic sector of the globe, including the education sector (Courville, 2011). The marriage of technology and EE is a perfect tool to enhance the latter. However, the implementation of both within the schooling system is often notably slow, as in South Africa. In line with this, the state of environmental education and how technology is used for it is largely unknown within South Africa.

In line with this, this study investigates the state of Environmental Education and the use of technology in Environmental Education in the Further Education and Training (FET) phase presented by Gauteng secondary schools of South Africa. For which data was collected from educators' utilising a questionnaire survey and was analysed by means of a SWOT analysis. The study found that similar challenges are faced in the implementation of both EE and technologies such as GIS and ICTs into the school systems in South Africa as are faced in countries around the world including South Korea and Tanzania. With the largest barrier to their implementation being a lack of access to resources. However, respondents of the study have largely embraced EE and the potential it has in creating environmentally literate citizens.

Keywords: Environmental Education (EE); South Africa; Information and Communication Systems (ICT); Implementation of EE in South Africa; SWOT analysis.

LIST OF ABBREVIATIONS

CAPS - Curriculum and Assessment Policy Statements

DBE - Department of Basic Education (South Africa)

EE - Environmental Education

EEASA - Environmental Education Association of Southern Africa

EECI - Environmental Education Curriculum Initiative

EEPI - Environmental Education Policy Initiative

EPA - Environmental Protection Agency (United States of America)

FET - Further Education and Training

GET - General Education and Training

GIS - Geographic Information Systems

ICT - Information and Communication Technologies

IT - Information Technology

IUCN - International Union for the Conservation of Nature

MOE - Ministry of Education (Taiwan)

NAAEE - North American Association for Environmental Education (United States of America)

NCS - National Curriculum Statement

NEEP - National Environmental Education Programme (South Africa)

NEMA - National Environmental Management Act of 1998 (South Africa)

NQF - National Qualifications Framework

NTU - National Taiwan University (Taiwan)

OBE - Outcomes-Based Education

OECD - Organisation for Economic Co-operation and Development

OEE - Office of Environmental Education (United States of America)

RNCS - Revised National Curriculum Statement

SLP – Short Learning Program

UNEP - United Nations Environmental Programme

UNESCO - United Nations Educational, Scientific and Cultural Organization

USA - United States of America

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CHAPTER 1: ORIENTATION OF STUDY

1.1 INTRODUCTION

In the past, Environmental Education (EE) was not taught directly in the South African context at the school or classroom level. It was only through school outings or excursions to botanical gardens, museums, nature-orientated or school camps - to name but a few - that EE could be taught directly in South Africa (until around the late 1980's) and in fact in many countries around the world (Mosidi, 1997). It was not until major international conferences aimed at addressing environmental issues and development that the importance of EE was realised by governments around the world.

The world's first Intergovernmental Conference on EE took place in October, 1977 in Tbilisi, Georgia, and was organised by UNESCO (United Nations Educational, Scientific and Cultural Organization) in partnership with the UNEP (United Nations Environmental Programme). During this conference, the Tbilisi Declaration was adopted. It decrees the importance of EE in society - at all levels and for all ages in formal and non-formal settings. The Declaration lays out the role and objectives, as well as the tenets of EE, and perhaps, most importantly, provides twelve guiding principles for Environmental Education (UNESCO, 1978).

Such conferences most notably include the United Nations Conference on the Environment and Development (otherwise known as Earth Summit), which was held in Rio de Janeiro from the 3 -14 June, 1992. Agenda 21, which was adopted at the Rio Conference, stated that signatory governments (*inter alia* South Africa) should strive to "update or to prepare strategies aimed at integrating the environment and development as cross-cutting issues into all levels of education within three years following the conference, and that this should be done in cooperation with all sectors of society" (UNEP, 1992). Agenda 21 recommended that a multidisciplinary approach be taken in respect of environmental and developmental issues, along with their socio-cultural and demographic aspects, and that linkages between them be considered (UNEP, 1992).

It is in terms of the above-mentioned declarations and conferences a platform was provided from which EE could take place both on a global and national scale. Evidence for this is seen in the fact that EE has been accepted globally, with almost every nation

signing agreements formulated at intergovernmental conferences for EE, as well as at environmental and development conferences (Mathenjwa, 2014). There is further evidence of the leading role taken by numerous states and national governments around the world in their development of curricula and policies for EE to be integrated into their respective schooling systems. Such examples include New South Wales in Australia; the Netherlands, as well as several states (e.g Wisconsin) in the United States of America (Jacobson, 2006). South Africa can also be included in this group to the extent that multiple policies and laws have been put in place to accommodate EE as a learning area in the country's school curricula. The most obvious example of this is the National Environmental Management Act (NEMA) (1998), which commits the South African government to sustainable development, and emphasises the need for EE and capacity-building in all sectors of South African society (Strydom *et al.*, 2007).

The South African national government has realised the importance of technology within the realms of education. One minor example of this the emphasis that the South African Department of Basic Education has placed on the importance of applying new technologies such as Information and Communication Technologies (ICTs) and Geographic Information Systems (GISs) in the Further Education and Training (FET) phase of the Geography syllabus (DBE, 2011a). Technologies such as GIS and ICT (the internet; smartboards, etc.) can be used in numerous ways to optimise Environmental Education and to enhance student performance in the classroom. The opportunities that such technologies present for EE and for secondary education as a whole are boundless. However, there are often significant barriers to the application of such technologies in the classroom as a result of financial constraints and the limited access to resources, especially in developing countries, including South Africa, which has one of the highest rates of inequality in the world (Harber & Serf, 2006.; Breetzke *et al.*, 2011).

1.2 BACKGROUND

Since the Industrial Revolution, humankind has consumed and used the earth's resources for its own gain, but at the expense of the earth's biosphere (Maluleke, 2005; Govender, 2011). As a result of the anthropogenic influences contributing to and accelerating climate change over the world, the consequences of this trend can

already be observed on a global scale (UN, 1992a; Vitousek *et al.*, 1997; Karl & Trenberth, 2003; Hoegh-Guldberg & Bruno, 2010).

These effects of climate change have not gone unnoticed in the realm of education. In fact, the roots of Environmental Education (EE) can be traced back to the 18th century when Jean-Jacques Rousseau identified the importance of Environmental Education in that it is a learning area that focuses on the environment (Eneji *et al.*, 2017). Rousseau established one of the first Environmental Education programmes, known as 'Nature Study', in the late 19th and early 20th centuries. It acted as a platform from which Environmental Education could be built upon.

Environmental Education gained a significant boost in the 1960s and 1970s and gained a global platform in 1972. In 1972, Stockholm, the capital of Sweden, hosted the United Nations Conference on the Human Environment, from which emanated a declaration to the effect that Environmental Education should be imperative as a tool to 'address global environmental problems' (Eneji *et al.*, 2017).

Since the 1970s, there have been significant advances in technology: from advances in automation to the use of mobile cellular devices and computers - in the form of laptops - that have become exponentially more efficient and mobile. The ultimate development has been the creation of the internet. In fact, the list of the types of technologies which have been developed and advanced since the 1970s is endless (Blažek *et al.*, 2017). They have had a significant impact on almost every sector - including the educational sector - of the global economy (Courville, 2011).

According to Courville (2011), the role of technology in a traditional educational setting is to provide for increased efficiency and effectiveness in education that moves towards the acquisition of knowledge and skills. Courville (2011) further adds that technology can be of assistance in the field of education in two primary ways, namely in the removal of physical barriers to learning, and secondly, in the "transition of focus from the retention of knowledge to its utilization" (Courville, 2011:3). In line with this, the marriage of technology and Environmental Education is a perfect tool to enhance the latter. However, the implementation of both within the schooling system is often notably slow, as in South Africa.

1.3 PROBLEM STATEMENT

Environmental Education (EE) made its first appearance in South Africa during the 1960s (Le Grange, 2002), but only featured nationwide in 1989 in the form of the 1989 White Paper on Environmental Education (Mosidi, 1999). This White Paper attempted to include guidelines taken from those adopted at the international conferences on Environmental Education held in Belgrade (1975) and Tbilisi (1977) (Le Grange & Reddy, 1997). However, these papers were never enacted in parliament and thus Environmental Education (EE) was not implemented nationwide at this stage. It was not until 1995, in the White Paper on Education and Training - that Environmental Education was listed as one of the key principles for Education and Training in South Africa in the 21st century (Le Grange, 2002). However, it is not clear to what extent Environmental Education is being taught in accordance with the South African secondary school curricula and to what extent technology, as in the case of Information and Communication Technology (ICT) and Geographic Information Systems (GIS), has been implemented in Environmental Education (Agnes & Nor, 2010).

The use of technology can greatly enhance the effectiveness of teaching subjects within an educational environment. According to Bednarz (2004), one such technology which can form an integral part of Environmental Education programmes is GIS. However, each year, when the South African Department of Basic Education (DBE) releases its diagnostic report breaking down the results of the final examinations, the conclusion that it comes to is that a fundamental knowledge of technologies such as GIS is generally lacking in the learners (and teachers) (DBE, 2014). The report further states that "many teachers are not familiar with GIS and are just teaching definitions but not the application of the techniques and skills" (DBE, 2014:105).

On the grounds of these circumstances, therefore, this study investigates the state of EE and the use of technology and GIS in the teaching of Environmental Education. Furthermore, it assesses the ability of educators to use technology and to teach GIS in the classroom environment.

1.4 AIMS AND OBJECTIVES OF THE RESEARCH

The main aim of this study is to investigate the state of Environmental Education and the use of technology in Environmental Education in geography in the Further

Education and Training (FET) phase presented by Gauteng secondary schools. The identified objectives that are related to the abovementioned aims are as follows:

- assess the degree of Environmental Education that is taught in Geography in the FET phase of selected secondary schools in Gauteng;
- determine the educators' viewpoints in respect of the status of Environmental Education in the Geography curriculum; and
- determine the use of technology and geographical information systems (GIS) in the teaching of Environmental Education in the Geography curriculum.

Each action that we as members of society perform could have a significant impact upon the environment and the planet's biosphere. It is vital that Environmental Education should be taught effectively at all levels of schooling around the world in order to produce an environmentally conscious perspective in world citizens and to ensure that the world's ecosystems are preserved for future generations.

1.5 OPERATIONAL DEFINITIONS OF TERMS

Owing to the fact that different researchers define terms in different ways, depending upon the context of the study, it is important to define important terminologies in the study in question in order to provide clarity and avoid any ambiguity (Mathenjwa, 2014). It is for this reason that two key terms have been defined below so that readers of this study can understand the research results in the same manner as the researcher has understood them. The terms that have been defined below should be viewed in the context of Environmental Education and the relevant technologies (e.g. ICT and GIS).

1.5.1 Information Communication Technology (ICT)

Information and Communication Technology or ICT encompasses the infrastructure and the components that allow for modern computing. There is no single global definition for ICT, but it is generally accepted as referring to all devices, networking components, systems and applications that allow users to interact with the digital world (Rouse, 2017). Since the components of ICT rely on the Internet and mobile spheres, which are in turn powered by wireless networks, an ever-growing list of components, including computers and smartphones, are relevant. In fact, ICT is sometimes used synonymously with Information Technology (IT) (Rouse, 2017).

1.5.2 Environmental Education

Environmental Education (henceforth referred to as EE) is a broad interdisciplinary term which tends to be integrated into school curricula as a cross-curricular theme. EE encompasses all aspects regarding environmental issues, which include awareness; sensitivity and attitude, to name but a few facets which reflect how the subject "feels" towards the environment (Tarabu & Fierrak, 2007). EE requires the development of skills which are necessary to identify and solve environmental crises in order to promote a healthy environment at all levels of governance (local, regional and national) (NEEP, 2000). On the other hand, the International Union for the Conservation of Nature (IUCN, 2008:7) states that "Environmental Education is the process of recognising values and clarifying concepts in order to develop the skills and attitude necessary to understand and appreciate interrelatedness among people, their culture and biological surroundings".

EE is perceived as a learning process which aims to increase people's knowledge and awareness of the environment, along with associated challenges. It helps to develop the necessary skills and expertise in order to address identified challenges and promotes attitudes and appropriate commitments in order for the learner to make informed decisions and to take responsible action (UNESCO, 1978). Furthermore, EE is a set of practices, which, in combination with one another, provide individuals and communities with the tools they need. Furthermore, it makes them accountable for their actions (Mathenjwa, 2014).

1.6 OUTLINE OF THE STUDY

The study consists of five chapters, the contents of which are briefly highlighted below.

1.6.1 Chapter 1

This chapter is about the orientation of the study and provides details concerning the steps which were followed when the research was conducted. With the purpose of the chapter being to inform the reader of the specific problem that was researched, this chapter provides a comprehensive picture of the research study. It is in this chapter that the following are provided to orientate the reader towards the study: an introduction; the background to the problem/issue; a problem statement; the aims and objectives of the study; operational definitions of terms, as well as an outline of the study.

1.6.2 Chapter 2

Chapter 2 focuses on reviewing the literature consulted for the purposes of this study. It is in this chapter that past and current research studies and literature relating to the research topic are examined, analysed and questioned in order to construct a theoretical background to the study. It further provides extensive information on what other researchers have found on the same and related topics. Apart from these aspects, it also allows the reader to gain a comprehensive and holistic understanding of past research at both an international level and a national (South African) level. This chapter also examines international case studies regarding the implementation of EE in secondary schooling systems in countries around the world, such as Lithuania, the United States of America (USA), and South Korea to name but a few.

1.6.3 Chapter 3

Chapter 3 explains the research methodology which was used during the study. The chapter provides in-depth details about the various research methodologies (e.g. questionnaires and interviews) which were used during the period over which the study was conducted, and the data collection platforms used. Along with this, it explains the manner in which the methodologies were used in order to collect data from the identified study group. Furthermore, it explains which ethical issues, if any, acted as guidelines in the selection of the sample groups participation in the research study.

1.6.4 Chapter 4

Chapter 4 contains information regarding the analysis of data and also includes an interpretation of the research findings pertaining to the study. The data analysis is comprised of numerous sets of tables, graphs, illustrations and figures. The chapter also contains summaries of the results which were obtained and interpretations of the results made by the author regarding the views of educators towards EE and the use of technology in EE (e.g. ICT and GIS).

1.6.5 Chapter 5

Chapter 5 discusses the findings of the research which were obtained during the overall research process in order to formulate conclusions of the research study. Chapter 5 serves as the concluding chapter of the research, drawing upon the various themes which have emerged from the research process in order to assess whether the primary aim and the objectives which were identified have been met.

This chapter further includes recommendations for future studies on similar topics as well as further reflections of what could have been done in order to improve the study – if it were to be repeated – are then presented.

1.7 CONCLUSION

This chapter has provided an introduction to the research ideas and provided an orientation towards the research study which is to be presented in the research study. With the problem being identified, the aims and objectives of the research study were presented. With the primary aim being “to investigate the state of environmental education and the use of technology in environmental education in the Further education and Training phase presented by Gauteng secondary schools” of South Africa. It has highlighted the importance of EE in education at all levels in society, especially over recent decades. By doing this, it has also highlighted the vast number of challenges which have been experienced in implementing EE in school curricula around the world, both at primary and at secondary school levels. While it is important to acknowledge the importance of EE in education systems around the world, the use of technology to enhance learning in the classroom environment can play an equally important role, especially with regard to EE in the classroom environment.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter sets out to review and examine the literature sources relevant to the study topic. It specifically examines the history of environmental education; its integration into school curricula, and specifically in the South African context. In line with these aspects, this chapter reviews the opinions of educators towards integrating EE into education systems and specific curricula around the world. Before finally examining the importance of the use of technology in education systems, EE is considered - especially in respect of two opposing contexts, namely in terms of developed and developing countries.

Countries around the world - including South Africa - have made it an objective of theirs to implement EE into their respective schooling systems as a cross-curricular theme. These efforts are observed throughout the annual international conferences which take place in cities around the world, and during which various resolutions are made to implement EE globally. As a result, the South African government (a signatory to numerous international conventions) has committed to addressing the global environmental crises through education (Schudel *et al.*, 2008).

EE and nature studies have been included as key learning outcomes in almost all of the eight learning areas in the South African school curriculum (Symmonds, 2008). While the status of the implementation of EE into school curricula is unknown to an extent (Le Roux & Maila, 2004), the views of educators towards EE in the classroom, as well as outside of it, remain not clear to a large extent. It is vital that educators develop a positive view towards EE for content in their respective curricula regarding the environment and that their learners be taught successfully. For this reason, literature from countries around the world needs to be examined to assess the role of teachers in EE and their views in respect of this field of study.

The implementation of technological programmes such as ICT and GIS are perfectly aligned with the teaching of EE in the 21st century and can be used to enhance learning in the classroom. This perception has led the Department of Basic Education (DBE) to acknowledge the potential for using such technology in the government schools of South Africa and has caused it to include these programmes in the Geography

syllabus of the CAPS curriculum (DBE, 2011a)[1]. The importance of and potential for applying both GIS and ICT are recognised by the Department in that both are included in one of the nine aims of the Geography syllabus for the Further Education and Training Phase: Grades 10-12. This aim, mentioned above, is to promote "the use of new technologies, such as Information Communication Technology (ICT) and Geographic Information Systems (GIS)" (DBE, 2011a:8).

This is one example of how new technologies have been included in the Geography curriculum for secondary education in South Africa. An in-depth analysis of this will be undertaken in the sections below, with a focus being paced on EE within the subject of Geography. However, before any analysis can be undertaken, it is necessary to discuss and examine the history of EE in a global context, as well as in the South African context.

2.2 THE HISTORY OF ENVIRONMENTAL EDUCATION

The roots of EE can be found as early as the 18th century, when Jean-Jacques Rousseau, in his book *Emile: On Education,* emphasised the importance of an education focusing on the environment (Eneji *et al.*, 2017). This call was emphasised again several decades later by Louis Agassiz, a Swedish naturalist, who firmly believed in Rousseau's approach and called for students to 'study nature, not books' (Disinger, 1985).

It is perhaps through these scholars that a foundation for an EE programme, known as Nature Study, was laid. The programme was presented in the late 19th and early 20th centuries, and gained popularity in the USA during this period (Eneji *et al.*, 2017). It was Disinger who identified three stages or experiences which preceded EE as we know it today. These were: Nature Study; Conservation Education and lastly, Outdoor Education (Disinger, 1985).

The Nature Study movement used fables and stories along with moral lessons to help students develop an appreciation of nature and allow students to appreciate the world around them. An academic by the name of Anna Botsford Comstock was a prominent figure in this movement. She went on to write a handbook for Nature Study in 1911 (Chase, 1985). However, even this was pre-dated by the writings of two authors

[1] CAPS (the Curriculum and Assessment Policy Statements) forms part of the Department's National Curriculum Statement and is used in the country's government schools (Simelani, 2013).

named John Muir and Enos Mills, who were perhaps the first to popularise nature as a source of recreation and relaxation in the early 1900s (Nash, 1989). Comstock and other prominent figures in the movement, including Liberty Hyde Bailey (Comstock's mentor), helped to develop Nature Study through a popular movement amongst various groups of society including teachers and scientists. This eventually led to changes being made to the science curriculum for children in the USA in order to accommodate this new perspective (Chase, 1985; Eneji *et al.*, 2017).

By the 1920s, a new type of EE had emerged - in part due to the Great Depression and the Dust Bowl events which took place in the USA during the 1920s and 1930s (Eneji *et al.*, 2017). This new type of EE was called 'Conservation Education' and focused on scientific training as opposed to natural history. Thus, it was seen as a major scientific management and planning tool which could assist in solving the social, economic and environmental problems facing the USA during the 1920s and 1930s (Eneji *et al.*, 2017).

Conservation Education extended the ideas of Muir and Mills that nature can be used for enjoyment and for recreational activities, while at the same time it emphasised the fact that there is a need to conserve the natural environment so that natural resources can be used and consumed indefinitely. Such ideas of conservation were echoed by the renowned American author and pioneering environmentalist, Aldo Leopald, in his book, one of the first to explore the relationship between people and the environment, entitled *A Sand County Almanac* that was posthumously published in 1949 (Leopald, 1949; Bodzin *et al.*, 2010:5). This book went on to become and still is the "cornerstone of the American Environmental movement and of modern environmental thinking and writing" (Bodzin *et al.*, 2010:5). Conservation Education, elements of which can still be found in EE as we know it today, continued to gain momentum throughout the middle of the 20th century, but eventually made way for the rise of outdoor education in the years following World War II (Swan, 1975; Roth, 2008; Eneji *et al.*, 2017).

Outdoor Education attempted to combine elements of Nature Study and Conservation Education in the years immediately following World War II and was regarded as a teaching methodology which drew from both Nature Study and Conservation Education (Disinger, 1985). The underlying philosophy for outdoor education can be largely traced back to John Amos Comenius (1592-1670), who placed the emphasis

on learning which involved the senses. Outdoor education came to be perceived as a study largely involved with school camping (Sharp & Partridge, 1947). It was during the post-war years that Outdoor Education and school camps became increasingly commonplace in the schooling system (Sharp & Partridge, 1947).

The three abovementioned precursors to modern EE continue to be active fields contributing to the knowledge base of EE, yet still benefiting from EE's own spinoffs. It was Holsman (2001) who stated that the modern EE movement that is known today and which gained momentum in the 1960s and 70s, stems from Nature Study and Conservation Education.

The dissemination of environmentally-focused programmes did not occur until the 1960s, when attempts were made to reach international standards for the conservation and protection of the environment (Eneji *et al.*, 2017). However, before this period, numerous academics expressed concern for the environment and the effects that humans were having on it.

The relevant academic literature at this stage included Emerson's *Nature* (1836) and George Perkins Marsh's *Man and Nature* (1864), and later, the works of Robert Marshall (1901-1939) and Aldo Leopald (1887-1948) (Stegner, 1990). The difference between the thought processes of the academics mentioned above, together with the premises of the EE philosophy, which emerged in the 1960s, is that these thought processes focused on the conservation of resources and on the preservation of habitats whereas in modern EE the focus is on the quality of the environment, environmental awareness, and environmental literacy (Stegner, 1990).

Although the International Union for the Conservation of Nature (IUCN) was established in October 1948 in Paris, it took the work of an environmentally literate bureaucrat by the name of Rachel Carson to shift the environmental movement up a gear. It was Carson who authored the iconic *Silent Spring* in 1962 to bring the attention of the public to the threats that pesticides pose to both the environment and society (Carson *et al.*, 1962).

There was a second book, authored by Steward Udall[2] and entitled *The Quiet Crisis*, which was published in 1963. It was almost as influential as *Silent Spring*, and also

[2] President John F. Kennedy's Secretary of the Interior

promoted this shift in thought (Carson *et al.*, 1962). The book went on to raise the alarm to the threats that inter alia pollution poses to the natural resources of America and called for the protection of the USA's natural resources.

It was in the year of 1969 that the first definition for EE made its appearance in the inaugural issue of the *Journal of Environmental Education*, first published in the autumn of 1969. The definition first featured in an article by Stapp *et al.* (1969) who insisted on the necessity of EE in society. Stapp later went on to become the first Director of Environmental Education for UNESCO. The definition provided by Stapp *et al.* (1969:1) was worded as follows: "Environmental Education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution". Later in 1969, President Nixon passed the National Environmental Education Act, which was meant to incorporate EE into K-12 schools in the USA.

In the international context, EE gained international recognition when one of the most important international conferences regarding the environment took place. This was the United Nations Conference on the Human Environment, which was held in 1972 in Stockholm, Sweden. It was during this conference, that a declaration mandated that EE had to be applied as a tool to address global environmental problems. UNESCO, along with the United Nations Environmental Programme (UNEP), subsequently formulated three major declarations which have guided the course of EE and which are elaborated upon in the sections to follow (Eneji *et al.*, 2017).

However, it was the two international conferences which took place during the same decade of the 1970s which today remain as the central hubs for EE on the global stage. These conferences took place in 1975 and 1977. The first was the International Workshop on Environmental Education which was run in Belgrade, Yugoslavia (now Serbia), and which produced what is now known as the Belgrade Charter (UNESCO-UNEP, 1976). The Belgrade Charter aimed to build on the framework which had been established during the Stockholm Conference, and went on to describe the goals, objectives, target audiences, as well as the guiding principles of EE. Furthermore, it went on to propose what is now the most widely recognised definition of EE:

> "Environmental Education is a process aimed at developing a world population that is aware of and concerned about the total environment and its associated problems, and which has the knowledge, attitudes, motivations, commitments, and skills to work individually and collectively towards the solutions of current problems and the prevention of new ones" (UNESCO-UNEP, 1976:13).

The first of the abovementioned conferences was the world's first Intergovernmental Conference on Environmental Education, which took place in Tbilisi, Georgia, in 1977. The outcome was the document now known as the Tbilisi Declaration (UNESCO, 1978), which in many aspects remains as the definitive document for what EE is and what EE should be.

The goals formulated in the Tbilisi Declaration have provided the foundation for the majority of fieldwork undertaken since 1977 (UNESCO, 1978; Mosidi, 1999). The Tbilisi goals include the following:

- to foster clear awareness of and concern about economic, social, political and ecological interdependence in urban and rural areas;
- to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment; and
- to create new patterns of behaviour towards the environment in individuals, groups and society as a whole (UNESCO, 1978).

The Tbilisi Declaration "noted the unanimous accord in the important role of Environmental Education in the preservation and improvement of the world's environment, as well as in the sound and balanced development of the world's communities" (UNESCO, 1978:13). This can be regarded as the transition from traditional approaches of conservation towards sustainable development. The Declaration which emerged from the conference went on to update and clarify these goals, objectives, tenets, and guiding principles which first emanated from the Stockholm Declaration in 1975, and led to the emergence of the Belgrade Charter two years later (Mosidi, 1999).

The principles which were set out for EE in the Tbilisi Declaration include the following:

- consider the environment in its totality, that is, its natural, human-made, technological, socio-economic, cultural, moral, and aesthetic aspects;
- Environmental Education should be conducted as a continuous lifelong process, beginning at the pre-school level and continuing through all the formal and informal phases of education;
- Environmental Education should be interdisciplinary in its approach, drawing on the specific content of each discipline, thus making a holistic and balanced perspective possible;
- Environmental Education should examine major environmental issues from local, regional, national and international points of view so that students may gain insights into environmental conditions in other geographical areas;
- Environmental Education should focus on current and potentially problematical environmental conditions whilst taking into account the historical perspective;
- Environmental Education should promote the perception that local, national and international co-operation is valuable and necessary in preventing and solving environmental problems;
- Environmental Education should enable learners to play a role in the learning experience and provide them with opportunities for making decisions and accepting their consequences;
- Environmental Education should bring environmental sensitivity, knowledge, problem-solving skills, and value clarification to every age category, but with special emphasis being placed on environmental sensitivity to the learner's own community in his/her early years;
- Environmental Education should emphasise the complexity of environmental problems and thus the need to develop critical thinking and problem-solving skills; and
- Environmental Education should be a means of using diverse learning environments and a broad array of educational approaches to investigate all aspects of the environment. Practical activities and first-hand experience should form part of the learning and teaching process (UNESCO, 1978; Mosidi, 1999).

Elliot (1994) went on to state that EE encourages reflective responsible action where students should:

- perceive the environment as a sphere of personal experience;
- examine the environment as a subject of inter-disciplinary learning and research;
- shape the environment as a sphere of socially important action and interaction; and
- accept the environment as a challenge to initiate responsible action (Mbatha, 2003).

While the above-mentioned international conferences are regarded as hallmark milestones for EE, there have been numerous other international meetings geared towards sustainable development and EE. Such meetings and conferences include the World Commission on the Environment and Development which took place in 1988 in Norway and was hosted by the Norwegian Prime Minister at the time, Mrs. Bruntland. The Commission produced a document by the name of *Our Common Future*, which is otherwise known as the Bruntland Report (Bruntland, 1987; Eneji *et al.*, 2017). The report placed importance on the relationship between the nature of the underdeveloped parts of the world and the social and environmental problems that prevailed during the 1980s. Furthermore, the report is an assessment of the earth's health. In fact, it presents scenarios of the level of atmospheric pollution; desertification; water shortages, and other threats to the biosphere (Bruntland, 1987; Eneji *et al.*, 2017).

Four years later, in 1992, the United Nations Conference on the Environment and Development, which took place in Rio de Janeiro, Brazil, produced a document known as *Agenda 21* (UNEP, 1992). Agenda 21 was essentially an action plan for governments at different levels to sign various agreements and to promulgate legislation which had been agreed upon beforehand by governmental bodies and organisations. Chapter 36 of Agenda 21 specifically deals with public education, awareness and training. This alone illustrates the importance of the role of education and the importance of positioning EE in the perspective of sustainable development (UN, 1992b; Eneji *et al.*, 2017).

It was in 2002, at the World Summit on Sustainable Development, in Johannesburg, that commitments for the full implementation of Agenda 21 were made. A programme for the further implementation of Agenda 21 was devised along with commitments being made in line with the Rio Principles of 1992 (UN, 2017).

The facts mentioned above illustrate how EE came to rise as a movement which has strong ties with specific forms of education such as Nature Study and Conservation Education. Government bodies have in fact come together to recognise the important role that EE plays in moulding citizens who are aware of environmental issues, and in providing them with the knowledge and skills to address these issues. Little is known, however, of the extent of the actual implementation of EE in the school system. This is compounded by the fact that the views and opinions of educators in respect of EE are also largely unknown (Budvytytė, 2011). It is also vitally important to ascertain whether educators tend to approach EE positively and whether they do in fact acknowledge issues such as climate change. The section below briefly investigates the implementation of EE in global school systems, as well as the mindsets of educators towards EE.

A detailed history of EE is provided in the section above in order to illustrate to the reader the development and evolution of EE into what we now it as today. This allows one to understand how both the philosophy of EE has evolved over time as well as what has shaped and influenced the development of EE. Such influences and developments have also influenced how EE has been implemented into education systems around the world.

2.3 IMPLEMENTATION OF ENVIRONMENTAL EDUCATION

Almost every country around the world has embraced the ideologies surrounding EE over the past five decades - since the 1970s (Gough & Gough, In Press). It was during this period that the three-major landmark conferences based on EE took place and from which landmark documents emanated. The relevant conferences were the Stockholm Declaration of 1972; the Belgrade Charter of 1975, and the Tbilisi Declaration of 1977 (Gough & Gough, In Press; UN, 1972; UNESCO, 1978; UNESCO-UNEP, 1978). However, while national governments have embraced EE as the culmination of a movement towards this worthy discipline, the implementation of EE in the respective national educational curricula at all levels (e.g. primary, secondary and

tertiary) has met with varying levels of success around the world. It is for this reason that the extent to which EE has been integrated into the national curricula of specific countries needs to be investigated.

The factors which need to be considered include how EE is taught in the school system and whether it is in fact taught by trained/skilled educators. Also relevant are the views of educators towards EE, a factor that is often overlooked. As presented in this literature review, the *modus operandi* for investigating these considerations is set out as follows:

- first examine the implementation of EE in the education systems of the United States of America (USA);
- discuss the implementation of EE and its respective education systems in South Korea;
- investigate the implementation of EE in numerous sub-Saharan African countries; and
- focus upon the South African context.

The reason behind this approach is so that both the author and the reader can gain an understanding of and a perspective on the implementation of EE in secondary educational systems around the world by considering the USA and South Korea (where education systems are seen to be highly developed) as case studies (Fasolya, 2016). References made to countries in sub-Saharan Africa such as Botswana; Namibia and Tanzania, will allow for a regional perspective to be gained of the implementation of EE in the context of South Africa. Special attention will be given to South Africa and the information will be used as a focal point of discussion in terms of the country's implementation of EE specifically at the secondary school level.

2.3.1 The United States of America

The United States is one of the founding countries of EE and is therefore expected to have a strong foundation supporting EE in its school curricula. From the literature available, it is clear that the implementation of EE in curricula is at the state level, with legislative guidance being provided at the federal level (Bartosh, 2003). It should however, be noted that there is no uniform state policy regarding EE in the United States. This means that the majority of decisions in terms of EE are adopted at the state, federal, or even school level (Bartosh, 2013; Fasolya, 2016).

EE in this country assumes a vast number of forms, methodological approaches and directions, all of which focus on the ultimate goal of developing a student's environmental literacy. This may be achieved in the ways identified above, with the focus being on environmental ethics in the context of all of the disciplines.

The dedicated involvement of communities and non-governmental organisations also plays an important role in this respect (Fasolya, 2016). The primary role of government at the federal level is to finance and fund initiatives and programmes concerning EE and to further enact and enforce federal legislation concerning both the environment and education (Fasolya, 2016).

Federal legislation concerning the environment is divided into legal acts in the field of environmental expertise and acts pertaining to specific resources. The first of the two groups include acts such as the National Environmental Policy Act of 1969, otherwise known as NEPA, which imposes a responsibility on the federal authorities to protect the environment and to oversee the realisation of environmental standards, along with making preliminary assessments of the impacts of legislation on the environment and the long-term programming of environmental activities (Fasolya, 2016).

Amongst numerous other acts, the second group includes the Clean Water Act and the Clean Air Act. It is these federal acts which give power and authority to the Environmental Protection Agency (EPA), established in 1970. The EPA aims to improve the quality of the environment; to assess federal programmes in terms of environmental protection and to organise measures on, amongst others, the scientific and practical protection of the air and water resources (Fasolya, 2016).

It is thus appropriate that in 1990 the National Environmental Education Act was enacted to promote EE, with the EPA playing a crucial role (Fasolya, 2016). This Act authorised the establishment of the Office of Environmental Education, an environmental education and training programme. This programme funds environmental education grants and student fellowships. Along with the President's Environmental Youth Awards, the Federal Task Force, and the National Advisory Council.

According to the EPA, EE promotes investigations into environmental problems involving problem solving, as well as measures to conserve and preserve the environment. It allows students to gain a comprehensive understanding of

environmental problems and, importantly, to gather the skills required to make the right decisions (Fasolya, 2016).

According to the US EPA (2016), there are five components of EE which include the development of skills and abilities needed to detect and resolve environmental issues. In order to enhance a student's environmental literacy, the EPA established the Office of Environmental Education (OEE) for the United States (in line with the National Environmental Education Act of 1990). There are a dozen goals formulated by the OEE (Fasolya, 2016), the last and most important of which is to "provide information on environmental education and training programs to local education agencies, state education and natural resource agencies, and others" (US Environmental Protection Agency, 2016:3328).

During the 1990s, the North American Association for Environmental Education (NAAEE) took charge of a major initiative to develop common standards of practice for use in the field (Ardoin & Merrick, 2013). This initiative was the National Project for Excellence in Environmental Education, which presented guidelines for excellence in attempting to define the content and focus of EE programmes, the nature of the materials used, and the level that professional development should attain in order to be considered to be of a high standard (Ardoin & Merrick, 2013). This project further attempted to show how the environment should be viewed within the context of human influences (Ardoin & Merrick, 2013).

EE itself has been embraced by many public schools in the United States. Examples of this can be seen through the polls held in 2011 by the Public Policy Institute of California, which revealed that 90% of the respondents thought that EE should be taught in public schools (Coyle, 2005). However, it should be mentioned that the incorporation of EE into public school curricula has been made increasingly difficult as a result of recent legislative reforms in the K-12 school system (Ardoin & Merrick, 2013).

Furthermore, numerous schools in the USA have in fact started introducing their own EE courses and sustainability approaches on their campuses. A movement which reflects this is the Green School Movement, which gathers federal support from competitions such as the 'Green Ribbon Schools Competition', which is organised by the Department of Education. This competition aims to recognise schools which are

leaders in mitigating the effects of environmental impacts, improving the health of students, and providing EE courses of a high standard (Coyle, 2005; Ardoin & Merrick, 2013).

'Hotspots' for EE in the school systems of the USA can often be found where universities offer EE in their undergraduate programmes and/or postgraduate programmes. Such examples can be found in the Midwest of the country (e.g. amongst others, at the University of Wisconsin; Ohio State University and Southern Illinois University). These universities are active in promoting EE in the schooling system and in disseminating information, while, on the other hand, regional associations such as the New England EE Alliance works towards supporting EE practitioners. In its turn, the NAAEE, which acts as an umbrella organisation for EE operations in North America, provides regional support and guidance (Ardoin & Merrick, 2013).

The detailed discussion above has outlined the theoretical implementation and support structures for EE in the USA, but a discussion around the implementation of EE in school curricula as such and the incorporation of EE into secondary school curricula has not featured at all. The reason for this is a large absence of literature concerning the extent to which EE has been implemented in secondary level schools in the USA. This is compounded by the fact that there is no literature concerning the views of educators, who play a vital role in educating citizens towards environmental literacy.

This is a matter for concern since the USA is one of the founding nations that initially promoted EE and is regarded by both developed and developing countries as an example in developing and improving educational systems. Furthermore, the issue explained above pinpoints the gap in literature which is needed to further develop EE on a local, regional and global scale.

2.3.2 Republic of Korea (South Korea)

A country which may not be an obvious example or case study for the implementation of EE in its educational curricula is the Republic of Korea (South Korea). Being the third most densely populated state in the world and accommodating a society that is highly advanced technologically and where competition is fierce, it is, importantly, a country in which education is vital to success (Govender, 2011).

The structuring of the education systems established by the South Korean Ministry of Education and Human Resources Development follows a similar pattern to that of

most education systems around the world in the sense that learners move from pre-school, to elementary school and then on to secondary schooling, whereupon the opportunity is provided for them to study at a tertiary institution or college (Govender, 2011).

What is notable in the South Korean schooling system is that secondary schooling is not mandatory (Govender, 2011). However, according to a study in 2005 by the OECD (Organisation for Economic Co-operation and Development), of 31 countries, including Finland; New Zealand and Germany, close to 97% of the young adults in South Korea completed high school - the highest rate of any of the countries of the sample group in Govender's (2011) study.

What is also of particular interest concerning the South Korean schooling system is the training of potential educators. Once students have completed their education degree from a recognised institution, they are required to write and pass a qualifying examination before being allowed to teach (ISEP, 2008). Furthermore, from 2009, the newly graduated educators are expected to undergo an intensive three-stage qualification process: Firstly, they are required to complete a selection-based written test; they then write an essay test; and lastly, they perform demonstrations and undergo interviews in order to be assessed in terms of the practical component of teaching (Govender, 2011).

This process allows only the best candidates to be accepted. Once educators are qualified, they are expected to attend training programmes and attend certificate courses to develop their skills as educators. Such training programmes may have different purposes, including: information digitalisation; training in the compilation of curricula; general training; and lastly teaching training (ISEP, 2008). It is in such an environment that educators are exposed to EE for the benefit of their students.

The implementation of EE was not initially regarded as an immediate priority for the South Korean government during the post-Korean War years (Choi, 1995; Govender, 2011). During the 1950s the focus was on economic development often at the expense of the environment. It was only during the 1980s that the importance of the environment became a major issue on account of major industrial expansion over the three previous decades. The impacts emanating from this expansion included the

destruction of greenbelts and major water and air pollution problems which had become highly visible in South Korea.

The historical implementation of EE in the South Korean school system can be broken down into four stages: The first is considered as the Initial Phase - up to and including the year 1980; the second period is the Formative Phase (1981-1991); the third, the Settlement Phase (1992-1999); and the last period the Establishment Phase - from the year 2000 onwards (Choi, 1995).

It was during the Formative Phase that the South Korean Ministry of Education and Human Resources implemented its school EE Model Programme in both primary and secondary schools (Choi, 1995). With the aid of the material already available, this programme was incorporated into the regular subjects and was also presented in the extra-curricular programmes.

The South Korean Society for EE was established in 1989, at the same time as EE research in the local universities had started to gain momentum (Govender, 2011). When the South Korean national curricula were changed in the Settlement Period, the curricula included guidelines for EE (JEEF, 2007).

The EE included in primary school education in South Korea is a multidisciplinary, integrated subject which is commonly concerned with environmental pollution, the natural environment and environmental conservation. High schools and intermediate schools, on the other hand, offer an optional subject termed 'Environment' in intermediate school and 'Ecology and the Environment' in high school. Importantly, the textbooks produced for both of these subjects address aspects of environmental sensitivity and the relationship between man and the environment. In fact, the subject 'Environment' is offered as part of the national curricula.

What is a matter for concern is that only 11.8% of South Korea's intermediate schools offer the subject, while 30% of the high schools offer it (Govender, 2011). A possible reason for this is the lack of qualified teachers who are able to teach EE. Regardless of this, an issue that remains is that the EE that is offered in the South Korean national curricula is optional. As a result, not all students are exposed to the knowledge base and skill sets that they could benefit from by studying EE.

The South Korean government has in recent years adopted a more sustainable and green approach to development which will hopefully be reflected in their education systems in the years to come. It is hoped that developing countries such as those in sub-Saharan Africa that are still implementing EE in their education systems can look to South Korea as an example in this respect.

2.3.3 Sub-Saharan Africa

The examination of the implementation of EE in sub-Saharan African schools will be based on an investigation into the implementation of EE in the school curricula of four countries, namely Botswana; Tanzania; Nigeria, and South Africa (which will be examined in more detailed in the section below). The reason for selecting the above-mentioned countries is in part due to the fact that, as opposed to the USA and South Korea, they are all developing countries and, as a result, may have different priorities and resources available for the development of their economies and for education their citizens. Furthermore, the selection of these countries was influenced by the literature available to the author.

The implementation of EE in Botswana is undertaken through the formulation and implementation of policies which are based on and facilitated through an administrative structure, which operate from the macro- to the micro level (Ketlhoilwe, 2007a). Policies relating to education are designed and supervised by the Ministry of Education, which distributes these policies to the relevant departments. Of particular importance is the statement on EE issued by the Revised National Policy on Education. This body has sent out a mandate to the Department of Curriculum Development and Evaluation to integrate EE into the range of national curricula in Botswana. It is this department which is responsible for revising syllabi and updating them to include relevant content (e.g. EE) and which provides guidelines for the implementation of policies (Ketlhoilwe, 2007b).

Another department which is important in the implementation of new educational policies is the Department of Teacher Training and Development. Based on the development of national curricula, and providing support to educators in the country, this department is responsible for the training (pre-service and in-service) of teachers (Ketlhoilwe, 2007b). Attempts have also been made to decentralise support from the macro to the micro level of governance (Ketlhoilwe, 2007a).

The educators in Botswana act as micro-agents at the school and local levels in terms of the structural and local conditions in which they operate. As such, the educators are influenced by the environments in which they teach and operate in regardless of the policies formulated and implemented by the various government bodies and departments (Ketlhoilwe, 2007b). To put this into context: Botswana as a country faces major socio-economic challenges, to the extent that it does not have the financial capacity to provide appropriate salaries to teachers. It is often also not able to provide suitable or adequate training and development courses for educators; nor is it able to provide the educators with the necessary teaching aids and resources (Ketlhoilwe, 2007b).

According to a study conducted by Ketlohoilwe (2007b), there is evidence that EE has been introduced into the Botswanan schools at the primary school level. There were three relevant patterns/perceptions that he could identify: These were as follows:

- Environmental Education is considered in the same light as it is presented in the Environmental Management courses in the schools;
- expressions of frustration in terms of the limited resources available for field trips; and
- Environmental Science is considered as being equivalent to Environmental Education.

These observations should be a matter for concern - especially if they reflect the views of the educators themselves. Most respondents in this study stated that the objectives and content of Environmental Science and Environmental Education are similar, which reflects a lack of understanding as to how EE should be integrated in to the national curricula (Ketlhoilwe, 2007b).

Kethoilwe (2007a; 2007b) further identified the lack of continuity between Environmental Management courses undertaken at the schools and in the communities in which the schools operate, often making the process of EE more complex and difficult. As such, EE is viewed only from a scientific perspective rather than from a holistic one. This same misunderstanding could also be applied to the view of undertaking Environmental Management courses in schools as an adequate form of EE as opposed to approaching these Environmental Management activities as supplementary to EE in school curricula. Furthermore, the recurrence of

Environmental Management content, which dominates the content of the subject taught at schools, is then perhaps a reflection of the absence of normal teaching materials such as textbooks, and as a result, EE is represented only in policy texts (Ketlhoilwe, 2007b).

The information mentioned above gives some idea of the extent to which EE has been implemented in the Botswanan national curriculum and serves as an indication that a lack of governmental capacity and support for educators serves as a major obstacle in the successful implementation of EE.

Attention can now turn north to Tanzania, a country which has actively sought to incorporate EE into its education system. It was during the 1990s that Tanzania, through its Ministry of Education, took the first steps to include EE in its education system. This initially took place through the formulation of EE courses, whereupon EE was incorporated officially into secondary school curricula at all levels as an integrated subject as opposed to one standing alone (Mwendwa, 2017). The Tanzanian Education and Training Policy focuses on EE as a learning area, as seen in the fact that one of the policy's major objectives is to "increase the quality of environmental conservation through environmental education at all education levels" (URT, 2009:10).

The country adopted an integrated approach towards EE as was intended by UNESCO and the UNEP. The advantages of this approach, which were identified by Mwendwa (2017), include the following:

- it allows teachers to plan their classes in such a way that they contribute to the development of key skills and understanding that surpass the individual subjects;
- it assists teachers in establishing the foundations from which students could build upon and develop their own knowledge; and
- it ensures learning which is meaningful.

In the same study, conducted by Mwendwa in 2017, it was found that teachers often find it difficult to link EE content with subject content owing to the fact that there is no clear formula for the implementation of EE into the syllabi of subjects. As a result, teachers may not be comfortable teaching through the integration of content across many subjects (Drake, 2004).

The study undertaken by Mwendwa (2017) used Mtibwa Community Secondary School in the Morogoro region of Tanzania, and established in 2004, as a case study. Elements of EE in this school were found in two subjects, namely Biology and Geography. However, they were found only in one of the Forms (form is the term used for grade within Tanzania, with Form V then being Grade 12) of the Biology syllabus as opposed to those found in Forms 1 to 4 of the Geography syllabus.

The study suggests that this type of integration of EE into curricula raises misconceptions since the majority of learners and educators tend to consider environmental issues to be more inclined to be Geography related. Thus, by reducing the cross-cutting nature of EE and incorporating it into other fields, this could lead indirectly to the overcrowding of the subject content in subjects such as Geography.

It was found in the same study that only two teachers had received some form of training in EE, while only three of the eight teachers interviewed were satisfied with the EE-related content in the curricula. When probed as to what might be missing or what should be changed in terms of the content of EE, the interviewees gave responses that varied from whether aspects concerning environmental sustainability and those around culture and beliefs should be included and considered as relevant (Mwendwa, 2017). These issues concern the inadequate localisation of EE-related content which would enhance learning and allow both learners and teachers to feel more connected to what they are exposed to in the subject curricula.

The issue of a major lack of support from higher authorities was raised even when the same authorities were pushing for the increased inclusion of EE in class syllabi (Mwendwa, 2017). This lack of support may be related to the lack of capacity of the Tanzanian government to provide the required resources and skills, something which could hopefully be found in a sub-Saharan African country such as Nigeria, which has a much more developed economy.

Nigeria, like Tanzania, embarked on a National EE programme in its schools in the early 1990s. Led by the Ministry of Education in partnership with the Nigeria Conservation Foundation, it worked towards sustainable development (Agnes and Nor, 2010). The national workshop on integrating EE into the school curricula provided an impetus for research studies, which focused on the need to functionally implement EE in the secondary school curricula of Nigeria.

However, in spite of numerous attempts, the return on the investment of actually implementing the learning area in the curricula, and of making the public aware of EE in Nigeria have not been encouraging in the slightest. According to Agnes and Nor (2017), there is a vague consensus in Nigeria as to whether the implementation of EE in school curricula should be conducted individually, or whether a multidisciplinary approach should be adopted for this purpose.

Numerous statistics gleaned during a study conducted by Agnes and Nor in 2010 in which the analytical implementation of EE in Malaysia and Nigeria was compared, showed the extent to which EE had been implemented in Nigeria at that stage. Of greatest concern is the fact that only 12% of the Nigerian schools within the study had the necessary facilities for EE as opposed to the 100% in the case of the Malaysian schools (Agnes and Nor, 2010). This then presents a major obstacle to the implementation of EE, especially when considered in conjunction with the fact that only 40% of the Nigerian teachers in the study had had some form of EE in-service training. Furthermore, it was found that only 28% of the Nigerian schools in the study had the space for some form of EE-related displays (Agnes and Nor, 2010).

The text above is a brief examination of the implementation of EE in education systems and has shown that despite significant investment by the state for the implementation of EE, the level of success that has been attained has been insignificant, as is evident from an analytical study conducted in 2010.

The implementation of EE in the three sub-Saharan countries discussed above gives an indication of the extent of the implementation across this extensive region. Along with their mentioned successes and shortcomings respectively, it is hoped that these illustrations will give perspective and context to the implementation of EE in South Africa, which, is seen to be a leading force in the region.

2.3.4 South Africa

According to Irwin (1990), who is one of the founders of EE in South Africa, the foundations for EE in South African educational institutions were laid by non-governmental, as well as state-owned conservation agencies. Interest in respect of EE in the country was first observed as early as the 1960s decade when global interest in EE grew (Mohammed, 2016).

It was not until 1989 that attempts were made to include EE in nation-wide formal curricula. This first attempt came in the form of the 1989 White Paper on Environmental Education (Mosidi, 1997). However, this White Paper only selectively incorporated Tbilisi principles and the White Paper itself was never enacted in the South African Parliament. This resulted in minimal formal implementation at school level (Le Grange, 2002).

A major party involved in finding sound reasons for the inclusion of EE in the new national curriculum was the Environmental Education Association of Southern Africa (EEASA), which was established in 1982. The group played a key role in the inclusion of environmental content in the curriculum, which was being developed by the Department of Education through the Environmental Education Policy Initiative (EEPI), as well as through the Environmental Education Curriculum Initiative (EECI). As a result, the EEPI was formally implemented in the education system/sector in 1992 (Mohammed, 2016). The EEPI facilitated a more inclusive process of collecting and formulating EE policy options within the realms of formal education in South Africa (Mohammed, 2016).

A major outcome of the process outlined above was that EE was included in the March 1995 Government White Paper on Education and Training as one of the key principles for the policy on Education and Training in South Africa in the 21st century. This principle reads as follows:

> "Environmental Education, involving an inter-disciplinary, integrated and active approach to learning, must be a vital element of all levels and programmes of the education and training system, in order to create environmentally literate and active citizens and ensure that all South Africans, present and future, enjoy a decent quality of life through the sustainable use of resources" (RSA, 1995: 22).

The above-mentioned principle is in line with the themes of inclusivity and education for all which are reflected in the new South African Constitution and the Bill of Rights for a post-Apartheid society after the country's first democratic elections in 1994. The Bill of Rights in fact provides every South African citizen with the right to a healthy environment, while key policy documents further emphasise the importance of using the country's resources in a sustainable manner (ANC, 1994).

It was during this period of legislative reform at a national level, that a process of educational reform took place. Such reforms in the educational sector were needed in order to allow for inclusivity in the schooling system, as well as to restructure the school curricula. This reorganisation led to the establishment of a National Qualifications Framework (NQF) and the replacement of a contents-based education with an Outcomes-Based Education (OBE) curriculum (Le Grange, 2002).

On a structural level, the forty-two subjects which were previously offered to learners in South Africa were replaced by eight areas of learning to create a more holistic approach to learning (Le Grange, 2002). There have been several revisions of the national curricula since the mid-1990s. The manner in which these curricula approached EE is discussed below.

The OBE-based curriculum was launched in 1997 by the Ministry of Education, and was entitled Curriculum 2005 or C2005 (Mokhele, 2011). C2005 was intensively learner-centred as opposed to the teacher-centred pedagogy that had prevailed in the previous curriculum. It was during this period that there was a movement away from the development of a national education policy in South Africa towards curriculum development. As such, initiatives such as the EEPI, along with the EECI[3], which was established in 1996, become even more important in curriculum development (Mohammed, 2016).

The emphasis in the C2005 curriculum was placed on a process of life-long learning, much the same as was intended for EE, and was supposed to be contextually appropriate. On 5 June 2000, the South African Ministry of Education formally introduced the National Environmental Education Programme (NEEP), marking the Department's commitment to EE and the development of this discipline in South Africa (Mohammed, 2016). The NEEP was seen to have two phases, the first of which was a research phase and the second a professional development phase in which the overall goal of the process was the development of "practitioner skills within an environmental framework" (Schreuder, 2002: 109).

However, according to Reddy (2011) the OBE-based curriculum was incompatible with EE since the pre-determined outcomes of OBE did not allow for the holistic approach

[3] an initiative which was tasked with furthering the goals of the EEPI and formally contributing to curriculum development in the country

to learning as intended for EE to take place. Dube (2012) took it a step further when he stated that the OBE-based curriculum had failed on account of policy tensions and criticism, much of which focused on the conceptual basis of OBE (Mohammed, 2016). Owing to the failure and shortcomings of C2005, there was a desperate need for a revised national curriculum.

Since 1997, there have been further revisions of the national curricula to become the Revised National Curriculum Statement (RNCS) in 2002. This was then further revised to form the Curriculum and Assessment Policy Statement (CAPS) in 2012 (Mokhele, 2011, Björklund, 2015). The RNCS curriculum was criticised for being a curriculum that was largely inaccessible to teachers, especially to those in under-resourced schools. However, the RNCS did allow for the incorporation of environmental concerns and issues into learning areas in the formal education system of South Africa. This was seen as a major step forward (Björklund, 2015).

The CAPS national curriculum is the most recent to be realised by the Department of Basic Education (DBE). The two previous national curriculum statements (Grade R-9 and Grades 10-12) are now combined into a single document known as the 'National Curriculum Statement: Grades R-12', which, according to the DBE (2011a:3), represents a "policy statement for learning and teaching in South African schools and comprises of the Curriculum and Assessment Policy Statements (CAPS) for all approved subjects".

The policy document for this National Curriculum Statement (NCS)-CAPS promotes aims which fall into two distinct categories. The first presents general aims for cross-curricular implementation, and the second presents aims which are specific to each subject. Of these, principles around human rights, inclusivity, and environmental and social justice, are integrated into the aims of the curriculum (Mohammed, 2016). EE is no exception to this. The aims around environmental concerns can be found extending across numerous subjects or are addressed in specific subjects within the NCS-CAPS system.

Instances and case studies of the implementation of EE include research conducted by Mokhele (2011), who analysed the implementation of EE in two primary schools in Mpumalanga Province in South Africa and who observed how policy statements were found to guide the process of implementing EE in these schools. The two schools

investigated were Hillside Primary School and Sea Point Primary School. In both schools, a champion for EE was selected from the school's staff to use the guidelines published by the Department of Education to formulate and adapt lesson plans on the basis of a quotation by one such educator, stating the following:

"When you don't have the policies, you don't know where you are coming from and where are you going. You won't have your goals. You won't know why you are teaching this." (Mokhele, 2011: 81). This illustrates that such policy guidelines are valued by educators and are of benefit to them in the classroom.

Schools such as Hillside Primary have taken this a step further by producing their own EE policy documents which were written by the Science and Technology teachers at the school. The existence of such a policy document raises the question as to how common such documents are in schools in South Africa.

It was in Sea Point Primary School that the point of finding time to include EE in the content taught in the classes proved to be an issue which challenged teachers. As such, this content would often be sacrificed for issues and content that would feature more prominently in the various syllabi. It should be noted that the trends identified in the primary schools could also be expected to be relevant in the secondary schools.

Literature concerning case studies of the implementation of EE within South African schools such as the study discussed above by Mokhele (2011) are largely absent or could not be found be the researcher. This indicates that there is a lack of depth of literature concerning EE within South Africa. Education systems globally have been changing at a rapid rate with technology playing a large role in this change, as the section below indicates.

2.4 The Role of Technology in Environmental Education

Technology - a trend that will only increase in its effects over time - has become ubiquitous in people's lives. Ensuring that technology will play a role in the educational sector in the 21st century is critical. Around the world, education systems have been experiencing significant changes owing to advancements in digital technology (Kerski *et al.*, 2013), so much so that it is hard to imagine a world in which the role of technology in teaching is not irreplaceable (Blažek *et al.*, 2017). This becomes especially apparent when considering how readily learners engage with the new technologies which become available to them. However, in saying this, one needs to

be cautioned against depending upon technology in teaching the required content, as opposed to using technology to enhance learning in the classroom environment. When used correctly, technology can enhance learning areas such as EE greatly, by enhancing a students ability to visualize environmental issues and better grasp EE learning areas at hand.

The range of technologies which are available to education systems has increased dramatically in recent decades and can be viewed in different ways, depending on who one asks. If one were to ask a Geography teacher what types of technology (s)he uses, one would get a different answer from that given by the teacher of another subject. The same could be said if one were to ask a subject advisor or educators of different ages. One could be sure that the answers would vary notably. One can even consider the influence that age might have in the role of technology in environmental education. It is necessary to examine the various forms of technology and other content in the relevant curricula available to EE educators for use in the classrooms/fieldwork.

The technologies which are available to educators for incorporation into their education systems to enhance learning in the classroom environment are often taken for granted and are overlooked. When specifically looking at Geography as a subject and how technology could be used within its domain, there are three distinctions which can be made in terms of the types of technology. The first includes geospatial technologies; the second the application of GIS, and lastly, the use of geocaching in the teaching of Geography (Blažek *et al.*, 2017). Each of these distinctions will be discussed below.

"The use of ICTs in education has the potential to add value to curricula and to transform students into knowledge constructors" (Nkula & Krauss 2014: 242). The term ICT stands for Information and Communication Technology, which are not isolated nor limited to the educational sector, but rather used across almost every economic sector. ICT is a widely-ranging term in nature and is defined by UNESCO (2002:13) as "the combination of informatics technology with other related technologies, specifically communication technology". This then includes a range of software functions extending from, for example, PowerPoint to the use of digital sound

clips or videos, to the use of platforms such as Google Earth, and even all the way to the use of smartboards in the classroom.

According to Blažek *et al.* (2017), forms of constructivism (learning by doing) conducted through ICTs include the following: cloud computing, Google Disc, YouTube, mobile technology, social networks and data visualisation. Furthermore, a vital but often overlooked form of ICT is the internet (Dede, 2009; Nkula and Krauss, 2014). All of the above mentioned are of great use to educators and are important tools to enhance learning. The different types of ICTs are divided into groups and are discussed below in order contextualize what technologies are available to educators for the purpose of EE.

2.4.1 Computers and Audio-visual Devices

Computers first appeared within the realms of education during the 1940s with the appearance of the MARK I in 1944 at Harvard, and the ENIAC in 1946 at the University of Pennsylvania (Molnar, 1997). These two examples are the first of the operational computers that were put to use.

The first operational computer was used in Mathematics, Science and Engineering as a problem-solving tool. It replaced the slide rule and was able to deal with issues more directly. In 1959, at the University of Illinois, a programme called PLATO was initiated by Donald Bitier. PLATO was the first large-scale project promoting the use of computers in education. Initially, research students would stand in queues for extended periods of time with punch cards for batch processing which allowed for calculations to be performed on their behalf (Molnar, 1997). Over time, however, as technology improved, and the more advanced students became involved in mastering the relevant technological methods, they were able to take on an active role in the learning process.

Initially, since computers were expensive and bulky, a time-shared systems strategy was used to restrict usage in order to provide access to as many people as possible, especially in regions where the resources were limited. However, in 1975, low-cost microcomputers, leading to the personal computer revolution, were developed. By the end of the 1970s, personal computers were in common use, especially within the realms of education and the school environment (Molnar, 1997).

Technology has advanced immensely since the personal computer revolution. Thus, computers have become exponentially more powerful. Allowing for the tasks that modern personal computers can undertake, tasks which exceed human capability can now be undertaken. One way in which computers and audio-visual devices can play a role in EE is through visualisation.

To expand on this further, computer graphics and visualisation methods are used to overcome complexity, as well as the limits of the written word. Computer visualisation changes the ways in which humans perceive phenomena, as well as the ways in which people approach them. According to Molnar (1997), computers are able to restructure a problem so that it can be more easily processed through human visual and perception systems.

A major example of computer visualisation techniques includes digital platforms and Geographic Information Systems (GIS), both of which are elaborated upon in the sections to follow. However, both are dependent upon various forms of software which are used to operate computers and audio-visual devices.

2.4.2 Software, Operating Systems and Digital Platforms

Operating systems are the systems and programming software upon which computers are built. Amongst others, they include systems such as Windows, and Mac for Apple devices. With regards to software, there are many different forms of software which can be used to enhance learning and education. These include: Microsoft PowerPoint; Microsoft Word; Microsoft Excel and other Microsoft programmes, all of which make it easier for students to complete their schoolwork and better understand the concepts they are taught (Cuban, 2001).

According to Berežný (2015), there is software that has been designed specifically and exclusively for educational purposes, examples of which include MATLAB and LibreOffice, which are offered to schools at discounted prices. The software specifically appropriate for studies in Geography and Environmental Education is less obvious as opposed to the software designed to enhance Maths and Science learning

(e.g. MATLAB). Such software will be discussed and elaborated upon in the section below.

A major form of technology which has recently emerged is the internet. The first user-friendly form of the internet was developed at the University of Minnesota. The demonstration system it used was called a 'gopher'. Later, the University of Nevada developed VERONICA, which was a searchable index of gophers (Johnson, 2011). Initially, these search indexes were limited to use by the military and academic institutions.

In the 1990s, with the internet becoming more commercialised through the establishment of companies such as Delphi in 1992, the internet became completely dependent on commercial companies in 1995. The launch of Windows 98 transformed the internet by incorporating a browser into a desktop (Johnson, 2011).

Since then, the internet has transformed the way in which information is shared across the world and the way in which people live their lives (Howe, 2010). The educational sector has also been transformed through the emergence of the Internet in that it allows students to access information at speeds not seen before, as well as to share information that they have found. In addition, the internet allows students to gain a better spatial awareness of their surroundings and the potential environmental issues that might affect them.

An additional element which can be used to enhance learning in the classroom environment is that of digital platforms. Digital platforms can be defined as the software or hardware of a site (Bunskoek, 2013). This then includes sites in which information can be accessed. To name just two amongst thousands, if not millions of sites, Google and YouTube are such examples which can be used to enhance education.

2.4.3 Geographic Information Systems in Education

A major form of technology used in the classroom environment, specifically in Geography, is the Geographic Information System (GIS). Previously, educators would rely on paper-based maps in their classrooms to discuss spatially-related matters, but now, thanks to digitisation, vast new possibilities have arisen through GIS, a technology which has proved to be controversial within the realms of education.

GIS first emerged as a technology in the 1960s. It was first developed by the Canadian Land Inventory System, with many contributions from various parties resulting in GIS as it is known today (Kerski *et al.*, 2013; Sanders & Schoeman, 2017). There have been numerous attempts to define GIS since its development, with one of the first individuals to define it being Burrough (1986: 6). He defined it as "a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world".

The advent of the internet, accompanied by exponential rates of development in digital technology (e.g. software; and the availability of spatial data), has allowed GIS to become more than merely a set of computer tools, and rather a powerful platform which is used in virtually every economic sector, and also in education (Kerski *et al.*, 2013). Initially GIS was used only within the realms of the tertiary education sector.

By the 1990s, educators in secondary schools started to regard GIS as a way in which to encourage their learners to start careers within the fields of science and engineering, as well as a way in which to introduce them to various types of technology (Goodchild & Kemp, 1990). By the early 2000s, GIS was more than a tool to encourage students to make use of technology. It had evolved into a tool that could be useful in promoting an inquiry-based learning environment on the secondary school level (Lemberg & Stoltman, 2001; Sanders, 2016).

The development of GIS as an educational tool which has been driven by institutions, as well as through individual efforts, allowed for it to be used for subjects in a secondary school environment. These subjects include, amongst others, Geography; Biology and Mathematics. In fact, Geography has become the champion subject for GIS in schools (Broda & Baxter, 2003; Demirci *et al.*, 2013).

A vast number of countries have embraced and encouraged the use of GIS in their school systems. Initially, GIS was taught in schools in the USA, Canada, and the United Kingdom (UK) (Broda & Baxter, 2003; Demirci *et al.*, 2013). As GIS evolved as an educational tool, its use on the secondary school level increased globally. Countries such as Japan; China; South Africa; India; Finland, and Norway - to name just a few – benefited by using it (Demirci, 2008; Demirci *et al.*, 2013).

However, each of these countries has faced varying degrees of pedagogical, curricular, technological, and infrastructural challenges (Kerski *et al.*, 2013). While

schools, especially in the developing countries, might find GIS useful to varying degrees, Kerski *et al.* (2013) discovered that GIS is not well known to educators. Thus, as a result of GIS being little known, and combined with the challenges and obstacles that these educators and schools face, GIS is taught in only a small percentage of schools.

Kerski *et al.* (2013) observed that the adoption of GIS took place at a faster rate in countries which had made its inclusion in their curricula mandatory. As such, the teaching of GIS-related content is compulsory in certain subjects. Examples of such countries include South Africa; Norway; Japan, and Taiwan - to name but a few (Huyn *et al.*, 2012; Kerski *et al.*, 2012; Kerski *et al.*, 2013; Ito, 2015).

To investigate this matter further, this next section considers two developing countries, namely Taiwan and South Africa, in order to demonstrate the way in which GIS is used as an educational tool. More attention is given to the case of South Africa since the investigation deals with the inclusion of GIS in the South African Geography syllabus.

GIS first made its appearance as an elective for matric students in Taiwan's senior high school curriculum in 1995. When the curricula for senior grade students were revised by the country's Ministry of Education (MOE) in 2006, and then in 2010 the course hours for GIS were extended, an introduction to the relevant GIS concepts was integrated into the Geography syllabi to also feature in Grades 10 and 11 (Chen, 2012). In response, the MOE, in partnership with the Department of Geography at the National Taiwan University (NTU), started sponsoring training programmes for educators. The educators, in fact featuring as a vital component in the successful teaching and implementation of GIS in the school system, were overwhelmingly positive about this development (Chen *et al.*, 2012). Since they were given the authority to develop their knowledge around such technological tools, they were encouraged to use technologies such as GIS and ICT in their classrooms and to enhance learning in topics related to the environment (Chen *et al.*, 2012).

South Africa has faced similar challenges in the implementation of GIS in its school system. Firstly, it is important to acknowledge that South Africa is one of the few countries in the world where GIS has been integrated into its national curriculum (Kerski *et al.*, 2013). As mentioned previously, the initial focus in the use of GIS within the realms of education proved to be in the tertiary educational institutions, with the

majority of South African universities offering a degree/diploma in GIS or including it in related degrees/diplomas (Breetzke, 2007). However, the implementation of GIS in the national curricula of South Africa has been notably slow, with the curriculum for GIS being introduced to Grade 10s in 2006, to Grade 11s in 2007 and to matric students (Grade 12s) in 2008 (Breetzke *et al.*, 2011).

Three challenges which South Africa faces in terms of successfully implementing GIS in its national curricula were identified by Beetzke *et al.* (2011), who listed them as money; support, and time. The lack of capital is regarded as the largest obstacle to the successful implementation of GIS in schools in South Africa. Globally, it is widely accepted that the implementation of any GIS system in a school requires a large amount money.

One of the major aims of the syllabus for Geography within the CAPS Further Education and Training (FET) framework for senior grades in South Africa is listed as follows: "[to promote] the use of new technologies, such as Information and Communication Technology (ICT) and Geographic Information Systems (GIS)" (DBE, 2011: 8a), This reflects the government's embracement of new technologies which can benefit both learners and educators. However, it must be cautioned that new educational technology can be seductive (Bednarz, 2004). Further caution should be given to prevent one from 'falling prey' to techno-centrism, where the justification for the use of technology is found in the 'Mount Everest' rationale, whereby technology or tools are used simply because they are there (Bednarz, 2004).

In countries where the use of GIS in the national curricula is not mandatory, the question posed by Bednarz (2004: 194) arises: "Given the limited amount of time in the curriculum for Geography, is it worthwhile to spend it mastering GIS?". In a country such as South Africa where it is mandatory to include EE-related content and GIS in its national curriculum, educational tools such as ICT and GIS should be used to enhance learning in the classroom environment so that when GIS is used as an instructional support tool in a place (with the emphasis on localisation), and environmental settings are significant, cognitive gains can be made, especially in the case of EE (Bednarz, 2004).

Even in countries such as South Africa, which faces severe inequality as well as developmental challenges, the benefits of using new technologies in secondary

education cannot be ignored, especially in the context of EE, which can use such technologies to cement itself within the educational systems of countries around the world.

The above sections have gone into depth explaining how technologies such as ICTs and GIS can and are utilised within the realms of education, with EE included within this. Whether it be, the use of computers, software, the internet and all the platforms that comes with it or technology such as GIS. All can and are utilised for EE purposes. This is seen through the fact that computers bring access the later types of technologies and the uses for them are extremely broad in nature, while the uses for GIS are more specific. Such that a GIS can aid in students visualising the change in land uses over time in a specific region or area which can help illustrate the degree of deforestation or degradation of a habitat within a specific region to name just one example. However, with the degree of advancement that has taken place over the past few decades it is easy for educators to fall prey to techno-centrism and become overly dependent on technologies such as ICTs and GIS.

2.5 Problems Experienced by Educators in Using ICT

Such challenges or barriers are broad in nature and include, amongst others, the following categories: a lack of access to resources; inadequate professional development or educator training programmes, as well as unrealistic beliefs and attitudes amongst educators (Nkula & Krauss, 2014). A lack of access to resources includes the following aspects: limited access to the ICTs themselves; limited access to the ICTs which are available – both locally and at the time; and limited time and technical support available. The last-mentioned factor, namely technical support is particularly important in schools which may have limited access to resources for the purposes of ICT or where educators have limited experience with certain technologies (Hew and Brush, 2007). Such educators require the highest level of technical support to use ICTs in order to obtain the maximum benefit for themselves and their students.

The second barrier raised by Nkula and Krauss (2014) is pinpointed as the level of professional development or training of the educators. This is the most frequently cited barrier to the integration of ICTs into the classroom environment (Ertmer, 2005; Evoh, 2007; Du Plesis and Webb, 2012). An educator's ability to use technology (e.g. ICTs) will significantly influence his/her willingness to integrate ICTs into the classroom

situation, regardless of the content that is being taught in the classrooms (Hew & Brush, 2012).

The third and last barrier identified by Nkula and Krauss (2014) includes the beliefs and attitudes of the educators towards the strong role that ICTs play in their use of technology in the classroom situation. As long as educators believe that their use of technology will benefit their students, they are more likely to use it (Nkula and Krauss, 2014).

The use of such technologies in the classroom environment allows students to communicate and spread new knowledge and to develop the necessary skills which may be required in the workplace (Dede, 2009; Madumere-Obike & Imgbi, 2012; Martinovic & Zhang, 2012). The development of the internet and the digitisation of large quantities of data have allowed for the rapid sharing of information and the development of new knowledge.

It has been suggested that the idea of using ICTs in schools first arose on account of the limitations of the computer programmes in schools focusing on computer literacy as opposed to the use of ICTs for the purposes of learning and integrating technology into the classroom situation (Wilson-Strydom *et al.*, 2005; Nkula and Krauss, 2014). The implementation of ICT, together with its integration into the classroom environment, is regarded as being more beneficial to both students and teachers themselves (Nkula and Krauss, 2014; Blažek *et al.*, 2017). The implementation of ICT together with integration involves learning through a computer or the use of a computer, while the implementation of ICT without integration is regarded as the acquisition of technical skills and information (knowledge) about computers.

Of these two options, Nkula and Krauss (2014) claim that implementation with integration places ICTs at the centre of learning, thus allowing for a smoother use of such technologies at a cross-curricular level. As with any form of technology, there are major challenges to the implementation of ICTs in school curricula, whether it be implementation with integration or without integration.

2.6 Resource and Infrastructure Problems in South African Schools

This is particularly relevant in the context of South Africa where there is severe inequality (social and economic) across the country as a result of the country's political past. This has resulted in the infrastructure and resources available to schools being

at the two extremities or poles in the range (Harber & Serf, 2006; Breetzke et al., 2011). This is not to say that there have not been efforts made by both government and the private sector to facilitate the teaching of GIS in the classroom. An example of this is a paper-based GIS educational package developed by ESRI (South Africa) to teach the basic principles and components of GIS to students in schools where there is no sign of the necessary ICT infrastructure (Breetzke et al., 2011; Kerski et al., 2013).

Because governmental efforts include the investment of significant amounts of money in the development and improvement of the ICT-related infrastructure across the country, and the intention is to overhaul the system to develop education and skills at all levels, ICT is expected to function as a significant tool in this respect. Furthermore, the government has guaranteed that all educational institutions in the country will be granted discounted rates of up to 50% for access to the internet (Isaacs, 2007).

The implementation of the e-Education White Paper lies with the provincial departments of education. In fact, some provinces, such as Gauteng, have already introduced provincial programmes for the integration of ICT into their school curricula and are, as a result, already implementing the goals of the policy (Isaacs, 2007). However, the problem remains that according to a 2006 draft Education Implementation Plan for ICT, less than five percent (5%) of the schools in South Africa can afford internet connections so that the quality of the ICT programmes for teaching and learning is of a very low standard (Isaacs, 2007).

In a 2005 study, data reflecting the number of schools with computers showed that 78.8% of the schools in Gauteng province had computers for both teaching and learning. However, on a national scale, only 22.6% of South African schools had computers for both teaching and learning (Harris, 2006). Furthermore, according to Isaacs (2007), the majority of schools still struggle to gain access to the 50% discount on Internet services which was promised to them in 2002.

The statistics mentioned above are the most recent that the author could find, thus reflecting the fact that data regarding the availability of ICT technology for South African schools is sadly lacking. This makes it extremely difficult to determine the level of success that could be expected for the successful implementation of GIS in the national South African curriculum.

While significant issues and barriers exist in the implementation of both EE and technologies into the classroom environment within South Africa, it is necessary to make a distinction between what is considered EE in Geography within the South African context. The section below discusses this in-depth especially taking into account the national curriculums which have developed and evolved since 1994 within South Africa and how EE has found its place within these national Geography curriculums in South Africa.

2.7 What is Considered Environmental Education in Geography in South Africa?

To understand what is considered EE in Geography in the South African school system, one needs to firstly examine how the curricula for Geography have evolved and changed since the post-Apartheid era in South Africa. In 1995, the South African government began the process of developing a new curriculum for the South African school system for the new post-Apartheid era. This was done for two reasons. Firstly, the world had changed tremendously since the national curriculum had first been introduced during the Apartheid era in terms of the new knowledge which had been acquired, and the more modern teaching pedagogics. This was compounded by the emergence of new technologies leading into the 21st century.

However, the most important reason for this curriculum change was that South Africa itself had changed (DOE, 2005; Innes 2012). Thus, not only had the landscape of Geography education changed after 1994; the geography of the country had changed through the delimitation of the nine provinces of South Africa (DOE, 2005). The provision of education and schooling became the responsibility of the individual provinces, and new policies were implemented dictating that children of all races should have equal access to equitable education (Innes, 2012).

The compilation of the first version of the new curriculum was undertaken in 1997 for the General Education and Training (GET) phase (Grade 0 to Grade 9) and was termed Curriculum 2005 or C2005 (Innes, 2012). With the curricula for the Department of Further Education and Training still being developed, serious issues concerning the level of fragmentation of the C2005 curriculum, especially for Grades 7 to 9 were raised.

Furthermore, C2005 was extremely teacher-centred in its pedagogics, which assumed a generalised approach. One of the ways in which this was demonstrated is that discipline boundaries were collapsed so that Geography and History were subsumed within the human and social sciences learning area (Beets & Le Grange, 2008). In addition to this, specific content was not prescribed for each grade. This meant that teaching EE and learning about the environment and environmental issues were not enforced or encouraged (Beets & Le Grange, 2008; Innes 2012).

On account of the concerns which were raised by numerous parties, including educators, a review of C2005 took place in 1999. This led to the development of the Revised National Curriculum Statement (RNCS) for the GET phase and the National Curriculum Statement (NCS) for the FET phase (DOE, 2005).

In 2006, the RNCS was implemented in stages with the introduction of a new NCS for Grades 10-12 Geography at the FET level, for the Grade 10 class in 2006, the Grade 11 class in 2007, and the Grade 12 class in 2008 (DOE, 2003). For the NCS curricula, Geography and History once again became separate subjects. There had been numerous policy reforms from 1994 onwards, which, according to Wilmot and Dube (2015), made it difficult for educators to follow without the necessary support structures, which were largely absent. This resulted in further reforms in curriculum policy, the first being introduced in 2009, and termed the Curriculum and Assessment Policy Statement (CAPS) (Wilmot and Dube, 2015).

This new curriculum had a simpler design and featured a content-based orientation as opposed to an outcomes-based orientation. Amongst others, the subject guidelines for Geography specifically aimed at the following: “develop a commitment towards sustainable development”; “make and justify informed decisions and judgements about social and environmental issues”; “describe and explain the dynamic relationship between the physical and social worlds”, and lastly, “use new technologies, including ICT and GIS” (DBE 2011a:8). It is through these aims that EE is cemented within the objectives of education and learning within the South African schooling environment and that the use of technology is banded with the objective of developing and maintaining a commitment towards sustainable development within South Africa. This commitment to sustainable development can be guaranteed through the education of South Africa’s future leaders and citizens.

The content for each grade in the CAPS curriculum was clearly specified for each school term. This provided the necessary support structures which educators required. According to Wilmot and Dube (2015), the CAPS Geography curriculum focuses on 50% environmental and sustainability-related content. As such, it has a strong environmental component to it.

As published by the DBE (Department of Basic Education) (2011a), the tables below display environmentally-based content extracted from the NCS-CAPS Policy Statement for the Geography syllabi for Grades 10 to 12. It should be noted that the content below does not reflect the entire Geography curriculum for senior grades in the Further Education and Training (FET) phase of the CAPS curriculum. However, the content pertaining to environmental concerns and issues has been extracted and is displayed below. Much of the content presented below in the Grade 10-12 Geography curricula pertains to Physical Geography and not necessarily to EE as an independent learning area.

Table 1: Environmental Content covered during the Grade 10 year for Geography in the CAPS FET syllabus (DBE, 2011a)

School Term	Environmental Content Covered

Term 1	• The Atmosphere
	  ○ The greenhouse effect and its impacts;
	  ○ Global warming (evidence, causes and consequences with reference to Africa);
	  ○ The impact of climate and climate change on Africa's environment and people (e.g. rising sea levels)

Term 2	• Earthquakes
	  ○ How earthquakes and tsunamis affect people and settlements
	• Volcanoes
	  ○ Types of volcanoes (e.g. dormant or extinct);
	  ○ Impact of volcanoes on people and the environment (positive and negative)

Term 3	• Population Growth
	  ○ World population growth over time;
	  ○ Managing population growth;
	  ○ Concept of overpopulation
	• Population Movements
	  ○ Kinds of population movements;

	○ Causes and effects of population movements
Term 4	• The World's Oceans ○ Oceans as sources of oxygen, food and energy; ○ Relationship between oceans and people (pollution, overfishing and desalinisation); ○ Strategies for managing the world's oceans • Water Management in South Africa ○ Rivers, lakes and dams in South Africa; ○ Factors influencing the availability of water in South Africa; ○ Strategies towards the sustainable use of water (role of government and individuals)

Table 1 above shows that it is not necessary to teach environmentally-based content directly to learners in Grade 10 each term. However, concepts pertaining to the environment are taught in each of the four terms, with the concept of what happens to the biosphere (positive or negative effects) having an impact on people - either in a positive or negative way. However, this connection might not always be clear. This pattern continues into the Grade 11 Geography curriculum, as can be seen in Table 2 below.

Table 2: Environmental Content covered during the Grade 11 year for Geography in the CAPS FET syllabus (DBE, 2011a).

School Term	Environmental Content Covered
Term 1	• Africa's Weather and Climate ○ Africa's climatic regions; ○ The role of oceans in climate control in Africa; ○ El Niño and La Niña processes and their effects on Africa's climate • Droughts and Desertification ○ Areas at risk (regional and local); ○ Causes of droughts and desertification; ○ Effects of droughts and desertification on people and the environment; ○ Management strategies
Term 2	• Mass Movements and Human Responses ○ Concept of mass movements; ○ Kinds of mass movements;

	○ The impact of mass movements on people and the environment; ○ Strategies to prevent or minimise the effects of mass movements (South African case studies)
Term 3	• Frameworks for Development ○ Factors that affect development, including access to resources; natural resource limitations, and environmental degradation • Development Issues and Challenges ○ The effect of development on the environment
Term 4	• Using Resources ○ The relationship between resources and economic development; ○ Exploitation and depletion of resources; ○ Concepts of sustainability and the sustainable use of resources • Soil and Soil Erosion ○ Soil as a resource; ○ Causes of soil erosion; ○ Effects of soil erosion on people and the environment; ○ Management strategies to prevent and control soil erosion • Conventional Energy Sources and their Impact on the Environment ○ Impact of coal mining and thermal power stations; ○ Case study of nuclear energy; ○ South Africa's potential to meet long-term energy needs using conventional sources • Non-conventional Energy Sources ○ Solar power and Wind energy; ○ Future of non-conventional energy in South Africa; ○ Possible effects of using more non-conventional energy on the South African economy and the environment • Energy Management in South Africa ○ South Africa's changing energy needs; ○ Energy management towards greener economies and sustainable lifestyles

The Grade 11 Geography curriculum embodies an extensive and thorough inclusion of environmentally-related content especially for the last term of the year where the bulk of the content which is covered in terms of geographical knowledge pertains to resources and sustainability. What is of vital importance is for educators to connect the dots between development and sustainability in order to mould their learners into environmentally-literate and -aware citizens in order for sustainable development to

become an accessible and inclusive ideology in South Africa. However, as can be seen below, the emphasis towards environmental content and issues is less prominent in the Geography curriculum for Grade 12 learners.

Table 3: Environmental Content covered during the Grade 12 year for Geography in the CAPS FET syllabus (DBE, 2011a).

School Term	Environmental Content Covered

Term 1	• Tropical Cyclones
	  ○ Impact of tropical cyclones on human activities and the environment.
	• Urban Climates
	  ○ Reasons for differences between rural and urban climates
	  ○ Urban heat islands (causes and effects);
	  ○ Concept of pollution domes (causes and effects);
	  ○ Strategies to reduce the heat island effect
	• Catchment and River Management
	  ○ Importance of managing drainage basins and catchment areas;
	  ○ Impact of people on drainage basins and catchment areas;
	  ○ Case study of a catchment area management strategy in South Africa

Term 2	• Urban Settlements
	  ○ The origin and development of urban settlements - urbanisation of the world's population
	• Urban Settlement Issues
	  ○ Case studies which show how selected urban areas in South Africa are managing urban challenges, handling environmental, economic, and social justice concerns

Term 3	• Mining ○ Significance and contribution of mining to the South African economy and its development

Term 4	• Revision for Final Examinations
	  ○ Climate and weather;
	  ○ Geomorphology;
	  ○ Settlement Geography;
	  ○ Economic Geography of South Africa;
	  ○ Geographical skills and techniques

From Table 3 above, it is evident that there is a significant reduction in the reinforcement of environmental learning as opposed to this aspect in the Grade 11

year. This allows for content to be forgotten or not paid attention to until the fourth term when revision for the Grade 12 final examination takes place.

It is a matter for concern that the environmental issues surrounding mining and the mining sector are not addressed more thoroughly during the third term of the Grade 12 year. To add to this, the impact on the environment as a result of the rapid urbanisation of the world's population is not addressed although it is a major issue affecting the movement of populations and the growth of the world's population. Steps should be taken to allow learners to connect the dots between the different learning areas that are taught and that allow them to understand why such issues are relevant.

The presentations above have outlined the curriculum requirements for the NCS-CAPS curriculum for Geography in the context of the South African education system. Life Orientation and Life Sciences contain EE content to some extent, but this content is beyond the scope of this study.

The conceptual and theoretical frameworks established through policy statements such at the National Statement for the Curriculum and Assessment Policy, published in 2011 (DBE, 2011a; DBE, 2011b; DBE, 2011c), does not necessarily align itself with the capacity of educators who are expected to teach this content; nor with the resources which are available to these educators.

This is not limited to the South African context only. Curriculum policy frameworks where EE content has been included in the syllabus of school subjects around the world would be based on the assumption that educators have the ability to teach this content. When training programmes are offered to educators around the country, it is very difficult, if not impossible, to ensure that every educator is expected to include this new content in the relevant subject that he/she teaches, and to receive the appropriate training. However, what is more commonly observed is that schools do in fact adapt the policy statement documents published by the Department of Basic Education and use them as guidelines to establish teaching goals and to plan classes in terms of the context and the capacity of the school in question.

The section above examined and analysed the extent to which EE has been implemented in senior education systems in various countries, with the specific focus being on the South African context. Especially with regard to the integration of environmentally-related content into the latest South African curriculum for Further

Education and Training for Grades 10-12, it remains to be seen whether or not the policy statements which have been published by the South African DBE (2011a) have had far-reaching effects on all the schools in the country and whether or not educators do in fact closely follow the guidelines contained within these policy statements. Schools such as Hillside Primary and Sea Point Primary are two examples of schools which have followed these guidelines, with Hillside Primary School even compiling its own EE policy document.

On taking a step back and comparing the implementation of EE in the school curricula of countries around the world, each country faces its own challenge as it seeks to mould its learners into environmentally-literate citizens, as intended by the various hallmark documents and declarations published since the 1970s. One of the reasons for these challenges is that there is no set formula for the implementation of EE into a country's education system. What may work for one country may not work for another, even to the extent that an integration of EE at a national level may not be successful. Instead, the content of EE might need to be localised and adapted in order to be appropriate for the respective regions in a country and may be dependent upon the resources available to the schools and/or the belief systems of the respective communities.

Looking forward to the implementation and approaches taken towards EE in the future, one cannot ignore the role that technology will play in enhancing the teaching and learning of environmental issues such as climate change. It is in the section that follows below that the role of technology and its importance will be investigated, both on a global scale and on a local scale in the context of South Africa.

2.8 Conclusion

The Chapter above has examined numerous aspects of EE in great depth, with the emphasis being placed on the implementation of EE in South African school curricula. These aspects included the following: the history of EE on a global scale; the implementation of EE in education systems and national curricula around the world; the challenges associated with this; the importance of using new and emerging technologies such as GIS and ICT; the challenges involved in using such technologies to enhance learning - particularly in the context of Taiwan and South Africa.

The investigation has allowed one to understand that the history of EE is long and complex with its roots entrenched over numerous decades. Nevertheless, the adherents of EE have struggled to cement its place in the national curricula and in educational systems around the world. It is hoped that the use of ICTs and GIS technologies for environmentally-related content and topics will help cement the place of EE in national curricula.

While there is clear-cut evidence of the embracement of EE-related content in a vast number of countries around the world, there appears to be a lack of research pertaining to the attitudes and views of educators towards EE in the classroom situation. Educators are vitally important in deciding whether the implementation of EE in an education system will be successful or not. Therefore, it is crucial for research to be conducted and for data to be made available to determine the views and attitudes of educators towards EE. In fact, as long as educators are enthusiastic towards and are knowledgeable about EE-related content, there is a greater chance of moulding learners to be environmentally literate and aware of the need for sustainable development and progress towards a bright future. It is for this reason that this research intends to help bridge the gap where there is not an abundance of such data and research. The next chapter explains how the research will be conducted to achieve this.

CHAPTER 3: METHODS AND METHODOLOGY

3.1 INTRODUCTION

This chapter focuses on the research methodologies which were adopted in this study. The first two chapters points towards the value that an empirical investigation would be necessary. Such investigations allow for knowledge to be gained regarding the research objectives through direct or indirect observations and/or experiences. In addition, empirical investigations allow for either qualitative or quantitative research methods to be used. The research design consists of a mixed-methods (qualitative and quantitative) non-experimental survey design. The research survey serves as the primary tool for collecting data. Which helped contribute to a comprehensive and in-depth process for the collection and analysis of data which is in line with the identified objectives of this research.

This chapter discusses the research design and research methods; the design of the questionnaire; the sampling method; and the research procedure. It goes into ethical considerations; the methods for collecting and analysing the data, as well as the limitations of the research methods, before ending with a conclusion.

3.2 RESEARCH METHODS

Research is the systematic procedure of collecting and analysing data in a logical manner for the set purpose of resolving new or existing problems and/or proving new ideas and developing new theories (McMillan and Schumacher 2006; Govender 2011). While research methodology is the systematic way to resolve a problem, it is, to be more specific, the science of studying how the actual research is carried out. Alternatively, research methodology is regarded as the study of methods from which knowledge is gained (Govender, 2011).

The data that are collected may be qualitative or quantitative. The concept *qualitative data* is expressed through words, pictures or objects, thus describing the qualities of the data set, while quantitative data are expressed through numbers (Neuman, 1997). According to Creswell (1994:2), qualitative research “is an inquiry process related to acquiring an understanding of a social or human problem based on building a complex, holistic picture, formed with words, reporting detailed views of informants, and conducted in a natural setting”. The definition provided by Creswell (1994:2) for quantitative research is “an inquiry into a social or human problem, based on testing

a theory, composed of variables, measured with numbers, and analysed with statistical procedures, in order to determine whether the predictive generalisations of the theory hold true". An examination of a few of the strengths of each of the approaches now follows.

Quantitative research allows a researcher to develop a hypothesis before actually starting an investigation. The work produced is objective and allows the researcher to study a problem or phenomenon as an outsider. In addition, no more than a single meaning may be attributed to a word that a researcher has used, leading to concepts with explicit meanings and definitions (Mouton and Marais, 1990).

Qualitative research, on the other hand, is extremely effective at simplifying and managing data without compromising its integrity and complexity (Atieno, 2009). It allows for researchers to learn from participants in a setting from which they experience certain issues, and, if approached correctly, allows the researcher to understand the attitudes of participants towards certain issues. As a result, qualitative research tends to be interpretive in nature as opposed to quantitative research, which tends to consist of objective numerical data (Mouton and Marais, 1990; Atieno, 2009).

However, in order to use the strengths of both qualitative and quantitative research, the researcher has chosen to make use of a mixed-methods research approach in order to meet the objectives of the research. Mixed-methods research involves the collection, analysis and integration of both qualitative and quantitative data within a single study (Sadan, 2014). It is an approach which encourages multiple world views and is regarded by Sadan (2014) as a natural and logical approach which involves philosophical assumptions to guide the direction of the data collection and analytical processes, an approach supported by Creswell (2003).

Qualitative and quantitative research each have their own respective strengths and weaknesses. Mixed-methods research seeks to alleviate the weaknesses and maximise the strengths of the individual research methods. This is done by combining methods which have complementary strengths and non-overlapping weaknesses (Creswell, 2003). According to Atieno (2009), the two research approaches (qualitative and quantitative) can be synchronised for a better and more comprehensive result.

This is due to the following reasons: all quantitative data are based on qualitative judgement, where according to Atieno (2009:17) "numbers can't be interpreted without

understanding the assumptions which underlie them". It can also be understood that anything which is qualitative can be assigned numerical values in order to allow the researcher to better interpret and provide greater insights into the data under scrutiny. This shows that at certain stages, the distinction between the two research approaches can become extremely blurred in that they are almost inseparable. To expand on this further, mixed-methods research helps to answer questions and/or resolve problems which qualitative or quantitative research alone cannot answer (Sadan, 2014).

It is due to these reasons that the researcher has chosen a mixed- methods approach above a qualitative or a quantitative approach. In the section to follow, the details of the research design are explained and justified in line with a mixed-methods approach.

3.3 RESEARCH DESIGN

The research design is the overall plan to show how the research is conducted by shedding light on the collection and analysis of the data (Creswell, 2007). A research design is similar to an architectural outline. In addition, it is an actualisation of logic in a set of measures in order to optimise the validity of the data collected (Creswell, 2007). This could then be expanded upon by the researcher to the extent that he/she seeks to plan, structure and execute the research in order to validate the findings of the research.

This study utilised a classic data collection method including a research survey. In its most basic sense, exploratory research seeks to gain further insight into an identified issue and makes use of primary and/or secondary research. The study seeks to learn more of the state of Environmental Education (EE) and the degree to which technology is used in EE in secondary schools in South Africa.

In order to meet the objectives which were identified in Chapter 1, the researcher decided on a two-stepped research design. The first step presents a literature review; the second is a research survey in the form of a questionnaire. Each of these steps are now discussed.

3.3.1 Literature Review

According to Statpac (2009), a literature study involves a review of all the relevant literature available, either primary or secondary. Primary sources are direct descriptions of an occurrence or an event by an individual who observed such an event

(Borg and Gall, 1989). Such sources may also include written or oral accounts of an event by a direct witness and may include photographic evidence and a videographic recording of the event (Welman and Kruger, 2002).

Secondary sources, on the other hand, are publications written by an author who was not a direct observer of an event and who, as a result, has gained second-hand information. The author may have obtained the information from an individual who witnessed the event directly or even from other secondary sources (Borg and Gall, 1989; Welman and Kruger, 2002). Secondary sources were used extensively in writing the literature review of this research study. This was done in order to collect pre-existing literature surrounding the research topic allowing the available literature to be reviewed.

Such a review of available literature is necessary in order to gain an understanding of the current body of literature pertaining to the subject matter covered by this study. To undertake a comprehensive literature review is important for a number of reasons. These include the following: to ensure that the study is not a duplicate of an existing study; to discover the most recent and commanding research conducted on the subject; to discover what the most widely accepted empirical findings in the specific field of study are; and to determine the type of instrumentation used for similar studies in order to ensure the validity and reliability of the results for the current study. Furthermore, a literature review aids in avoiding repetition and in providing a clearer path forward (Mouton, 2003; Govender, 2011). The literature review contributed to the formulation of questions and issues - a necessary step in the research survey phase of the research design is.

3.3.2 Research Survey

A survey can be described as a cross-sectional and longitudinal study which uses either questionnaires or structured interviews for the purpose of data collection in order to formulate generalisations about a sample group in a population (Creswell, 2003). In terms of this, a written, electronically-distributed questionnaire was selected as the primary form of data collection for the study. In short, a questionnaire is an instrument which is used to collect data. Participants respond to a set of questions constructed so that the researcher can gauge their beliefs, attitudes, and reactions towards certain issues and subject areas (McMillan and Schumacher, 2001; Govender, 2011).

The reasons for selecting an online-questionnaire include the following: It allows the researcher to reach population groups which would otherwise be difficult to access or which might be hesitant to participate face-to-face in the research process. Such a data collection method saves the researcher time and allows participants to complete the questionnaire when it is convenient for them. Furthermore, it is less intrusive than a telephone interview or a face-to-face interview. It allows the participants to withdraw from the research process at any time and allows them to remain anonymous during the data collection process (StatPac, 2009; Wright, 2017). The design of the questionnaire used for this study is described and explained in Section 3.4 below.

3.4 QUESTIONNAIRE DESIGN

The questionnaire[4] which was designed for this study stayed true to the aims and objectives which were identified for this study. In addition, the questions were constructed in such a manner that the questionnaire would ensure that the questions were relevant to each of the individual respondents. The participants were identified through contact lists from the University of Johannesburg's Department of Geography, Environmental Management and Energy Studies which were created through hosting short learning programmes for the training and development of educators st the university. The participants were then contacted electronically before the questionnaires were distributed to invite them to participate in the study. If they agreed, the questionnaire would be sent to them. The questionnaire would also be accompanied by a letter assuring the participants that their answers would remain confidential and anonymous and that if they wished to withdraw from the process at any point, they would be welcome to do so.

The questionnaire is based on two key components, these being Environmental Education in Geography in secondary schools in South Africa, and secondly, the use of technology for Environmental Education purposes. As a result, the survey has three sections to it, namely: General and Demographic Information; Environmental Education in Geography, and the Use of Technology for Environmental Education Purposes.

[4] The questionnaire can be found in Appendix A.

The first of these seeks to establish particular demographic information concerning each of the participants. This includes *inter alia* the gender; age group of the participant; the highest educational qualification attained; as well as the size of the Geography class in question. The other two sections of the questionnaire focus on the objectives of the study, seeking to explore the extent of Environmental Education in secondary schools from the perspective of the participants, and the manner in which technology is used for the purposes of Environmental Education.

In order to do this, a variety of question types were posed to gather the greatest amount of information from participants in a limited period of time in order to thoroughly explore the identified subject areas. The closed fixed question type, from which participants could choose the most appropriate answer from a set of possible answers, was used (In some cases, they might have been required to provide reasons for some questions). Other types included Likert-styled questions from which participants could choose the most appropriate answer, as well as open-ended questions in which participants could express their opinions with regard to certain subject areas.

The nature of the questions catered for both the qualitative and quantitative aspects of the research. In fact, the attitudes and opinions of the participants towards certain subject issues were gauged, while the results obtained were quantified to allow for the statistical analysis of the data. In order to gain a better understanding of the approach taken towards the collection of the data for this study, as presented above, it is essential to understand the sampling process and procedure which influenced the research design.

3.5 SAMPLING AND PROCEDURE

When conducting research, it is vital to the success and validity of the study to identify and obtain the correct sample group to participate in the study. A sample group is a subset of a population which is used for research purposes. There are various types of sampling techniques which may be used when selecting a sample group, with each type having its own strength. One such sampling method is the convenience sampling method which falls within the domain of a non-random or non-probability sampling group.

Convenience sampling is a specific type of non-random sampling method which identifies and relies upon a group of individuals/professionals who are conveniently

available to the researcher and suitable candidates in terms of the research requirements (Dudovskiy, 2017). Convenience sampling finds its strength in the fact that it is simple to use; the data collection process can be facilitated in a short period of time; and it is the cheapest form of sampling as opposed to other sampling methods. In addition, such a sampling method is helpful for collecting data for pilot studies or for formulating hypotheses (Dudovskiy, 2017). However, convenience sampling is often criticised for allowing bias in the selection of the sample group in order to bring about favourable results.

It is for these reasons that the researcher decided to use the convenience sampling technique over other techniques in his selection of a sample group. A total of 69 respondents participated in the survey. This number was reached after numerous attempts were made to collect data using Google Forms as a data collection platform. Emails were sent individually to invite teachers to participate within the research study. A second stage of data collection was completed in which the researcher met with subject advisors for Geography from the GDE in order to get additional teachers to participate in the study. This then allowed for the total number of responses to reach 69. It was identified by Govender (2011) that response rates for questionnaires are normally very low, especially with regards to digital questionnaires.

All the educators within the sample group worked at public secondary schools within Gauteng, with the size of the schools and the resources available to them varying. Some respondents within the sample group were reached through short learning programs (SLPs) which, hosted by the University of Johannesburg and were financially supported by the DBE and other educational bodies within South Africa. These SLPs focused on the following topics: An Introduction to GIS; Basic Mapwork Skills; as well as Advanced Mapwork. These SLPs served as platforms for the continuous development of educators including Geography teachers such as the ones included in this research study.

In addition, the researcher attended a specific regional meeting for geography teachers within the Gauteng province to reach the ideal number of responses for the questionnaires. This allowed the researcher access to a large group of potential participants who teach geography classes and thus have a vested interest in the success of the study. With regards to the critique of potential bias in terms of selecting

a sample group which would lead to favourable results the research was designed to be of an exploratory nature in order to discover the status of Environmental Education in secondary schools. As such, the researcher had nothing to gain by selecting a sample group which would produce feasible results for the study.

3.6 DATA ANALYSIS PROCESS

Statistical methods were used to analyse the quantitative portion of the data which were collected during the data collection process. They were used to interpret the collected data and also to lead to clear and concise conclusions[5] regarding the nature of the data (Terreblanche *et al.*, 2006).

As regards to the qualitative data, obtained from the research survey, certain trends and patterns were identified on the basis of descriptive statistics. These were used to determine the attitudes/opinions of participants with regard to specific issues.

The questionnaires which were completed by the participants were captured on the Google Forms platform and could, as a result, be easily converted to a Microsoft Excel spreadsheet. Where possible, the data which had been captured were illustrated using graphs and visual imagery (pie charts; bar graphs and tables). The use of graphs, tables and figures allowed the researcher to identify trends and information from the data which might not have been identifiable without these aids. Thus, the data captured during the data collection process could make it possible for the researcher to come up with significant conclusions.

Once the data had been analysed by the researcher, a SWOT analysis was conducted to identify the strengths; weaknesses; opportunities and threats to Environmental Education in secondary schools in South Africa. At the same time, cognisance was taken of the application of technology for Environmental Education in secondary schools in South Africa.

3.7 ETHICAL CONSIDERATIONS

Ethics can be defined as “guidelines or a set of principles for good professional practice which serve to advise and steer researchers as they conduct their work” (Bloor and Wood, 2006). In addition, Bloor and Wood (2006) see ethics as a branch of philosophy concerned with morality, integrity and the difference between right and

[5] the demographic attributes of the participants/educators in the sample group

wrong. It is crucial for researchers to follow a certain code of good practice in order to respect the rights and responsibilities of potential participants within the identified sample group in order to develop good relationships with the participants, fellow researchers, and various funding bodies. Thus, in order for such relationships to be developed and for the sake of the code of good practices adhered to in this study, it was necessary to consider and identify certain ethical considerations. Such ethical considerations are discussed below.

A crucial part of following a professional code of ethics for research is respect for persons or participants such that they are treated as independent and autonomous individuals (Trichom *et al.*, 2016). This was achieved by allowing potential participants to give their informed consent to be part of the study. This means that the participants of the study were provided with sufficient information regarding the study, including the objectives of the study; a background to the research topic, the benefits of the study, as well as a reminder that they might withdraw their participation from the study at any point should they feel uncomfortable or should they no longer wish to continue participating in the study (Dunn and Chadwick, 2004).

A second component concerning the participants who were required to provide their informed consent to participate in the study was that they should understand the nature of the research in which they were participating. Thus, they should fully understand the nature of the questions posed and how they should answer them.

These two conditions allowed for participants to take part in the study voluntarily. In addition, it was made known to participants that all information and answers provided for questions posed during the study would be kept strictly confidential. By following a code of ethics and taking into account the ethical considerations discussed above, respect could thus be given to the participants in order to maintain the integrity of the study.

Even though attempts were made to maximise the strength of the research methods used through a mixed-methods research approach, there were still certain limitations that prevailed. The nature of these limitations is discussed below.

3.8 RESEARCH METHOD LIMITATIONS

One primary research method was used to carry out the research and collect data. This method was a research survey. Each of these methods has been discussed in

detail in the sections above, with the limitations of each being acknowledged. The potential limitations of research surveys and group interviews in the context of this study are set out below:

A major limitation to using the research survey as a method for collecting data is that it has a low response rate since large numbers of questionnaires need to be distributed in order to receive an acceptable number back. With the issue as to whether the required response rate would be reached in mind, and against all odds, this researcher used the research survey as the primary means of data collection and was in fact able to reach the required response rate to justify the choice of this as an appropriate data collection method.

Besides this important consideration (a potential limitation), another shortcoming of this method whereby questionnaires are distributed electronically via the email, is that this researcher was unable to query answers to questions or to get additional information from participants on certain topics.

From the above, it can be seen that there are indeed limitations to the research methods which were used in this study. However, the limitations were not substantial enough to limit or delay the research which was undertaken.

3.9 CONCLUSION

A review was undertaken to examine the research methodology of the study. The review introduced the research methodology and the methods used. A mixed-methods approach was adopted to investigate the key issues in this investigation. This was followed by a detailed description of the implementation of the relevant research methods, which included an investigation into the research design; the design of the questionnaire; as well as the method by which the sample group for the study was selected.

Ethical considerations for this study were outlined in an in-depth manner in order to maintain the academic integrity of the study as well as to ensure that a code of good practice was followed. The limitations of the research methods were subsequently acknowledged and considered. Thus, showing that even while using a mixed-methods approach and multiple data collection methods, shortfalls in terms of the research methods used could still arise. However, the researcher felt that these limitations and shortfalls were not significant enough to force changes to the research design.

This chapter focused primarily on presenting descriptions of the respective steps in the research process and their applicability to the identified objectives of the study. The chapter that follows on this, addresses the findings and outcomes of the data collection process in detail.

CHAPTER FOUR: DATA ANALYSIS AND RESULTS

4.1 INTRODUCTION

Chapter 3 set out to explain the research design for this study. This chapter analyses the information and data that were collected, with the purpose being to present the results of the research in terms of the aims and objectives of the study which were identified in Chapter 1. With the primary aim, being namely, “to investigate the state of Environmental Education and the use of technology in Environmental Education Geography in the Further Education and Training (FET) phase presented by South African secondary schools”.

For the best visual impact, the collected data are presented in tables and in a diversified collection of graphs. By analysing the graphs, tables and figures, the researcher could identify trends and information from the data which might not have been identifiable without these aids. The information thus presented was then followed by a brief explanation of the results within the context of the literature. The questionnaire used for this study on which the data collection process was based is presented in Appendix A. A SWOT analysis of the data that was undertaken is then presented to further explain and interpret the results of the study.

4.2 PRESENTATION AND DISCUSSION OF RESULTS

Data were collected during the data collection process through the use of questionnaires (see Chapter 3). By using the questionnaire as the primary data collection method, a wide range of educators from various backgrounds and different districts in Gauteng, South Africa, could be accessed. Thus, the researcher had access to an ideal sample group that was diverse in nature and was a group of educators teaching environmental content in their classes.

On examining the demographics of the sample group of participants in this study, it became clear that there was a slight dominance in the gender ratio in favour of males, who made up 59.4% of the response group, as opposed to females (40.6%). Such a ratio allows for a fair and virtually equal representation of the views of both genders towards EE, along with the use of technology for EE purposes, in the high school environment in Gauteng Province.

The next demographical aspect which was considered was the age composition of the respondents. The breakdown of the ages of the respondents is illustrated in *Figure 4.1.*

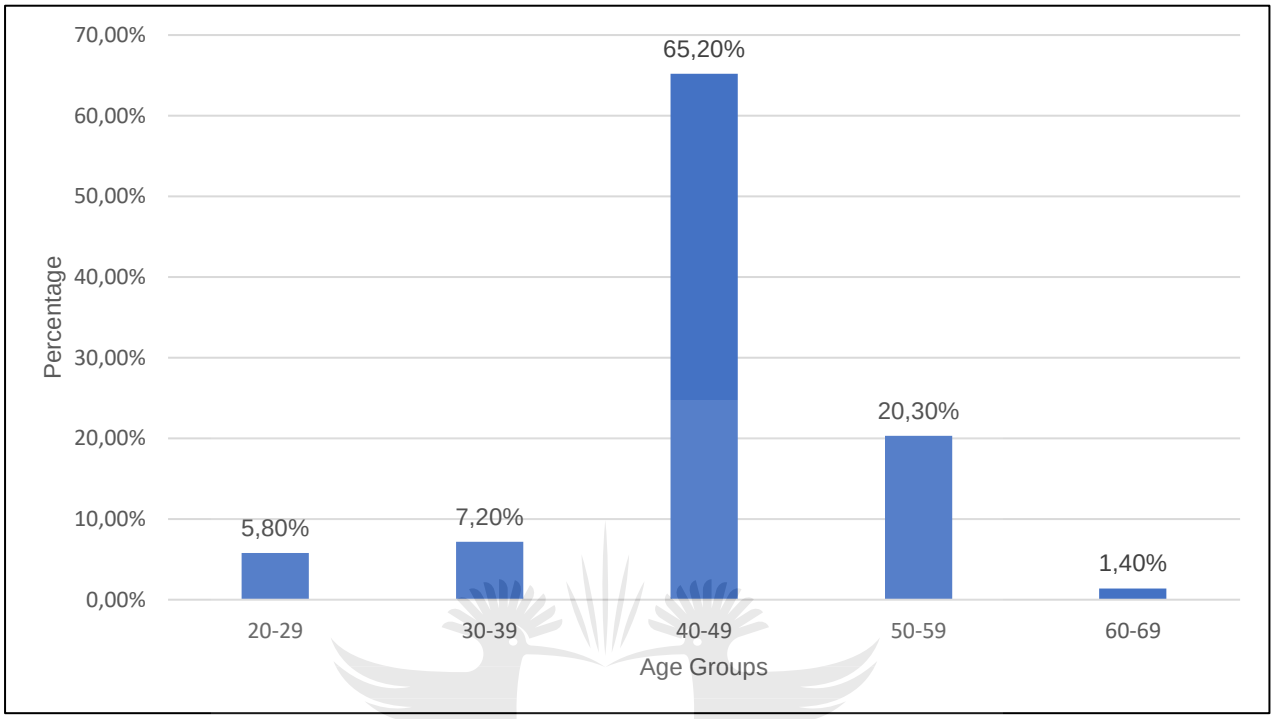

Figure 4.1: Age Groups

Figure 4.1, presenting the respective age categories of the respondents represents a mature sample group which would have a certain degree of experience as educators, especially given that 94% of the respondents were over the age of 30, and only two fell between the ages of 20-29. It is worth noting that only one respondent was over the age of 60. This then is a sample group that, given their experience as educators, could give reliable information regarding the issues at hand. This claim is supported by the fact that the average number of years that the respondents had taught Geography was close to 16 years (15.9), with the longest period being 34 years and the shortest period being a single year. It is further worth noting that 23.2% of the respondents had taught Geography for less than 10 years, thus indicating that a significant proportion of the sample group would have taught only the more recent editions of the South African Geography curriculum, which, according to Beets and Le Grange (2008) should focus on EE- related content.

Having a sample group which is mature in terms of age, as well as experienced in teaching a particular subject (Geography in this case) allows for in-depth answers to

be given. Furthermore, educators who have taught for an extended period of time would have experienced changes within the syllabi as the curricula have changed and been updated over time. They would, therefore be able to reflect on what has worked and what has not worked as regards content, including EE-related content. It was further necessary to gauge whether Geography was the only subject that the respondents were teaching in order to judge whether they had specialised in teaching Geography or had to cover a number of curricula in their classes. The results can be seen in *Figure 4.2*.

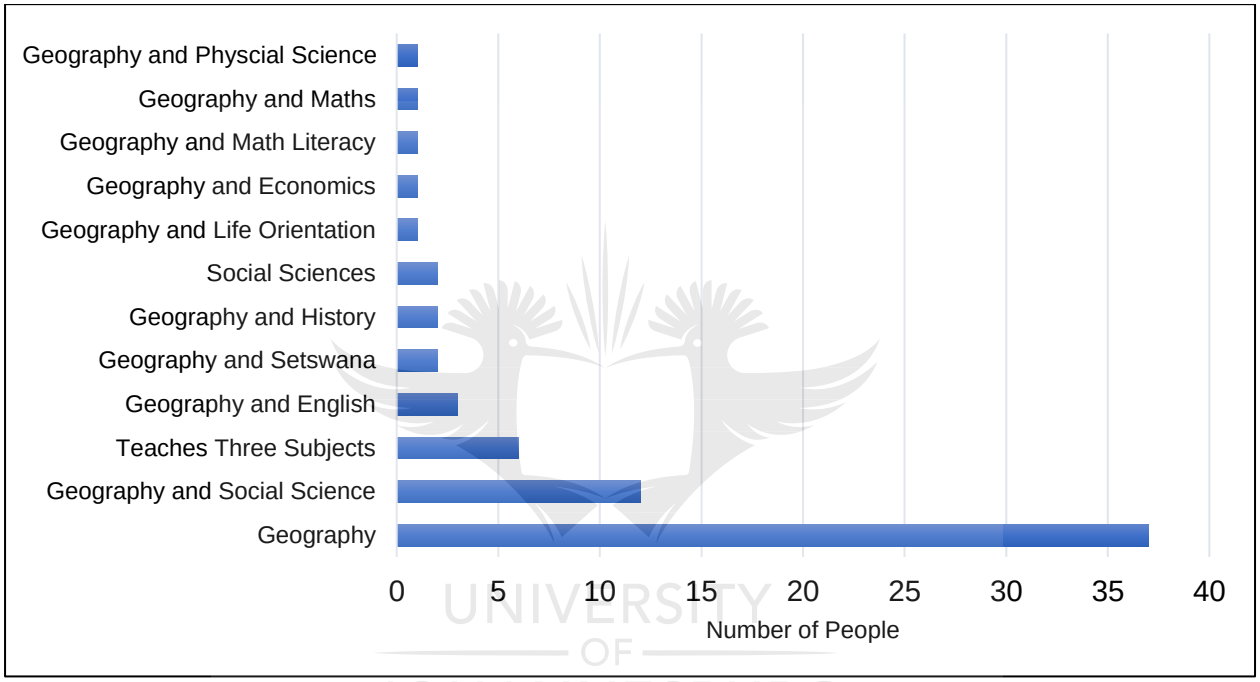

Figure 4.2: Subjects Taught by Respondents

It is striking to see that just over half (53.6%) of the respondents were teaching only Geography in their classes. This means that 46.4% of the respondents were expected to teach different subjects, this being a combination of Geography and a second or third subject. The other subjects included the following: Physical Science; Maths; Maths Literacy; Economics; Life Orientation; Social Sciences; History; Setswana and English, thus showing a large range of content in combination with the Geography curriculum. For example, while aspects of the Social Sciences and Geography curricula may overlap, the content for language subjects such as Setswana or English differs drastically from the content covered in the Geography curriculum.

What is noteworthy is that close to 9% (8.7%) of the respondents indicated that they were teaching three subjects. This can be interpreted as the fact that the resources

available to certain schools in Gauteng are stretched or that schools are short-staffed, forcing certain teachers to teach up to three different subjects. These circumstances would potentially lead to a decline in the quality of the teaching, as the teacher cannot afford to specialise in one subject (whether it be Geography or any another subject). Specialisation in a particular educational field or subject area is usually associated with the highest qualification that an educator could have. This can be seen in *Figure 4.3*.

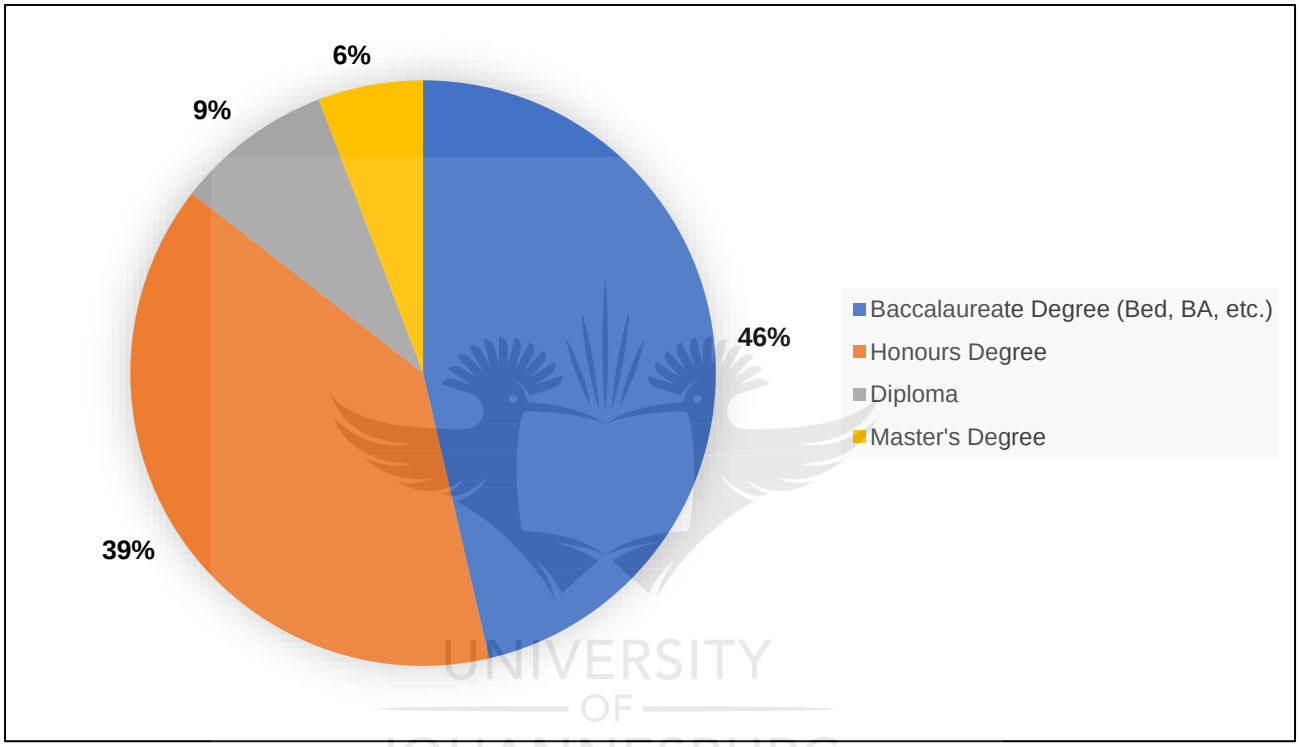

Figure 4.3: Highest Educational Qualifications of Respondents

Figure 4.3 indicates that at least 45% of the respondents had achieved an Honours or a Master's degree, indicating further specialisation within a particular field. It should be noted, however, that postgraduate degrees were not indicated by the respondents. While 46% of the respondents had a Baccalaureate Degree (BSc; BEd or BA), only 9% of the respondents had reached their position as a teacher via a non-traditional approach. *Figure 4.3* does not indicate any SLPs or continuous professional development programmes that respondents might have attended; only their highest tertiary qualification.

The location in which a school is found (its respective school district and/or residential area) is a good indication of the resources available to educators within the school

environment. For example, a school in a district in a wealthy residential suburb would have access to more resources than a school located in a township. Examples of these are indicated in the tables below.

Table 4.1: School Districts and Residential Areas of Select Schools of First 20 Respondents

School District	**Residential Area**
Gauteng East	Kwa Thema
Tshwane North	Temba
Gauteng West	Kagiso Central
Johannesburg North	Soweto
District 6	Mackenzie Park
Gauteng West	Ga Mohale
Gauteng West District 2	Kagiso, Mogale city
Tshwane West District 15	Winterveld
Gauteng West	Carletonville
Sedibeng West District 8	Bophelong, Vanderbijlpark
Ekhurhuleni South District 6	Vosloorus
Ekurhuleni South District	Thokoza Township
Ekurhuleni South District	Katlehong
Johannesburg North	Randburg
Tshwane South District 4	Atteridgeville
Soweto	Orlando East
Gauteng East District 4	Bakerton
District D14 Gauteng	Lenasia
Seshegong District 4	Olievenhoutbosch
District 12	Dobsonville

Table 4.1 indicates a sample group that is spatially spread out across the Gauteng Province, representing a variety of backgrounds and social levels. As such, an educator teaching out of Kagiso Township would have a different perspective towards EE as opposed to an educator teaching out of a school in Johannesburg North (Randburg) - to give just one example.

One last demographical aspect on which the respondents were questioned was the size of their classes for the three FET grades (grade 10-12). Some educators misunderstood what was asked of them here and gave the size of the grade rather

than the size of the individual class. As a result, the average class sizes could not be calculated. However, what could be identified were the largest and smallest classes indicated for the respective grades. For Grade 10, the largest class size was 50 students and the smallest was 15 students. For Grade 11, the largest class size was 54 and the smallest was 17 students, while for Grade 12, the largest class size was 52 and the smallest was 18 students. These large class sizes could be an indication of a shortage of schools and/or teachers within a specific school district. Furthermore, and of note is the fact that very large class sizes are the cause of much strain on the educators in understaffed schools.

Bearing the demographics of the sample group in mind, one can gain a better understanding of the core research issues at hand in order to meet the primary research aim, as identified in Chapter 1. The first core issue as identified in Chapter 1 to be addressed is Environmental Education in Geography.

4.3 ENVIRONMENTAL EDUCATION IN GEOGRAPHY

To understand and gauge the state of EE within high schools of South Africa, specifically within the Gauteng province, it is necessary to understand the views and attitudes of educators towards EE as well as the extent to which EE is taught. According to Govender (2011: 95) “If educators are not environmentally literate themselves, then instilling knowledge, attitudes, skills, awareness and action in learners will not be successful in achieving the goal of producing environmentally literate citizens”.

4.3.1 An Examination into Environmental Education in South African School Geography

Respondents were firstly asked whether in their opinion it is important to have EE included in the school curriculum, to which almost all (98.6%) of the respondents replied that it was important. Only one respondent stated that he/she was not sure. Some of the reasons that are of particular interest in respect of the question posed above can be seen in *Table 4.2* below:

Table 4.2: Reasoning of Importance for Inclusion of Environmental Education in School Curricula

Reasons of Importance:
"Our environment is under threat and which could lead to very serious problems for future generations."
"It creates awareness of environmental issues and makes students (hopefully) become responsible citizens."
"Learners are at risk, especially from informal settlements without environmental knowledge."
"Development without the environmental knowledge aspect does not lead to sustainability."
"There is no Geography without the environment."
"The environment is very much interlinked to the economy and our social environment."
"Our lives are intertwined with that of the environment. Interaction between us and that of the environment is affecting us both. Learners should know how their actions can affect the environment and the quality of our lives."
"Environmental education is solution to environmental catastrophes the world is facing. Doing it as a subject promote environmental sustainability."
"It is vital that we care for the environment on which we live...sustainable environments are key. If learners do not understand the importance of the environment... they will not respect or care for it."
"There is a lot of strain on the environment due to human activity. The limited environmental content has been of some benefit. Pupils get excited about environmental discussions. I feel more focus is needed on environmental education."

Table 4.2 above captures answers of particular interests from the respondents. Only ten responses have been listed above, but these reflect the common trends and views from the respondents. Almost all respondents recognized that there are serious environmental issues affecting the environment currently, and that these issues affect the quality of human lives. Whether this be in the form of climate change or the economy being affected by changes in the environment. As numerous respondents identified that the "environment is very much interlinked to the economy and our social environment".

An overwhelmingly common view that was expressed by the respondents was that EE allows students to gain an appreciation for the environment around them. Thus, they would begin to respect the environment more, which would lead to amongst others, reduced littering around schools (this was identified as a major issue by respondents).

By gaining an appreciation for the environment, students would realise that their actions have an impact on the surrounding environment and the important role that sustainable development plays. One respondent went so far as to state that development without a solid base of environmental knowledge would not lead to sustainability.

Table 4.2 and the answers that were provided whether it is important to have EE included within school curriculums by respondents illustrated that there was a complex understanding of the environmental issues which exist, both around the world and within a South African context. When queried whether respondents agreed with the inclusion of EE being integrated into multiple subject curriculums. *Figure 4.4* below shows the degree to which the respondents agreed to the inclusion of EE into a number of subject curricula.

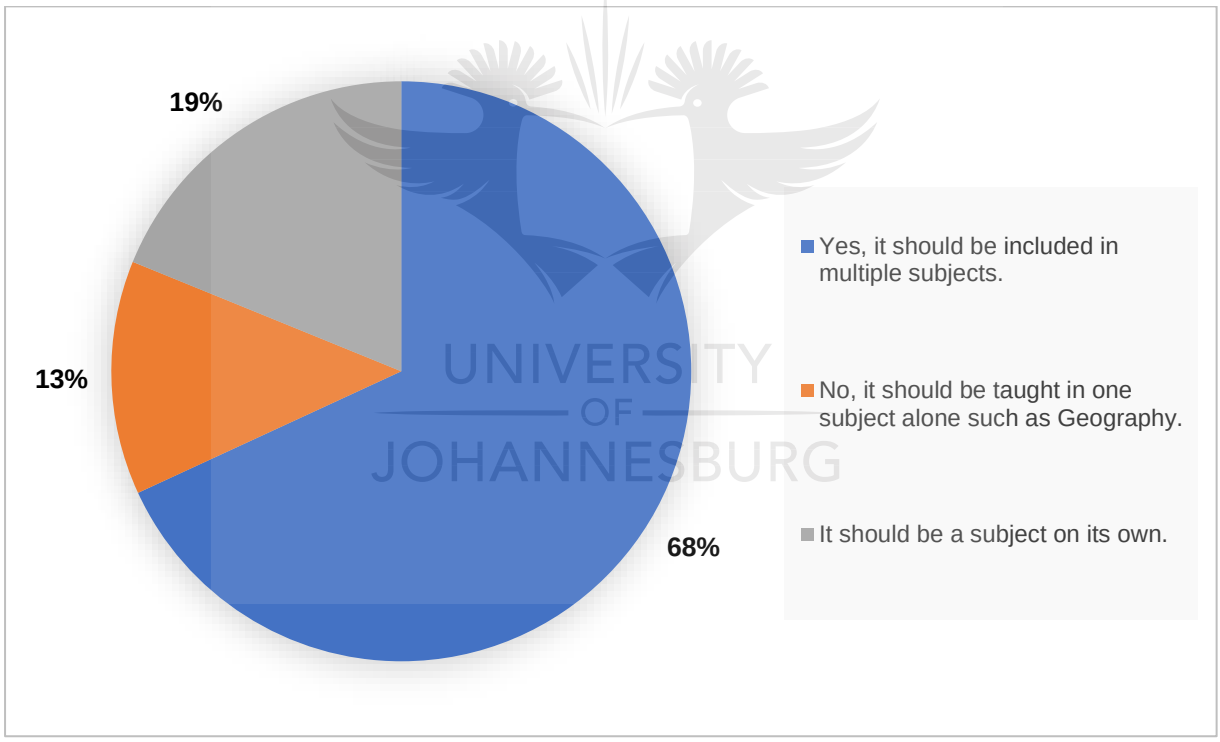

Figure 4.4: Agreement with the Inclusion of Environmental Education being Integrated into Multiple Subject Curricula.

Not surprisingly, all respondents agreed with the integration of EE into school curricula. However, opinions differed when it came to the question as to whether EE content should be included across a number of subject curricula, or whether it should only be included in a single subject such as Geography. The majority of respondents (68%)

agreed that EE should be included in a number of subject curricula, such as Geography and Life Orientation, while 13% thought that EE should be taught in a single subject such as Geography. What is of note in *Figure 4.4* above, is that just less than one fifth (19%) of the respondents felt that EE as a subject should be taught in its own right in the high school. If EE were to be taught across a number of subjects, however, a larger number of learners would be reached with the message of the importance of sustainable development and the environment in which they live. If EE were to be taught only in a single subject such as Geography, then only those students studying that particular subject would be exposed to EE-related content.

Furthermore, content related to the environment does appear in a number of subject curricula in South African high schools (Makhoba, 2009). However, as indicated by Maluleke (2005) and Beets and Le Grange (2008), it is particularly prominent in the Geography curriculum. To dive deeper into the views of educators as regards EE, respondents were asked to rate their level of knowledge of current environmental issues around the world on a Likert scale, with a response of one (1) being representative of little to no knowledge, and one of five (5) being representative of an excellent level of knowledge. The responses to this can be seen in *Figure 4.5* below.

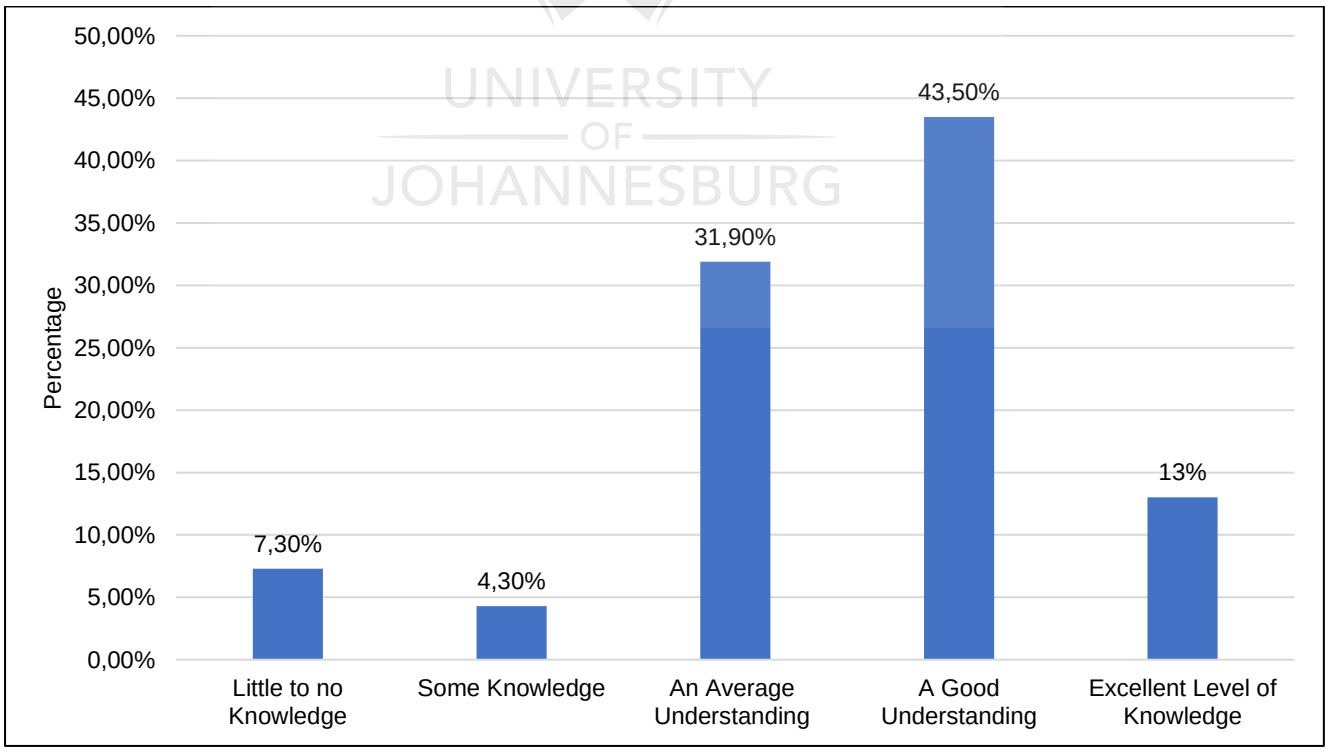

Figure 4.5: Levels of Knowledge of Environmental Issues that Exist Currently.

The figure above shows that over half (56.5%) of the respondents felt that they have either a good understanding or an excellent level of knowledge in respect of current environmental issues, while 31.9% of the respondents felt that they have an average understanding of current environmental issues. This is encouraging considering that educators in subjects such as Geography are expected to teach environmentally-related content, a fundamental part of which includes environmental issues.

What is a matter for concern is that 11.5% of the respondents felt that they have little to no knowledge or only some knowledge of environmental issues. This means that over 10% of the respondents are disconnected from the current environmental issues that the world is facing (e.g. rising ocean levels or the increased frequency of droughts). Such a disconnection limits these educators from conveying to the students the most pressing issues that the world is currently facing with regard to the environment. The respondents were then asked whether in their opinion they were knowledgeable enough about EE in order to teach it effectively. There is a difference between having an adequate knowledge of current environmental issues around the world and having enough knowledge concerning EE. *Figure 4.6* below addresses these issues.

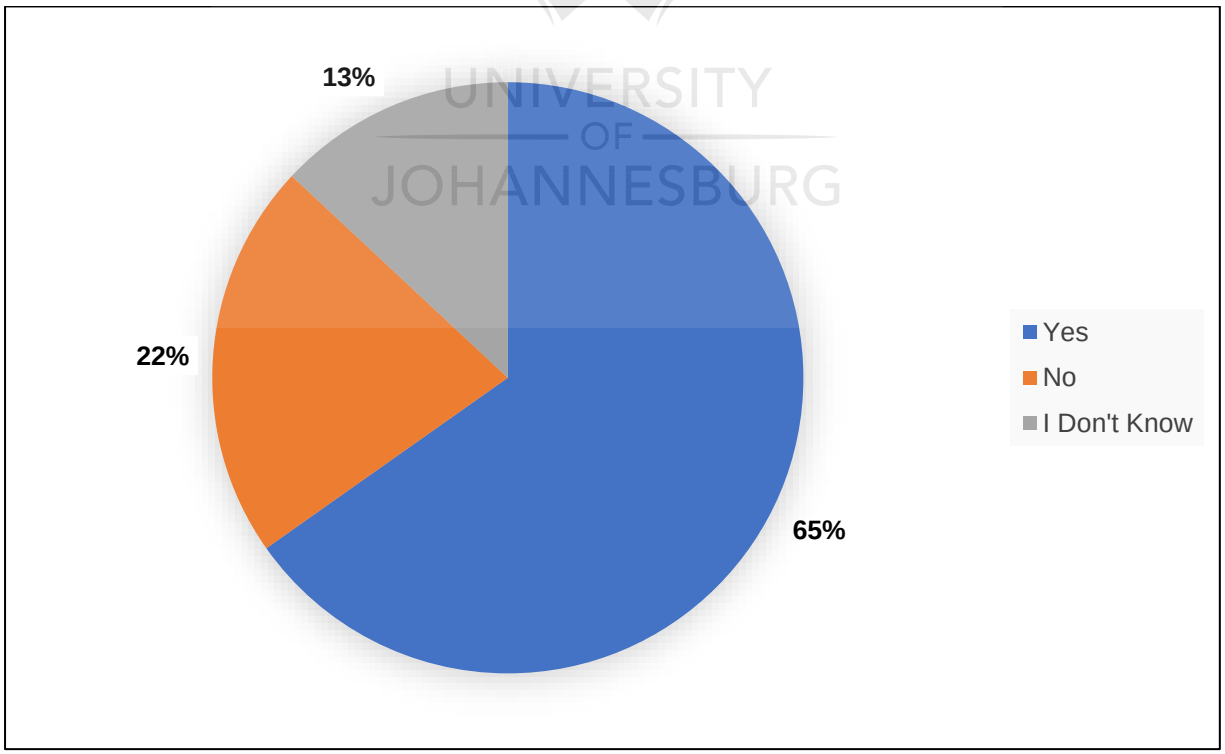

Figure 4.6: Responses to Whether Respondents had Enough Knowledge about Environmental Education to Teach it Effectively.

What is staggering from *Figure 4.6* is that over a fifth (22%) of the respondents felt that they do not have enough knowledge regarding EE in order to teach it effectively, while a further 13% were unsure. If educators feel that they are not knowledgeable enough in terms of a particular subject, this will influence their confidence in approaching the content in the classroom environment. Although 65% of the respondents felt that they have enough knowledge of EE to teach it effectively, the issue remains that 35% felt that they are lacking in knowledge or unsure of their assessment of themselves.

The 2017 Matric diagnostic report examines the performance of students in each of the subjects written in the Matric final examinations (suggestions for improvement and areas of weakness are identified within this report). In the case of Geography, questions often involve an environmental component. For example, in the 2017 Matric Paper 1 for Geography, learners were required to make a connection between the impact of urban development on the water table in one instance; in others, to provide sustainable solutions to the formation of urban smog and to explain the role of greenbelts in mitigating environmental problems (DBE, 2018). The 2017 Matric diagnostic report indicated that "an in-depth knowledge of such issues is required by the teacher, and this might have to involve informal research" (DBE, 2018:85). The 2017 Matric diagnostic report further indicated that "[t]eachers are encouraged to collect resources on an ongoing basis and to be aware of current events that are being taught in Grade 12". This is especially true for human geographical issues; for example, changes in the urban and economic environments. These should then be incorporated into lessons to ensure that lessons are topical and of significance to learners. As life-long learners, teachers must stay abreast of new developments in their subject" (DBE, 2018:85).

Such recommendations and suggestions are being made at the national level by the Department of Basic Education, where the expectation for educators to continuously develop themselves in order to benefit their students is being advanced. There are enormous quantities of resources available to educators to incorporate into their lessons and also to improve their own level of knowledge, thus contributing to an 'informal research process'. The more educators stay abreast of new developments within their subject field, the more their students will reap the rewards, especially when it comes to incorporating current events into their lessons, and thus allowing their

students to become aware of environmental issues and improving their ability to answer questions during the final examinations.

This will then affect the quality of the classes on EE related content that a large number of students will receive. In line with this, respondents were asked whether they taught EE content within their classes. To which just less than 80% (79.7%) of respondents indicated that they did teach EE related content within their classes. Leaving 20.3% of respondents not teaching EE related content to their students. A significant issue in of itself. Which for Geography, can have a significant impact as all respondents within the study are Geography teachers. Such teachers not only have the responsibility of preparing their learners to be responsible and environmentally-aware adults, but also of preparing them to answer such questions in their Matric exams.

4.3.2 South African FET Geography Curriculum

The next issue which was addressed was what parts of the Geography curriculum for the three FET Grades (Grade 10-12) includes EE related content. The common responses and overall trends of the respective responses are presented in the tables below.

Table 4.3: Environmental Education Related Content Indicated to be Part of Grade 10 Geography Curriculum.

Theme	Specified Content by Respondents
Global Warming	• The impact of climate change on Africa's environment and its people. • Evidence for global warming, causes and its consequences, with particular reference to Africa.
Climatology	• Processes associated with heating of the atmosphere (e.g. insolation, reflection; scattering). • The atmosphere. • Ozone depletion. • The Green House Effect
Water Resources	• Ocean currents and influences of the oceans. • Impacts of droughts

All the Topics cover the Environment	Respondents felt that all the content covered in classes could be considered environmental related content.
Not sure/None	Respondents weren't sure what was considered to be environmentally-related content in their classes.

The content in the table above shows a wide range of learning material in the Grade 10 Geography curriculum which is considered to be related to the environment. Although the above findings may be related directly or indirectly to EE, an issue which needs to be raised is the fact that three respondents indicated that there was no EE-related content in the Grade 10 curriculum, while some of them were not sure what could be considered to be EE-related content in the classes that they teach. A second complex issue which needs to be raised is that the respondents could name some of the themes such as Geomorphology; Population Studies and Development Studies, but that they could not identify how they are related to EE. In fact, every single aspect of Geography can be related to EE-related content. Geomorphology addresses accelerated soil erosion; Development Studies addresses sustainable development practices; Population Studies covers the exploitation and use of resources. This consideration alone is troubling owing to the fact that educators may not interpret or understand what they are teaching, resulting in students themselves having a limited understanding of the content. Furthermore, there was little consistency in the answers as to what could be regarded as EE-related content This indicates that there are real differences in what educators perceive EE-related content to be.

Table 4.4: Environmental Education Related Content Indicated to be Part of Grade 11 Geography Curriculum.

Theme	Specified Content by Respondents
Geomorphology	• Mass movements (e.g. landslides, mudslides, rock falls).
Sustainability/Economic Geography	• Concepts of recycling & • Management of natural resources.
Climatology	• El Nino and La Nina processes and their effects on Africa. • The role of ocean currents in climate control (focus on Africa).

	• Hydrological cycle.
Climate Change	• Desertification
Same as Grade 10	Content covered was the same as that covered in Grade 10.

In terms of the Grade 11 curriculum, much of the focus, as indicated by the respondents, was being placed on Climatology. Only a few respondents indicated that direct EE-related content was being covered in the Geography curriculum, while numerous respondents indicated that the Grade 11 curriculum covered the same or very similar content to that which had been covered in the Grade 10 curriculum. This is what is to be expected, namely that the base of knowledge learnt in the lower standards should be built upon for the more detailed content that is tested in the final examinations in Grade 12. However, respondents could still not name specific EE-related content which was being covered in themes dealt with in such sub-disciplines as Development Studies, again indicating a superficial understanding of the content which they teach.

Table 4.5: Environmental Education Related Content Indicated to be Part of Grade 12 Geography Curriculum.

Theme	**Specified Content by Respondents**
Same as Grade 10	Content covered was the same as that in Grade 10.
Water Resources	• Fluvial management. • Catchment management. • River systems.
Economic Geography	• Management of natural resources. • Effects of secondary activities on the environment. • Effects of mining on environment.
Climatology	• Tropical cyclones and reducing their impact. • Urban heat islands (their causes and their effects; strategies to mitigate the heat island effect).
Environmental Agreements and Sustainability studies	• Kyoto Protocol. • Agenda 21.
Settlement Studies	• Rural vs. urban settlements.

Not sure.	Respondents weren't sure what was considered to be environmentally-related content.

The Matric (Grade 12) curriculum is expected to contain the widest volume and range of EE-related content considering that it builds on content which had previously been taught. Similar concerns can be raised in relation to *Table 4.5*, namely that there were inconsistencies in what respondents considered to be EE-related content. In addition, three respondents again indicated that they were not sure what could be considered to be EE-related content - either directly or indirectly. This might point to a superficial understanding regarding the content that educators are required to teach. This can only be detrimental to students.

In order to establish whether Geography was the only subject in which EE was taught, the respondents were asked to indicate whether there were any other subjects within the FET which addressed EE that they knew of. They were asked to specify these subjects 21.7% of the respondents indicated that Geography was the only subject addressing EE. However, it should be noted that, as indicated in *Figure 4.2,* over 53% of the respondents were teaching only Geography, and as a result, might not have been aware of the content (e.g. EE inclusive) of other subjects. The other subjects including or addressing EE that the respondents indicated included the following: Life Orientation, Life Sciences, Tourism, Economics, Agricultural Science and Physical Science, with Life Orientation and Life Sciences featuring prominently. It should, however, be noted that the respondents did not specify the nature of the EE-related content addressed within these subjects. The fact that many subjects such as Economics and Life Sciences address EE-related content is a sure sign that EE has been implemented across a number of subjects within the FET curricula in Gauteng Province. As such, it appears that all students are exposed to EE to some degree (for example Life Orientation is a compulsory subject in the South African school systems, both public and private) (DBE, 2011b).

Respondents were then questioned as to whether they thought that the current Geography curriculum contained enough EE-related content. Their responses can be seen in *Figure 4.7* below.

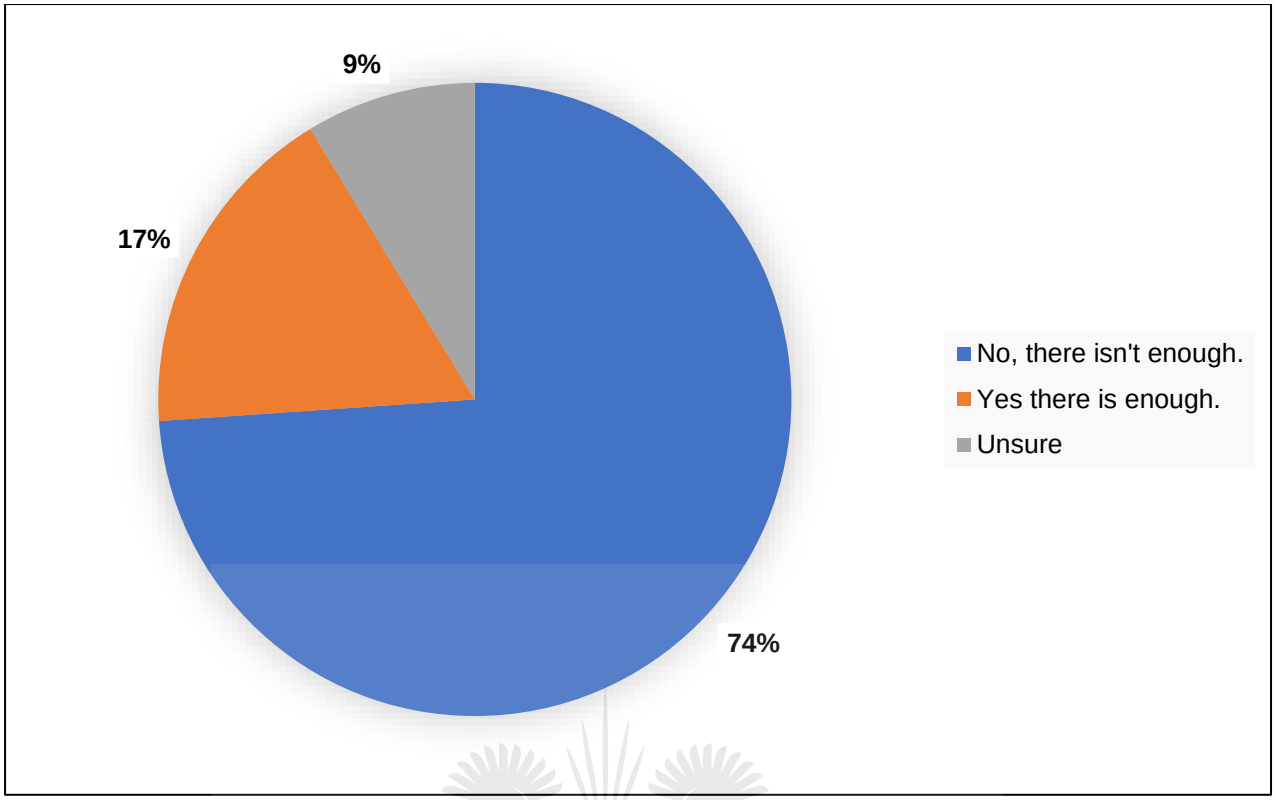

Figure 4.7: Responses to Whether There is Enough Environmental Education Content in Current Geography Curriculum.

The majority of respondents felt that the current FET GDE Geography curriculum does not cover enough EE content, with a further 9% of the respondents indicating that they were unsure. If educators feel this way, it is an accurate indication that the EE which is included in the curriculum is not sufficient to produce environmentally-literate learners/citizens, which, as mentioned previously, is the primary goal of EE. This is a factor which should be taken into account when considering future curriculum reforms and modifications to specific aspects of the curricula. Furthermore, the educators also identified certain components regarding EE which they felt should be included in the Geography curriculum. These aspects, varied in nature but with certain common threads to them, can be seen in *Table 4.6* below.

Table 4.6: Recommendations as to what Should be in Geography Curriculum for Environmental Education.

Recommendations:
• **The effects of environmental degradation within the real world especially with a strong local connection which students can identify with.**
• **A stronger link to local geography and case studies which affect students directly.**
• **Preservation of wetlands and water resources.**
• **Link between the theory taught and the direct impact on humans.**
• **Urbanization within South Africa and Africa.**
• **Environmental impact assessments – their effects, causes and solutions.**
• **Environmental policies and their impacts thereof.**
• **Environmental sustainability.**

The responses in *Table 4.6* above indicate a strong desire amongst educators to establish a much stronger link between the theory which is taught in the classes and the ties to local geography for the students. A reason for this is that if students can observe what they are learning in the classroom environment, then there is a much greater chance that they will appreciate as well as relate to what they are learning. An example of this would be the impact that littering has on the environment, whether it be around the residential community in which the students live, or around their schools. When students are taught about the impacts of littering on the environment, they are much more likely to actively try to solve the problem of litter in their local environment by doing something concrete to remove it. Another example is that if students are taught about acid rain in Europe, they might not pay much attention as it does not affect them directly, whereas this would be a different case if they were to be taught about and given examples (visual images) of littering in their own local environment.

The answers that were provided by the respondents showed an awareness in them of the strong trend of environmental sustainability. However, as it is, this is already a strong overarching theme in the FET curriculum. In fact, one respondent actually indicated that environmental impact assessments should be introduced into and dealt with in the Geography curriculum, whereas this is an aspect which is normally only

introduced at the tertiary level and is highly specialised, thus, making its inclusion as a response questionable at the very best.

What was of interest is that the respondents indicated that the impacts of the environmental policies of South Africa should be taught. Perhaps a way to go about doing this would be to explain to students the evolution of the South African environmental laws and policies and their impacts or intended impacts. Furthermore, students could be taught this aspect in relation to international policies and agreements to which South Africa is a signatory nation (already covered in the FET Geography curriculum).

When questioned as to whether they were aware that South Africa is a signatory nation to environmental agreements such as Agenda 21 (which requires EE to be integrated at all levels of education) (Mohammed, 2016), only 81.2% of respondents were aware of this, with 18.8% indicating that they did not know that they were legally required to integrate EE into the subjects that they were teaching. This is a matter for concern and something that all educators should be made aware of, either through the National Department of Education or through the provincial and regional branches of government - either through direct guidance (e.g. annual manuals) or instruction through workshops.

From what has been indicated in respect of all of the questions and queries above, it is not surprising to find that 97.1% of respondents felt that the inclusion of EE in school curricula could allow students to become environmentally-responsible citizens who are environmentally literate. With the reasons for their answers to this question being both insightful yet predictable, according to the literature such as that written by Mueller & Bentley (2009) and Govender (2011), Mueller & Bentley (2009:53) stated that “EE in schools represents an inclusive and multidisciplinary way for developing ecological awareness and fostering relations between learners and nature”. This viewpoint, built on Govender’s (2011:34) argument that in view of “the fact that the environmental awareness of young people influences their actions in terms of the environment, not only in the present, but also when they reach adulthood, it is essential that they be encouraged to act in such a way as to benefit the environment”. To name just two published papers which discuss the reasons for the inclusion of EE as a means to develop environmentally-literate students, and with Mwendwa (2017) pointing out the

fact that the main tools or aspects for achieving sustainable development are acquired through education, it has become clear that high school education forms a vital link in the education process. Common reasons behind the answers regarding the inclusion of EE in the Geography curriculum can be seen in *Table 4.7* below.

Table 4.7: Reasons Given that the Inclusion of Environmental Education can Help to Develop Students who are Environmentally Literate.

Reasons Provided:
• **To conceive a culture of sustainability in students early on in life.**
• **The awareness will develop responsibility and cooperation in future citizens and leaders.**
• **Learners will be aware of their responsibilities as citizens.**
• **Makes them aware of environmental issues.**
• **We are grooming citizens of South Africa and must give them the necessary information to take care of the environment.**
• **Students will know the environmental impacts of their actions.**
• **Help students to make informed decisions.**
• **Most students don't care about the environment.**

The majority of the common responses which were provided by the respondents could have been predicted from the content of international literary sources in which the impacts that EE has on students and its ability to create environmentally- literate citizens are identified (Le Grange, 2002; Gough and Gough, 2010; Govender, 2011; Haindongo, 2013). Le Grange (2002:83) described EE as "education's response to environmental issues and risks" in its ability to address environmental issues to the benefit of future generations. However, where the predictions end is when numerous respondents indicated that 'students do not care about the environment'. This then set up an urgent case where EE is crucial in addressing this issue and in changing the views of such students, for the betterment of society. In order to examine whether it is possible to achieve this change, educators were asked whether they could identify any strengths (if any) with regard to EE in South African secondary schools. Their responses are shown in *Table 4.8*.

Table 4.8: Strengths Identified Regarding Environmental Education in South African Secondary Schools.

Strengths Identified:
• **Integration of environmental education across curriculum.**
• **The concept of the pillars of sustainable education (reduce; reuse and recycle).**
• **Numerous environmental programmes existing in certain schools.**
• **Geography and Life Sciences include it widely.**
• **Promotion of sustainable development.**
• **Particularly strong around issues surrounding water resources**
• **Establishing the link between the environment and the economy, particularly through the role of ecotourism.**
• **Base of knowledge which is built concerning the environment.**
• **No strengths exist (especially in township schools) or the strengths are minimal in this regard.**

The answers provided by respondents to the question "What strengths can you identify with regard to Environmental Education in South African secondary schools?" are cause for particular concern. This is due to the last point, namely that there are minimal strengths within the current system, which was raised on numerous occasions and also by eight or 11.6% of the respondents. The respondents specified that educators are often textbook-bound and as a result don't read and do not prepare, leading to minimal attention being given to current events and impacts. In addition, one respondent pointed out that students do not take the EE content being taught seriously since littering at schools is still a major problem. To both of the points made above, arguments could be made for the lack of resources to teach beyond the textbook that the teacher has, or that there are inadequate waste disposal mechanisms at certain schools, thus leading to excessive littering. However, the issue remains that eight respondents felt that the current EE system in South African secondary schools has nothing or very little to offer (no strengths).

A positive note, however, is that a large group of respondents identified a wide range of strengths regarding this matter. They Indicated that numerous EE aspects have been successfully implemented across the board in South African secondary schools, some being more illustrious than others. Examples of these would be the environmental programmes or clubs in some schools, which, according to one

respondent, are mainly in Pretoria. The other strengths which were mentioned were more traditional and predictable and in line with the literature which has been published regarding the potential strengths of EE in secondary schools (Govender, 2011). Govender (2011) states that EE is holistic in its approach, in that it deals with, amongst others, the natural, manmade, economic, social and political aspects of the environment. Furthermore, EE is issue-orientated in that it deals with current issues on varying scales; and is also future-orientated in that it is concerned with both the current and future generations. To just expand on just a few of the strengths and characteristics which Govender (2011) had identified.

In line with the strengths which were identified with regard to EE in South African secondary schools and whether the inclusion of EE in school curricula could contribute to the development of students to become environmentally literate, only 34.8% of respondents felt that EE in its current form, as taught in South African secondary schools, plays a significant role in producing more environmentally-caring citizens. On the other hand, 53.6% of the respondents felt that the current system does not play any role in this respect.

This points to an urgent need for a reform in the secondary school system of South Africa to improve the ability of EE within the system to produce citizens which are environmentally literate from the perspective of educators. Whether this desire of educators will be listened to and adhered to by the different levels of the South African government is yet to be seen. Respondents in addition strongly felt that there is a need for further training which specifically addresses EE for educators, with 87% agreeing to this, while only 13% felt that additional training was not required.

While educators feel that further training is necessary for specifically addressing the issue of EE training for educators, information on environmental problems and issues has been widely published and is easily accessible from within the enormous volumes of information which can now, in the 21st century, easily be found, especially as a result of the internet. Within the South African context, an association by the name of the Environmental Education Association of Southern Africa (http://eeasa.org.za/) specifically caters for EE in Southern Africa. The fact that there is such an abundance of resources regarding EE available to teachers and that suggestions can be made by

the DBE (2018) at national level means that teachers can undertake 'informal research' themselves in order to gain an in-depth knowledge of this discipline.

Research indicates that either teachers do not know about the availability of this information and the resources, or they are not committed enough to do their own research. Other reasons for this could be that teachers do not have access to computers to collect the required data or they do not have the necessary skills or are unfamiliar with certain technologies. A factor which could well play a role in explaining this trend is the average age of the teachers within the study group. In fact, as seen in *Figure 4.1*.,65% of the respondents fall into the age group 40-49 (see *Figure 4.1.)*. Additionally, more in-depth research might be required in order to determine exactly what EE training educators would like to receive which would otherwise not be available to them through 'informal research'.

In addition, almost all of the respondents felt that the current EE in South African secondary schools could be improved, with various reasons being given for their opinion. There were only 2.9% of the respondents who indicated that EE in schools does not need any change, with a further 7.2% indicating that they were not sure. On examining the reasons why there should be a change in EE in the schools, widely-ranging reasons were given, which should not be viewed within and isolated in terms of the South African context but within the South Korean context since Govender (2011) himself was concerned and identified with the situation in South Korea. The reasons given can be seen in *Table 4.9* below.

Table 4.9: Suggestions Provided to Improve the Current Environmental Education in South African Schools.

Suggestions Provided:
• **The inclusion of fieldwork.**
• **Teachers with master's degrees must be employed in schools to increase the level of knowledge of educators addressing environmental education.**
• **Introduction of English debates specifically addressing environmental issues.**
• **Introducing environmental education as its own subject.**
• **Introducing environmental education to lower grades.**
• **Continuous empowerment of educators through training**

The suggestions made above are the same ones that can be found in school systems around the world, whether they be in Malaysia or South Korea (Govender, 2011). Within the context of Malaysia, a lack of specific resources has been identified as a major problem in the implementation and execution of EE plans and activities. Apart from this, there is a lack of capacity in training educators. In fact, the training of educators has been identified as a major stepping stone to solving this issue (Govender, 2011). On the other hand, Govender (2011) indicated that a greater number of EE-qualified educators in South Korea need to be employed in schools; that substantial improvements need to be made in the quantities of EE resources available within the schools (e.g. textbooks); and that appropriate changes should be made in the training of teachers in order to prepare them well for the challenges of EE.

Where issues of a lack of resources are continually identified as a major issue, whether in the form of a lack of financial resources or of educators not being knowledgeable enough in some areas of the subjects they teach, they are required to attend SLPs or courses to bridge the knowledge gap. The suggestion of introducing debates, which specifically address environmental issues and the components of EE, is valuable in that such an activity could stimulate critical thinking in the classroom environment and allow students to question the information at hand.

As with all attempts to improve the components of a country's education system, there are certain barriers or challenges to face. Respondents were asked to indicate what they felt were the biggest challenges in improving the current structures of EE in secondary schooling in South Africa. The answers can be seen in *Figure 4.8* below. It should be noted that respondents could select more than one option.

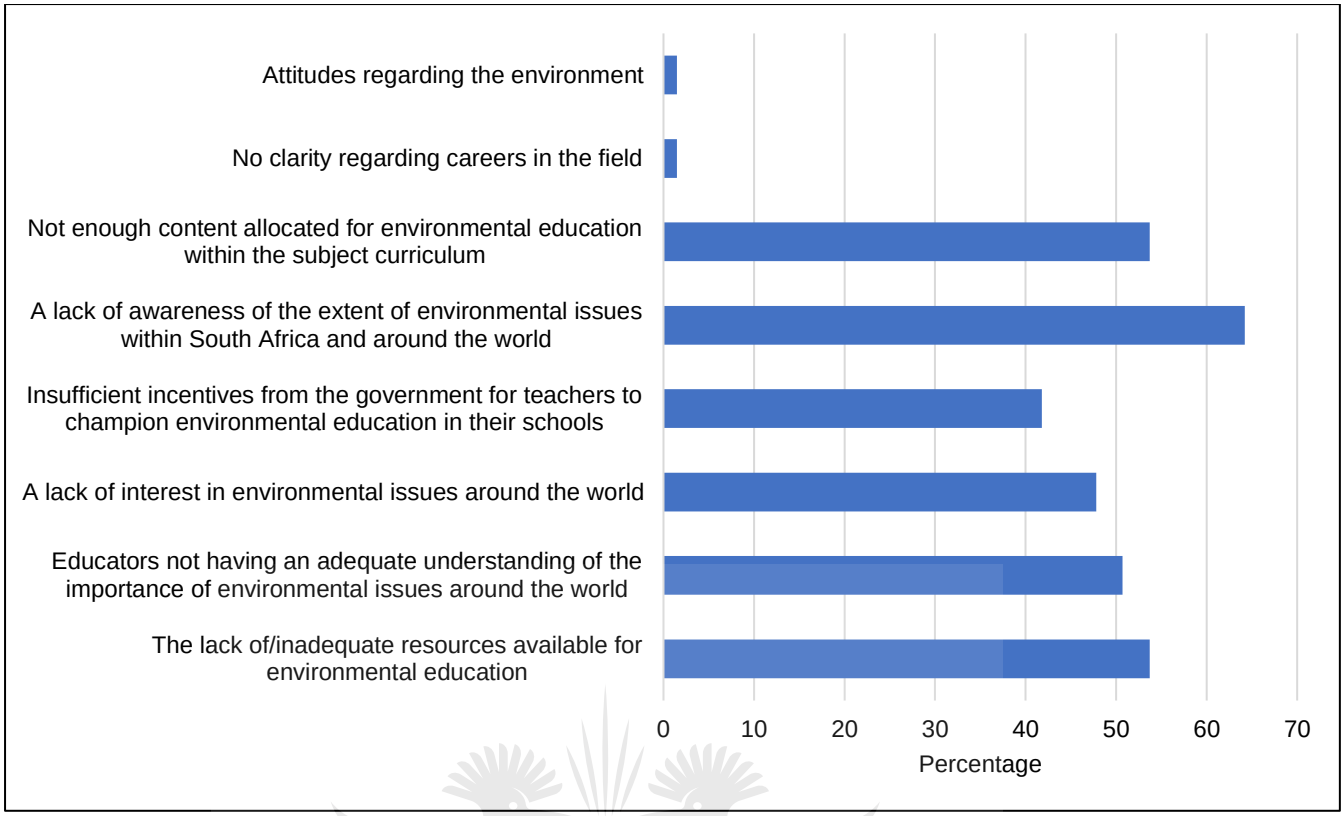

Figure 4.8: Challenges in Improving Current Structures for Environmental Education.

At least half of the respondents identified numerous challenges as major barriers to the improvement of the current structures for EE in secondary schooling in South Africa. With 'a lack of awareness of the extent of environmental issues in South Africa and around the world' being identified by 64.2% of respondents as the single greatest barrier to this improvement, this then shows that while educators may be aware of the importance of EE in the classroom environment, society within the South African context may not be aware of the environmental issues in a local as well as regional context in South Africa. On the other hand, a lack of resources available for EE and the lack of space allocated to EE content in the subject curriculum were both identified as the second-greatest barriers to the improvement of structures for EE in secondary schools. There are further indications to the effect that there are serious issues surrounding the availability of resources in the South African schooling system as a whole. However, the extent of the issues surrounding this aspect fall beyond the scope of this research. It is no surprise, therefore, to find that the availability of resources is an issue, since it has been raised time and time again in a country presenting with the greatest economic inequalities in the world and where large sections of the population live in severe poverty (Isaacs, 2007).

The sections above have presented the views of educators in respect of EE; and amongst other factors, how they approach it; and the factors influencing the implementation of EE across the South African schooling system. However, to gain a holistic image of EE within the South African schooling system, one needs to study the use of technology for EE purposes. This is examined in the section below.

4.4 USE OF TECHNOLOGY FOR ENVIRONMENTAL EDUCATION PURPOSES

As introduced in Chapter 2, technology has become ubiquitous in people's lives (a trend that will increase in its effects over time). Section 2.4 alluded to the importance of the role that technology will be playing in the educational sector during the 21st century, as well as the vast range of technologies which are increasing dramatically and which are now available to education systems around the world. With comments by Blažek *et al.* (2017) in mind, it is now difficult to imagine a world in which the role of technology in teaching is not irreplaceable. Amongst other reasons, this then makes it vital to gauge the views of educators themselves concerning the use of technology for EE purposes.

When questioned as to whether technology has the potential, as in the case of GIS and ICTs, to be used in the classroom for EE, an overwhelming majority of 85% of the respondents agreed to its strong potential. The responses to this question are shown *Figure 4.9*.

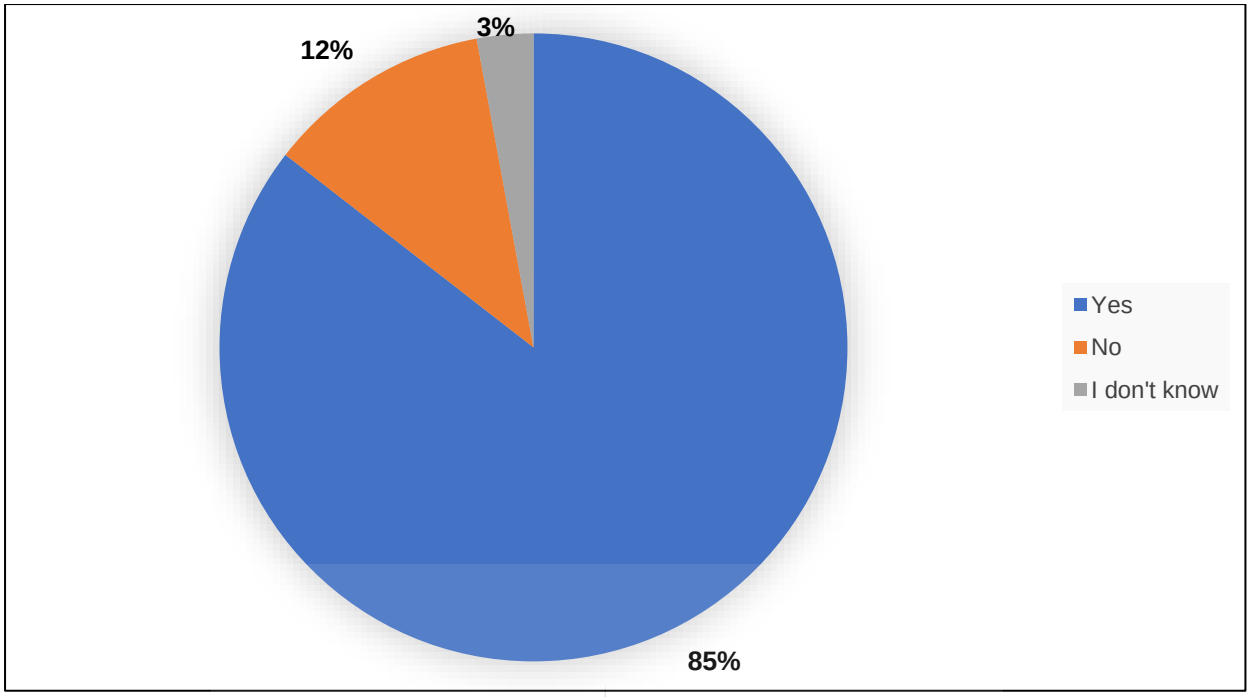

Figure 4.9: Views Towards a Strong Potential for Technology in the Classroom.

Such an overwhelming majority would suggest that educators would embrace opportunities to use such technologies in their classes and to seek to learn about them to the benefit of their students. Whether this is true, remains to be seen. Further research may be required to investigate this specific matter. However, educators may be held back in this regard on account of the lack of resources which are available to them, an issue which is investigated in the sections below.

4.4.1 Views Towards Technology for Environmental Education

The higher the level of knowledge of an educator in respect of a particular subject or piece of equipment, the more likely he/she would feel confident about approaching it and/or using it in the classroom. It is interesting to note that 84% of the respondents felt that they have an average understanding of GIS and ICT, or an even greater understanding of these technologies when they were interviewed on a Likert-styled question. The results can be seen below in *Figure 4.10*.

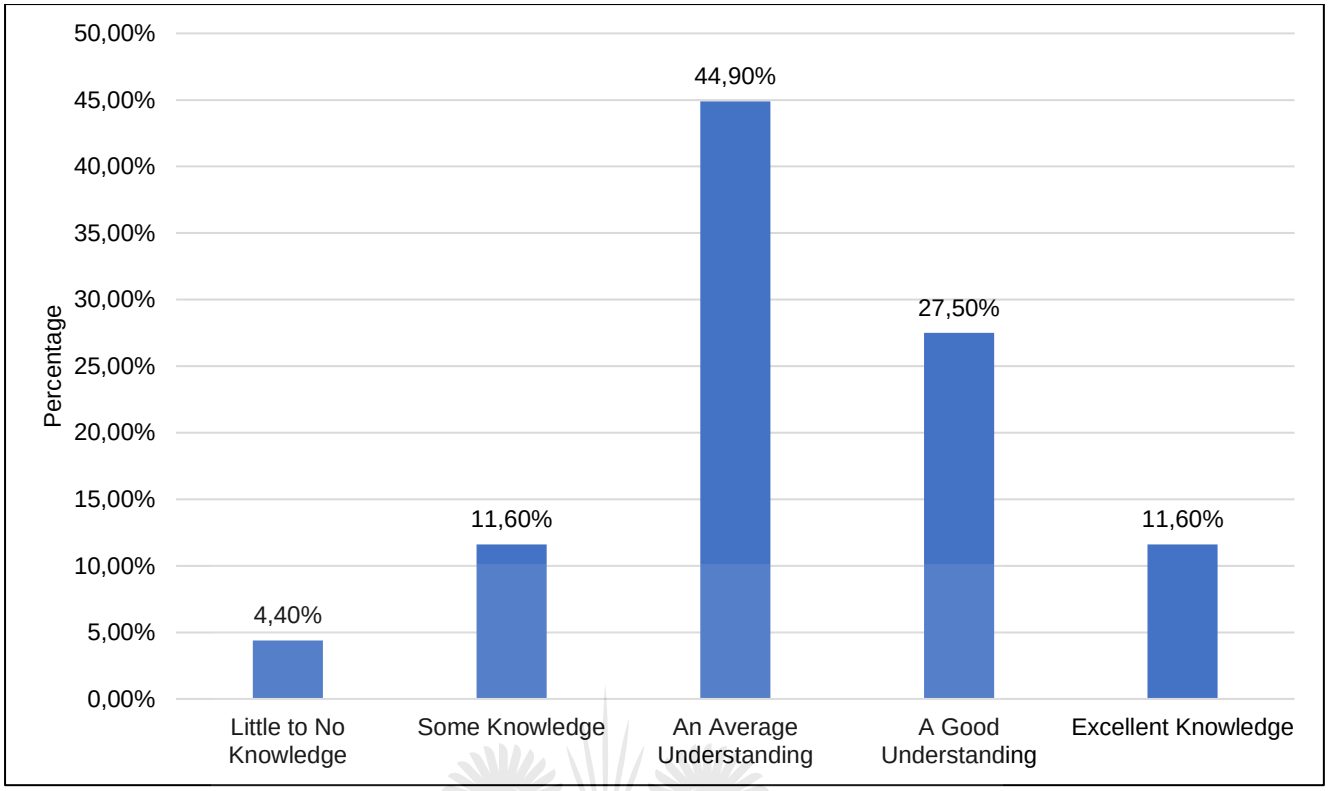

Figure 4.10: Level of Knowledge of GIS and ICT.

It is reassuring to note that 39.1% of the respondents felt that they have a good to an excellent understanding and level of knowledge of GIS and ICT. This would imply that 39.1% of respondents are confident in approaching GIS and ICT in their classes in order to enhance the quality of their teaching material and lessons. Depending on the resources available to them, it was not surprising to find that close to half (44.9%) of the respondents felt that they have an average understanding of GIS and ICT. It is of some concern that more than 15% (15.9%) of the respondents felt that they had less than an average understanding of GIS and ICT. This indicates that they would not feel comfortable/confident enough to teach or use these forms of technology in their classes.

In saying this, when the respondents were asked whether they felt that a form of technology such as GIS is relevant and should be taught in the classroom environment, 95.7% of them agreed, with only 4.3% indicating that they were not sure. At this stage in the investigation process, the educators had a very positive view on the use of technology in their classes in order to enhance the learning process for their learners. While this may be the case, there are significant challenges or barriers regarding the use of technology in the classroom for EE purposes, the likes of which

educators are all too aware of. Their responses to this issue are presented in *Figure 4.11* below.

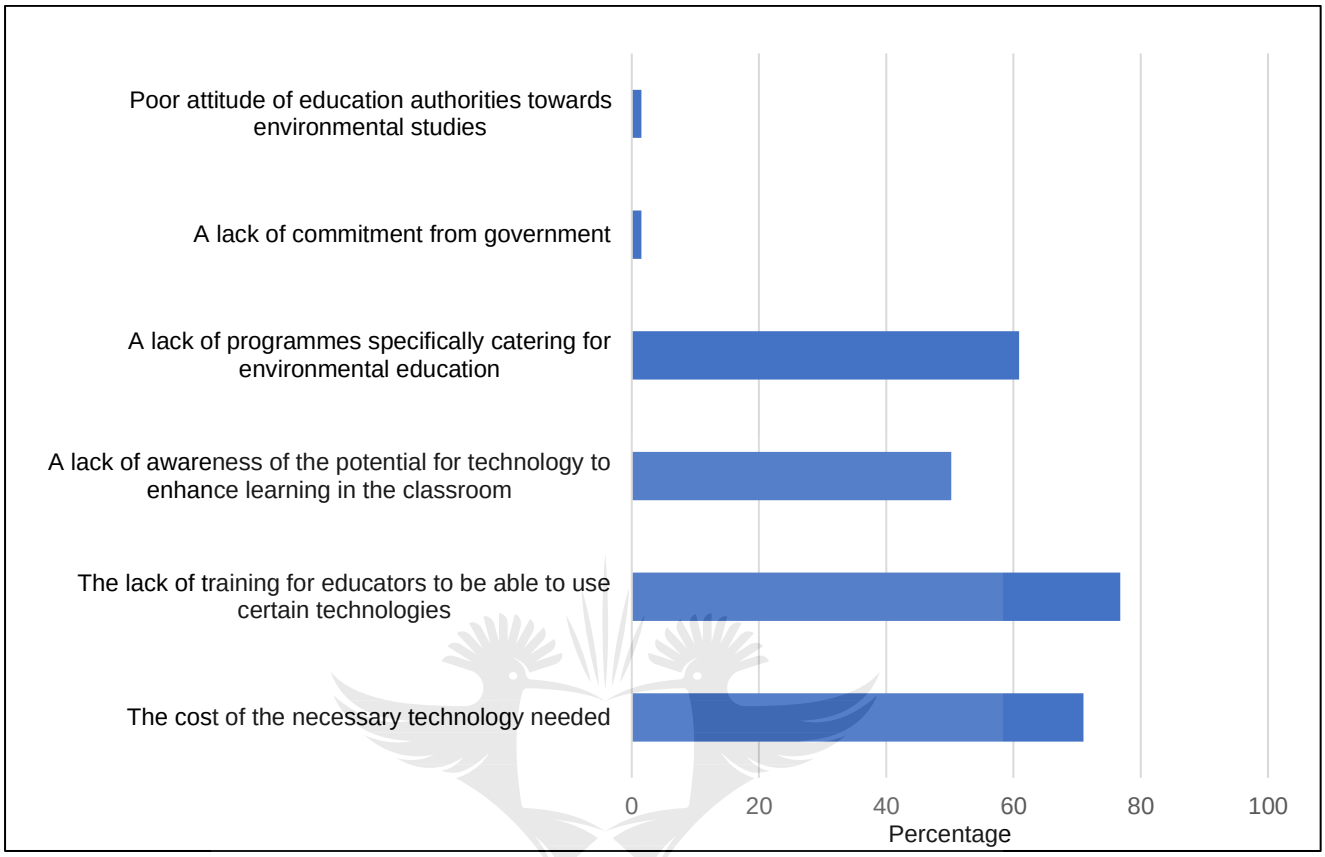

Figure 4.11: Greatest Barriers to Using Technology within the Classroom.

The options which respondents could choose from were provided by the researcher and were intentionally broad in nature. It is clear from *Figure 4.11* that there are four barriers, considered by the respondents to be the greatest, to using technology in the classroom for the purposes of EE. Considering the study group, namely mature educators with an average number of years in teaching Geography of just less than 16 years, it is not surprising that the "lack of training for educators in the use of certain technologies" was identified as the largest barrier, with 76.8% of respondents identifying this. This is especially relevant since most technologies are currently being used widely, and might even have been invented only after the respondents had graduated with their teaching degree. A "lack of commitment from government" and the "poor attitude of education authorities towards environmental studies" were considered as minimal barriers by 1.5% of the respondents.

In a study undertaken by Isaacs (2007), the national average for schools with computers for teaching and learning amounted to only 22.6%, while the average for the Gauteng province for the same variable was 78.8%. More recent and current figures showing access to ICTs in respect of the South African schooling system are hard to find/not available, or do not exist at all. Thus, it is not surprising to see that “the cost of the necessary technology” was identified as the second-greatest barrier to using technology in the classroom environment (regardless of which subject area was being taught). Globally, it is widely accepted that the implementation of any GIS in a school requires large amounts of capital, and this consideration is particularly relevant in South Africa, where severe inequalities prevail across the country. This means that if a school cannot afford the necessary equipment such as, amongst others, computers, software and projectors, then the educators do not have a choice as to whether to use particular technologies in their classes as the choice has been removed. The barriers which were identified by the respondents are in line with those identified by Beetzke *et al.* (2011). These researchers listed three challenges which South Africa faces in terms of successfully implementing GIS in its national curricula. These are money; support, and time.

This aspect then is a major disadvantage to learners who are not able to use ICTs in the classroom environment and can also not handle the practical aspects of GIS. As such, only the theory of GIS is being taught in the classroom, which may explain why the South African Department of Basic Education in its diagnostic report for Geography for 2014 concluded that a fundamental knowledge of technologies such as GIS is genuinely lacking in both learners and teachers (DBE, 2014). The report further stated that "many teachers are not familiar with GIS and are merely teaching definitions, but not the application of the techniques and skills" (DBE, 2014:105).

Taking a step back to the views of the respondents towards GIS and ICTs within the classroom environment, over 80% (81.2%) of the respondents felt that GIS should be used in subjects other than Geography, with 14.5% of respondents indicating that it should be used only in Geography. Thus, their opinions point to a wide acceptance of technologies which can enhance the learning process for their learners, and outside the bounds of the subjects requiring the inclusion of GIS in their curricula. When asked whether they were aware of the curriculum requirements of GIS within the Geography

CAPS curriculum, the positive view of the respondents towards GIS was strengthened. These results are shown in *Figure 4.12* below.

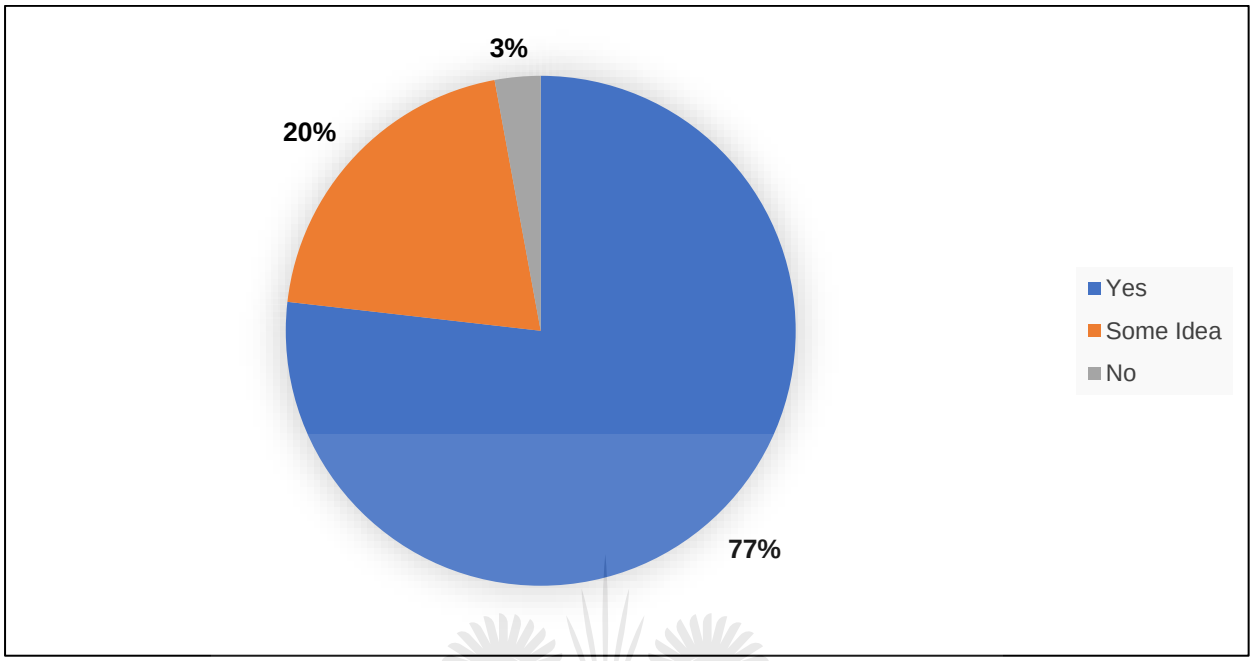

Figure 4.12: Awareness of Curriculum Requirements of GIS.

The section above shows that at least 77% of the respondents were aware of the curriculum requirements for GIS within the Geography CAPS curriculum, with a further 20% having at least some idea of these requirements. Whether the respondents met these requirements themselves is unknown. A major factor influencing this aspect would have been whether educators had access to the necessary resources for the practical components of GIS in their classes, or whether they themselves had enough knowledge to meet these requirements. A factor that further influences the manner in which GIS is used in the classroom environment is how educators themselves view GIS in a learning environment. These results are shown in *Figure 4.13* below.

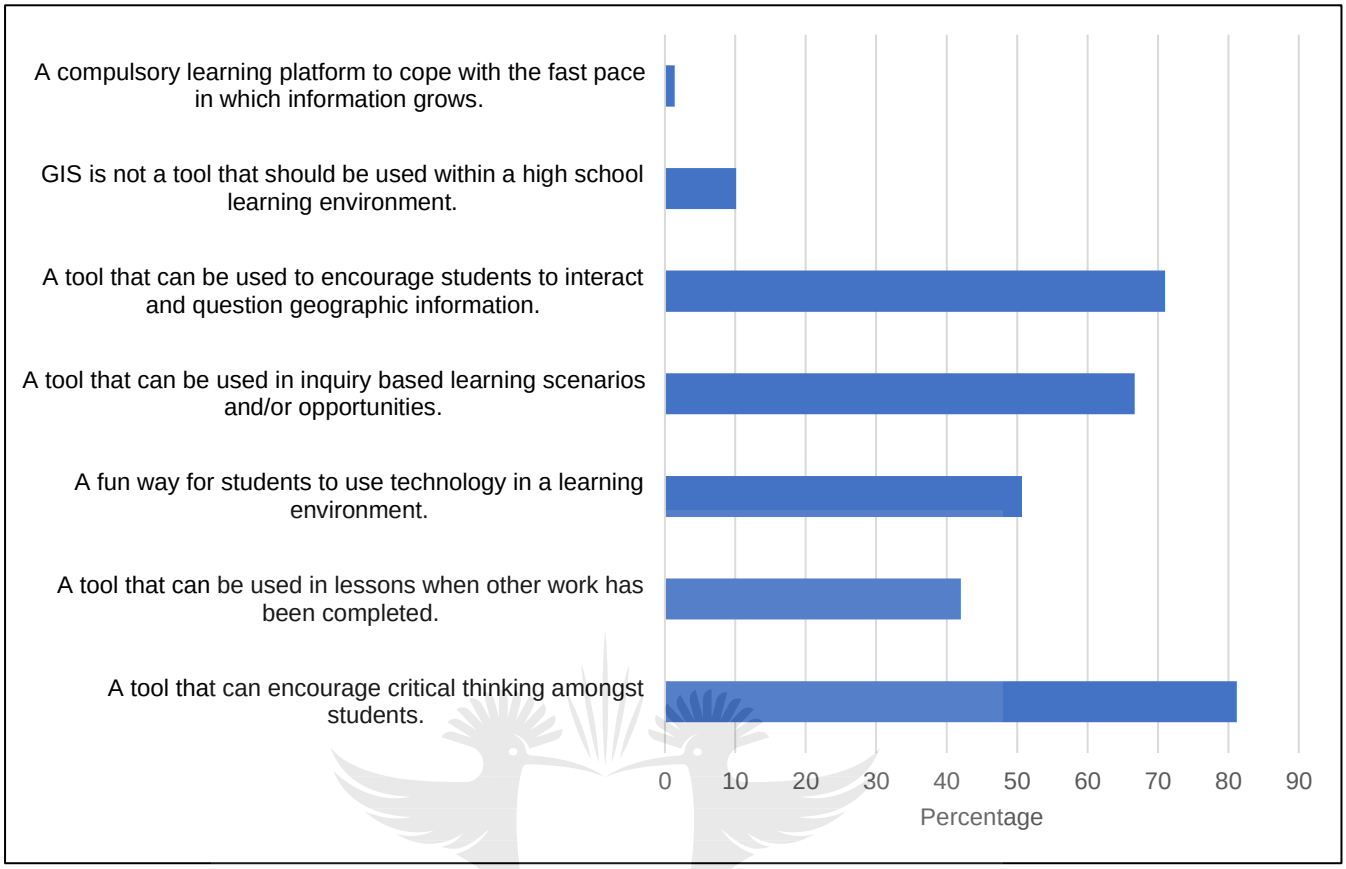

Figure 4.13: Views Towards GIS Within Learning Environment.

Figure 4.13 shows that the majority of respondents view GIS as a tool to supplement learning within the classroom environment. This is especially true for respondents who view GIS as a "fun way for students to use technology in a learning environment" (a view shared by 50.7% of the respondents) or as a "tool that can be used in lessons when other work has been completed" (a view shared by 42% of the respondents), thus supplementing and enhancing the work that has been covered. Respondents who view GIS as a tool which can aid in inquiry-based learning scenarios (66.7% of respondents viewed GIS in this way); which can encourage critical thinking amongst students (81.2% of respondents viewed GIS in this way); or encourage students to interact and question the accuracy of geographic information (71% of respondents viewed GIS in this manner), are more likely to take a hands-on approach and use GIS directly in their classes. Educators with these views are more likely to require their students to apply what they have been taught and challenge them to think critically. Such an approach would benefit learners greatly regarding subject areas such as EE and environmental issues.

A view that was of interest is that one respondent viewed GIS as a “compulsory learning platform to cope with the fast pace in which information grows”. This is a view that is indicative of how quickly information has already developed in the 21st century and that educators regard technology such as GIS as an ideal platform from which to address this issue. It should be noted that the respondents who indicated that GIS is not a tool that should be used in a high school learning environment selected a number of other options, thus indicating that even though they thought that GIS does not belong in the high school, they believed that it could still be of benefit to high school students, whether by encouraging critical thinking or by encouraging students to interact and question geographic information.

While GIS is included within the CAPS FET Geography curriculum and may be of great benefit to students to enhance the quality of learning within the classroom environment, as noted by Kerski *et al.* (2013) and discussed in Chapter 2, respondents indicated that almost all their students struggled with this section of the syllabus, as shown in *Figure 4.14* below.

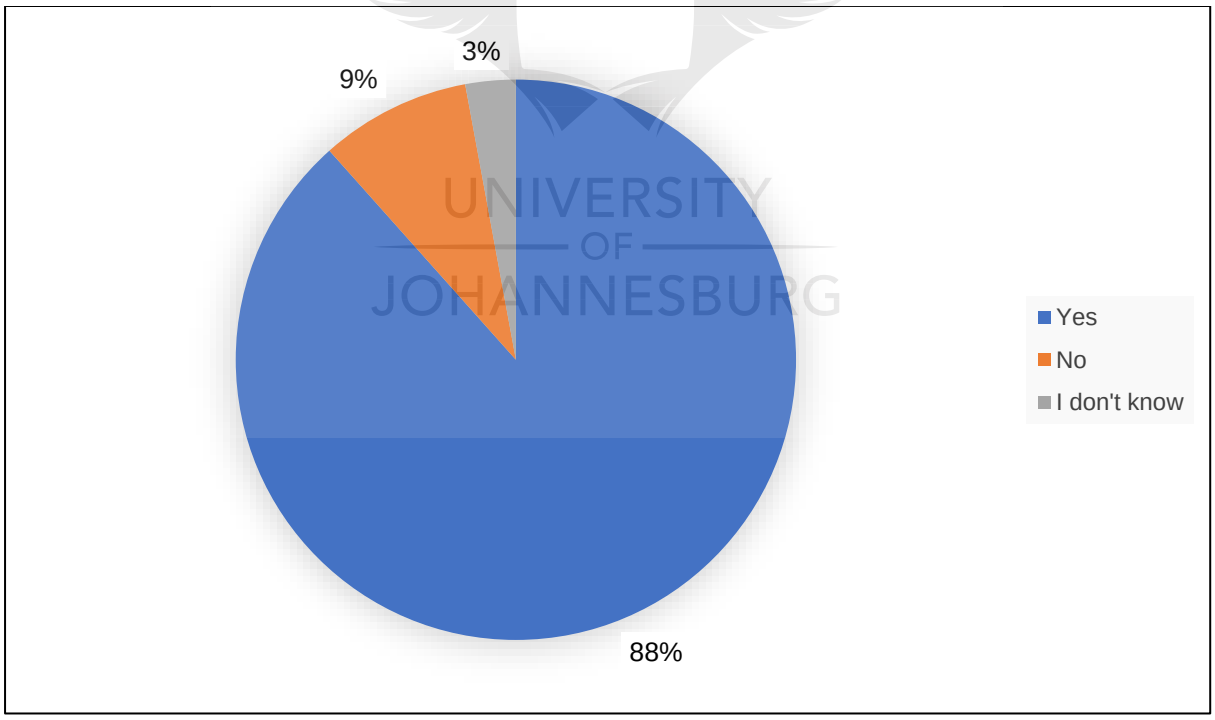

Figure 4.14: Views Towards Whether Students Struggle with GIS.

From *Figure 4.14*, the degree to which students struggle with the GIS component of the Geography curriculum is clear to see, with 88% of the respondents indicating that

students struggle with GIS-related content and only 9% indicating otherwise. The specific reasons why students struggle so much with GIS-related content is not clear.

As with international case studies, the implementation of GIS in high schools in South Africa has faced significant challenges and barriers. Only a handful of countries have integrated GIS into their respective national curricula. This group includes China; Finland; India; Norway; Taiwan and South Africa (Kerski *et al.*, 2013). However, how successfully GIS has been integrated across the board in the case of the South African schooling system is uncertain - with the views of educators in terms of the biggest barriers to the successful implementation of GIS often being overlooked. This is an issue that this research sought to address. On asking the respondents what they regarded as the biggest barriers to the implementation of GIS in high schools in South Africa, the following responses, as indicated in *Figure 4.15* below, were established.

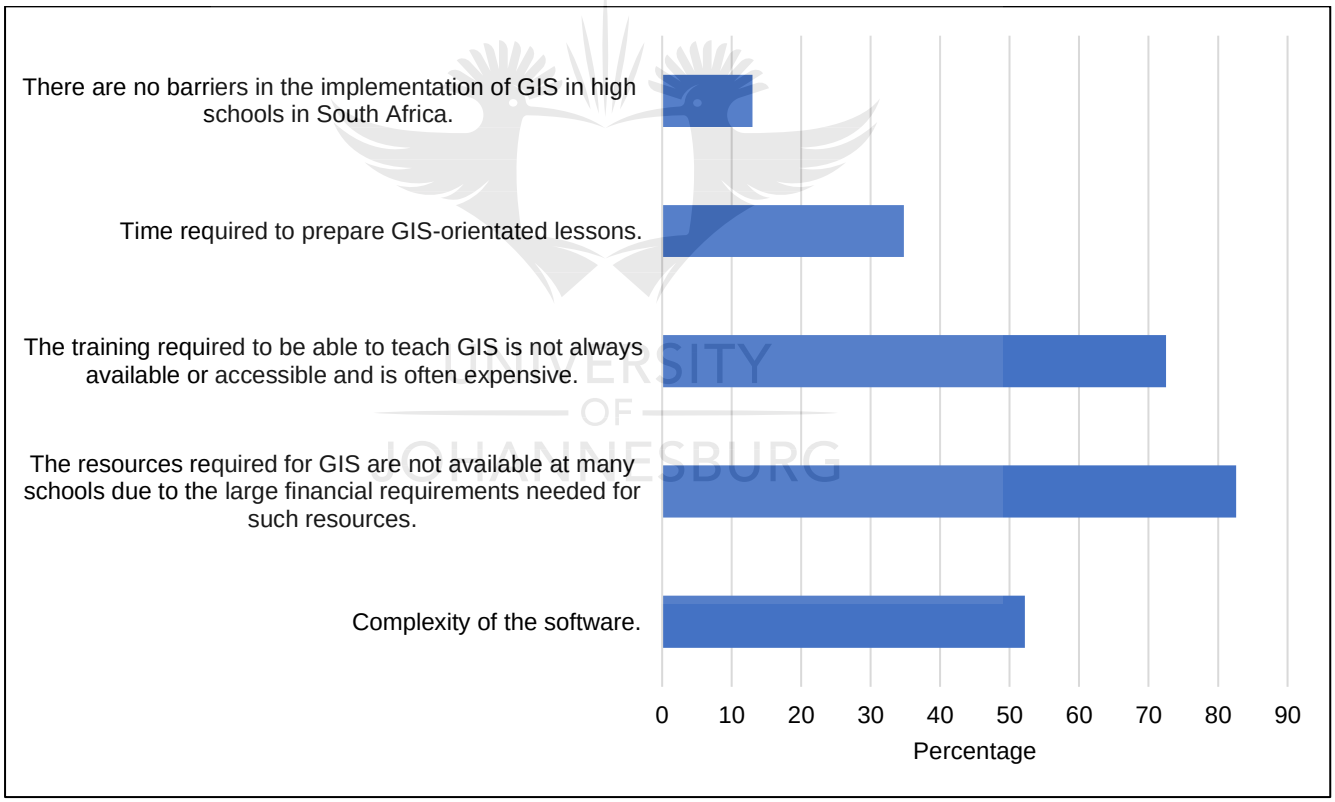

Figure 4.15: Biggest Barriers to the Implementation of GIS within High Schools.

The barriers identified above in *Figure 4.15* are very similar to those identified in studies such as those conducted by Bednarz (2004); Kerski *et al.* (2013) and Nkula and Krauss (2014). These references indicate that the challenges which GIS faces in its implementation in school curricula have remained very much the same since the

start of the 21st century and are not isolated in the South African context. It is again no surprise and was expected to a certain extent that 82.6% of the respondents felt that 'the resources required for GIS are not available at many schools on account of the large financial inputs required for such resources' and that this issue was indicated as the greatest barrier that GIS faces in its implementation. Reference has been made on countless occasions before to the fact that the South African society is deeply unequal, with access to resources (whether in the form of computers or textbooks) by public schools a major issue. Financial aid is not always the best solution, even though it may be the easiest 'quick fix' solution.

Inequality and a lack of resources partly explain why the second-greatest barrier to implementing GIS in the high schools in South Africa is that the 'training required to teach GIS is not always available or accessible and is often expensive', with 72.5% of respondents sharing this view. Training courses specifically addressing GIS for educators in South Africa are available but are extremely limited and are expensive unless sponsored by government or educational bodies. Should training programmes for educators be implemented to enable them to teach GIS, it would be possible to address the third-greatest barrier to the implementation of GIS, namely the 'complexity of the software'. In fact, over half of the respondents (52.5%) felt that this was a significant barrier to the implementation of GIS. If educators had the appropriate training for teaching GIS, the complexity of GIS software would not be a limiting factor, or at least only a far less limiting factor in implementing GIS successfully in the South African schooling system. However, addressing the costs of implementing GIS successfully into a country's schooling system is much easier said than done. What is of interest is that 13% of the respondents did not believe that there were any barriers to the successful implementation of GIS into the high schools in South Africa. While this brings a sense of optimism, this simply cannot be true, considering the barriers that the implementation of GIS into schooling systems faces globally (Bednarz, 2004; Kerski *et al.*, 2013).

What does bring a sense of optimism is that over 90% (91.3%) of the respondents felt that GIS encourages students to think critically, to question geographic data, and would be of benefit in real world scenarios if initially used in the classroom environment. As well as being of a great benefit to EE itself. This indicates that while there are significant challenges which GIS faces in its implementation and use within

the classroom environment, there are also significant benefits to be gained from it. A factor identified by both the respondents in the study and in the literature (e.g. that compiled by, amongst others, Kerski *et al.* (2013). Is that this positive view as to the extreme strength of GIS can be of great benefit to EE, especially in the light of the fact that EE largely deals with real world scenarios, with climate change being a good example of this. GIS and geographical systems can play an important role in showing the students the effects that climate change has on the environment, with extended periods of drought at the local level being a good example within the South African context. On the other hand, on the more extreme side, predication models can be used to show rising ocean levels and those areas that would be affected most. This, combined with the fact that GIS encourages students to question geographical data and to think critically, helps to encourage students to develop a positive approach towards environmental issues and sustainable development. It is through these means that solutions to environmental problems can be developed. While there may be great challenges and barriers to the implementation of GIS in high schools in South Africa, this form of technology might also hold great benefits to both the realms of Geography and EE.

Lastly, respondents were asked to list the types of ICT that they use in their classes for the purposes of EE. The various types of ICT which were listed and are used by the respondents are presented below.

Table 4.10: Types of Information and Communication Technologies Utilised.

Types of ICTs:
• **Internet**
• **Laptops and computers**
• **Projectors**
• **Tablets and smartphones**
• **Chalk boards**
• **White boards**
• **Videos and educational movies**
• **Interactive programmes**
• **Software programmes (e.g. Microsoft PowerPoint)**

A distinction can be drawn here between educators who use chalk boards and to an extent white boards and those who use digital technologies in their classes. An educator could use a combination of different ICTs in his/her classes (e.g. a white board and the internet) or when using digital technologies. However, educators who are restricted to non-digital technologies are limited in their ability to enhance the quality and effectiveness of their lessons through ICTs such as GIS. Restrictions normally come in the form of a lack of access to resources at a school, where financial limitations are a strong influencing factor. In schools where access to digital ICTs is limited, access to the practical components of GIS will then be even more limited.

Numerous comments were raised by the respondents concerning the use of both GIS and ICT in their classes. An overwhelming issue which was raised by respondents was the serious need for capacity development in order to improve a school's access to resources such as updated computers, access to the internet and GIS software, together with the necessary and appropriate training of educators in GIS, and methods of teaching the subject - an issue which has been raised previously. This development of resource capacity in government schools is an expensive and continuous process, especially if a large-scale impact is to be made. One respondent made an extremely important point stating that "the GIS syllabus implemented at FET is paper based: - many of the learners will know all the theory and be able to produce many paper traces for GIS. However, they have never sat in front of a computer in order to work with the GIS software". The respondent further stated that even as a teacher himself he only uses "projected pictures, screenshots, snaps of GIS, but not the actual application" when dealing with ICT in the classroom situation. This shows how educators are forced to make alternative plans to teach GIS content when access to the software itself is restricted.

In order to fully determine the state of EE in secondary schools in South Africa and to gain a holistic understanding of how technology is used for EE purposes, a SWOT analysis was used, the findings of which are shown and discussed in the section below.

4.5 A SWOT ANALYSIS OF RESEARCH FINDINGS

A SWOT analysis is an investigation into an organisation's strengths and weaknesses starting from the internal aspects of the organisation. While the second stage of a

SWOT analysis examines the opportunities and threats to the organisation from an external viewpoint (Piercy and Giles, 1989), a similar analysis was undertaken in this study in order to summarise the strengths; weaknesses; opportunities and threats facing EE, and the use of technologies for the purpose of EE. This SWOT analysis was built around the data concerning the results collected for the purposes of this study. The SWOT analysis was undertaken in order to gain a deeper understanding of the results which were obtained from the results as well as to provide a clear summary of the results which were obtained through the research process.

	Helpful	Harmful
Internal Origin	Strengths: • Educators recognize link between the environment and the economy. • EE successfully integrated across curriculum. • Positive views of educators towards EE and a shared concern towards the threats the environment is facing, • Educators understand the role EE can play in creating environmentally literate citizens. • GIS and ICT included within FET Geography curriculum. • Multiple EE related themes within FET Geography curriculums.	Weaknesses: • Lack of appropriate training for educators directly addressing EE. • Ineffectiveness of current EE systems in place. • The lack of/inadequate resources available for EE. • A lack of awareness of the extent of environmental issues within South Africa and around the world. • Amount of capital required to implement a GIS within a school. • Lack of training for educators to be able to use certain technologies.
External Origin	Opportunities: • Increasingly strong global movement towards sustainable development and practices. • Eagerness and demand from educators for current EE structures in South Africa to be improved. • Educators willing and eager to attend training directly addressing EE and how to approach it. • Wide acceptance for technologies which can enhance the learning process for students. • Availability of free GIS software (e.g. QGIS). • Educators understand the role EE can play in creating environmentally literate citizens.	Threats: • Result driven approach towards teaching in high schools. • A lack of capacity to implement a GIS within all public schools in South Africa. • Capacity of educators stretched due to teaching multiple subjects. • 10% of respondents are disconnected from current environmental issues the world is facing. • Over 20% of respondents felt they didn't have enough knowledge regarding EE to teach it effectively. • Over 20% of respondents don't teach EE related content in their classes.

The points which were identified for each of the components of the SWOT analysis are significant. The different sections of the SWOT analysis are discussed in greater detail below, beginning with the strengths of EE (including how technology is used for the purposes of EE).

4.5.1 Explanation of SWOT Analysis

The strengths which were identified vary in their nature. Crucially, in terms of the structure of the educational system in South Africa, EE has been successfully integrated into the secondary schooling curriculum. Proof of this lies in the fact that EE-related content is included across the Geography curriculum for the FET phase of the GDE. Furthermore, EE-related content is dealt with in subjects such as Life Orientation and Life Sciences within the FET phase of the GDE. Thus, by having EE successfully integrated into the range of curricula, the requirements and obligations set out in Agenda 21 to have EE integrated across school curricula have been met (UN, 1992).

Further strengths of the SWOT analysis are that the educators recognise the link between the economy and the environment in combination with understanding the role that EE can play in creating environmentally-literate citizens. This combination shows that educators themselves are able to recognise that while economic growth may be important to the state of a country's economy, this growth may be detrimental to the health of the surrounding environment, since it will in its turn affect the health of the people living in a particular environment. With this being said, the recognition by educators of the role that EE can and does play in creating environmentally-literate citizens is vital in promoting the transition towards creating an economy built on sustainable development. Furthermore, educators recognise the role that technology can play in enhancing the quality of their lessons to the benefit of their students. Educators also feel a strong desire to use technology in their classes for collecting data and not merely for the purposes of EE.

While there are significant strengths in terms of EE in the South African context and in the manner in which the technologies are used for its purposes, there are also considerable weaknesses (of a varying scale) that can be addressed over time. These weaknesses include the lack of appropriate training for educators directly addressing both EE and the technologies which can be used for its purposes - including

technologies such as GIS and geographical systems. If educators do not have the appropriate training to enable them to teach all the required themes in the respective curricula, they will not feel confident in approaching certain sections of the curriculum. In some cases, educators might not approach certain sections in their entirety. Furthermore, when the opportunity presents itself to use particular technologies, educators may shy away from them, denying their students the experience and opportunity to view certain components of the curriculum in a different manner (e.g. the growth of a city over a particular time period). On the topic of technologies such as GIS, a major issue that arises in schools using geographical information systems is the large amount of capital required to implement a GIS in a school. Owing to this large financial outlay, many schools do not even consider investing in a GIS for their school. One must bear in mind here, that numerous schools do not have access to computer labs at all; never mind to specific software programmes to use in the computer labs.

During the data collection process, it was noted that a 'lack of awareness of the extent of environmental issues in South Africa and around the world' is a major issue affecting EE in secondary schools as identified by 64.2% of respondents. A deduction emanating from this is that, if educators themselves do not have a clear understanding of the extent of the environmental issues in South Africa and around the world, then their students will not reach the level of awareness required to understand how pressing these environmental issues are. This would then mean that schools are failing to create and shape citizens who are environmentally literate. The identified weaknesses which are linked to this, include the 'lack of resources available for EE' and the 'ineffectiveness of the current EE systems in place'. The lack of resources available for EE purposes was widely cited as a major issue that the respondents were aware of during the data collection process, with 53.7% of the respondents indicating that this was a major challenge in improving the current structures for EE in South Africa, as indicated in *Figure 4.8*. While the ineffectiveness of the current EE systems in place stems in part from the lack of resources which are available for improving the current structures for EE, without enough resources, the state of EE in South Africa will hold the country back from development and sustained improvement. With this being said, there are examples of educators championing EE within their classes and

schools, such examples include Hillside Primary School and Sea Point Primary School as identified by Mokhele (2011).

While there are significant weaknesses in the state of EE in the South African context and in the manner in which certain technologies are used for its purposes, opportunities do exist which can improve upon its strengths, as well as seek to minimise its weaknesses. It was clear from the data collection process that there is a strong sense of eagerness and a demand from educators for the current EE structures in South Africa to be improved and for the current systems in place to be bult upon while improving the strengths which do exist. This should be viewed in combination with the enthusiasm and eagerness of the educators 'to attend training directly addressing EE and how to approach it'. While ever-increasing quantities of resources are needed for EE to maintain its current level, as well as to improve it, there is a strong eagerness amongst educators to champion the cause and make full use of the resources to improve the state of EE in South Africa. As mentioned previously, there are enormous quantities of EE resources that educators can access to train themselves at no cost through 'informal research'. With digital material being key to the ability of the educators to develop themselves, this type of 'informal research' will help to minimise the amount of training sponsored by the state, thus alleviating the burden that the state faces in training already-qualified teachers. As the quantities of resources available for EE increase, so the structures for EE can also be developed and improved upon. In this way, the structures which do exist can be made more effective with less strain being placed on the educational systems at both the provincial and the national levels.

As regards the use of technology for the purpose of EE, the data collection process made it clear to the researcher that there is a clear acceptance of the technologies which can be used to enhance the learning process for learners. While these technologies (e.g. GIS and geographical systems) are acceptable, there is still the issue of the large amount of capital required to fund the implementation of such systems. This then is where the availability of free GIS software such as Quantum GIS (QGIS) can come into play. Free GIS platforms remove the financial constraints in implementing a GIS in a school or organisation. As long as a computer meets the minimum requirements for the software and has access to an internet connection, the GIS software can be downloaded for free and both educators and students can use a

GIS for the purposes of EE. By doing so, the mandate set out by the GDE for the Geography curriculum to use new technologies such as GIS and ICTs can be met, without the injection of large amounts of capital to implement such systems.

Perhaps the single greatest opportunity for EE in South Africa and the technology which is used for its purposes is the 'increasingly strong global movement towards sustainable development and practices'. This movement should be exploited and maximised in order to move the state of EE forward. Through the exploitation of this movement, increased pressure can be placed on the various levels of government to champion this transition towards sustainable development. In addition, this movement can be used to build on the existing strengths of EE and to mitigate the identified weaknesses. Examples of the latter would be the lack of awareness of the extent of environmental issues which currently prevail in South Africa and around the world.

Finally, the threats which exist to EE within South Africa can be addressed and mitigated over time. However quick fixes to erase these threats are not available. A prime example of this is the 'results driven approach towards teaching in high schools'. Schools and teachers are often graded and judged by the average pass mark which their students attain in the end of year exams and on the amount of distinctions their students achieve. As a result, students are taught with the purpose of getting the highest marks possible, leading to less of a focus being placed on the content being taught. Unless major structural reforms take place, this result driven approach will only intensify.

The lack of capacity to implement systems such as GIS in schools and the over-extension of educators on account of their having to teach a number of subjects are directly related to the lack of resources which are available to schools in South Africa (Isaacs, 2007). The issue of 10% of the respondents being 'disconnected from [the]current environmental issues the world is facing' is directly related to the lack of awareness as to the extent of the current environmental issues. Such threats can be addressed by raising awareness on a short-term basis. However, the single greatest threat which can be identified from the SWOT analysis is the fact that 'over 20% of the respondents do not teach EE- related content in their classes'. This shows that either the respondents do not understand what falls within the boundaries of EE within the syllabi that they teach or the lack of an in-depth understanding of what the educators

are teaching. Even more so, but on a far more disturbing level, one in five of the respondents claimed they did not teach EE-related content at all, a matter which may need to be investigated further to be confirmed. As such, 20% of the students are missing out on vital EE-related content each year, which is negatively affecting them in both their exams and in their development as environmentally-literate citizens.

4.6 CONCLUSION

An in-depth analysis was undertaken of the data which was allocated during the data collection process of the research. The respondents of the study which made up the sample group were a mature group of educators, which had an average of 16 years teaching Geography within the South African schooling system. The sample group was comprised of educators from schools of various residential and socio-economic background.

To best present the data which were collected, charts, tables, and figures were used to give an in-depth significance to the data and to contribute to the data analysis and interpretation processes. The data were interpreted through the use of Microsoft Excel, as well as Google Forms. Furthermore, a SWOT analysis was conducted to summarise the strengths, weaknesses, opportunities, and threats facing EE and the technology used for the purposes of EE in the South African context.

Through the data analysis process, the researcher found that EE has been successfully implemented across the South African secondary education schooling curricula. Yet the degree to which EE is actually taught effectively in classes throughout the Gauteng province is largely unknown on account of a lack of research in this respect. However, this study found that over 20% of the respondents do not teach EE-related content in their classes, thus leaving a significant portion of the students unexposed to a crucial vehicle for achieving sustainable development (education). While this may be the case, it was found, however, that all the respondents had a positive perspective on EE. As such, the impact that EE could have on students and its ability to create environmentally-literate citizens were recognised.

Significant issues facing the implementation of EE in the secondary schooling systems were identified by the respondents. With numerous ways available to improve the current structures being identified by the educators themselves, numerous respondents were able to identify the absence of major strengths in the current EE

structures in the South African schooling system. The use of technology for the purposes of EE also proved to be no different here, with significant issues and barriers to using technologies in the classroom being faced, regardless of their purpose. With this being said, the opportunities for considering EE within the context of Gauteng, South Africa can strongly contribute to mitigating and addressing both the weaknesses and the threats facing EE in South Africa. This aspect is discussed and expanded upon in Section 4.5.1.

The primary aim of this research was to identify the overall state of EE in South Africa and to determine how technology is used for the purposes of EE. Besides a discussion on the objectives of this research and whether they have been met, conclusions are drawn in Chapter 5 below. The limitations of this research study and recommendations for future research are included in Chapter 5, the concluding chapter for this research.

CHAPTER FIVE: RECOMMENDATIONS AND CONCLUSIONS

5.1 CONCLUSION

The development of EE has had a relatively short yet complex history. With the roots of EE being traced back to the 18th century, when Jean-Jacques Rousseau in his book, "Emile: On Education" emphasised the importance of an education focusing on the environment (Eneji *et al.*, 2017). EE has gone through numerous stages of development since Rousseau's time to eventually become what it is today. It has been influenced by many different events, one of the more important being the Great Depression. The first definition of EE emerged much later, in 1969, in the inaugural issue of the 'Journal of Environmental Education' in 1969.

It was not until the late 20th century, when major international conferences were held, and environmental and development issues were addressed, that governments realised the importance of EE. One of the most important agreements to emerge from this period was Agenda 21, which was adopted at the United Nations' Conference of Environment and Development in Rio de Janeiro in 1992.

However, the implementation of EE in the respective national education curricula at all levels has been met with varying levels of success around the world. It is worth noting that each region has taken similar approaches to the implementation of EE, with varying degrees of support structures being established for EE in the respective countries (as has been illustrated in Chapter 2). Agenda 21 legally binds signatory nations to address environmental issues through EE (of which South Africa is a signatory nation) (Agenda 21, 1992). Through which legislation such as NEMA (1998) commits the South African government to sustainable development and emphasises the need for EE and capacity-building in all sectors in South African society (Strydom et al., 2007). South Africa has met this legal obligation through integrating EE related content and EE related themes successfully across the FET phase curriculums of the government education system (Makhoba, 2009). In addition, this has been integrated across multiple subjects, including Geography; Life Orientation and Life Sciences (as intended by the UNCED of 1992) (Agenda 21, 1992).

While educators strongly recognised the links and relationships that the environment and the economy share and how producing environmentally-literate students can be of immense benefit to South Africa, few educators realised that they were championing

EE in their schools. Research has shown that there is a strong willingness and eagerness amongst educators to be involved in the process of EE in the classroom. Educators themselves recognise that the state of the environment affects the health of the people living in it, and while economic development is important, one cannot ignore the impacts that development has brought to the environment.

In line with this line of thought, educators strongly recognise the positive role that technology can play in enhancing the quality of their lessons to the benefit of their students. This is especially important in the context of the 21st century, where technology has become ubiquitous in people's lives. According to Breetzke *et al.* (2011), the implementation of technologies such as GIS in the national curriculum of South Africa has been notably slow. The barriers to the implementation of technologies such as GIS and ICTs are similar in nature to those barriers to EE. The lack of resources and capital available for both EE and GIS/ICTs; the lack of appropriate training for educators; the ineffectiveness of the current systems in place, as well as a lack of awareness as to the extent of environmental issues in South Africa and around the world were expanded upon in Section 4.5.1.

The issues and weaknesses mentioned above were all identified by the respondents of the sample group in this research study. Many expressed the grave need for an upgrading of the infrastructure of their schools in order to better use certain technologies on the one hand; while on the other hand, imploring the relevant authorities to provide them with training that would directly address EE. This need for specialised training becomes crucial to students when over a fifth (22%) of the educators in this research study indicated that they felt that they were not knowledgeable enough about EE to teach it effectively. A major threat to EE which was identified in this research was that 20.3% of the respondents do not teach EE-related content in their classes. A further implication of this is that there is a lack of in-depth understanding of the FET phase curricula, to the extent that educators cannot differentiate between what is EE-related content and what is not. It further appears that educators may not be aware of or may not have access to the vast amount of information concerning environmental problems and issues which are published and are easily accessible, especially within the context of the 21st century and access to the internet. At a national level, the DBE (2018) strongly suggests that educators undertake informal research, thus minimising the need for training. However, the chief

issue at hand is the lack of resources available for EE and for the implementation of GIS/ICTs, a factor identified as a leading issue around the globe.

The use of technologies to supplement and enhance the quality of education that students receive in the classroom environment is strongly influenced by the technologies and resources available to the educators. The overwhelming majority of 85% of the respondents agreed that the potential for using technology in the classroom is strong. A majority may recognise this potential, but only 77% were found to be aware of the curriculum requirements explicably requiring technologies such as GIS and ICTs to be used and taught in the classroom. A further concern can be found in the diagnostic report of 2014 for Geography published by the DBE (2014) in which the DBE (2014:105) states that "many teachers are not familiar with GIS and are just teaching definitions but not the application of the techniques and skills". Their lack of familiarity with GIS can be linked to a lack of exposure to such systems, especially considering the sample group had been teaching for an average of 15.9 years.

The availability of resources at the school level is strongly influenced by the educational structures at both the provincial and national levels. While there are in fact support structures for EE in South Africa, with the Environmental Education Association of Southern Africa being one such structure, almost all of the respondents agreed that the current structures for EE could be improved. What is more disturbing is that over half of the respondents stated that the current structures for EE in South Africa do not contribute to the development of environmentally-literate citizens.

Perhaps the greatest opportunity for EE within the South African context is the increasingly strong global movement towards sustainable development and practices. This movement should be exploited to the benefit of EE and the people of South Africa. A strong platform for EE has been created and established in South Africa, especially in its schooling systems, which are a primary vehicle for driving EE. This platform has evolved with the transformation of the South African education system as was expanded upon in Chapter 2 of this research study. While this platform exists, there have been and still are significant issues and barriers to building on this platform, chief amongst which is the issue pertaining to the availability of resources. It is an issue far from exclusive to South Africa alone. The global movement towards sustainable development needs to be used to spearhead the deeper absorption of EE into the

South African education system. The championing of EE by groups of educators or individual teachers in the schools, combined with continual financial and structural support from the relevant government bodies, would provide the necessary steam power for EE to reach the strengths that it requires to produce environmentally-literate citizens, as intended by the UNCED of 1992, which produced the Agenda 21 agreement.

From what has emerged from the results of this research, it is possible to identify and make certain recommendations which could be used to improve the current state of EE within the South African context and the way in which the technologies are used to advance the purposes of EE to complement these improvements. Furthermore, recommendations are made for future studies addressing similar topics.

5.2 RECOMMENDATIONS

A fundamental theme within the realms of education such as in the case of the discipline, EE, can always be developed and improved upon, irrespective of the education systems in which it may be found. Whether it be in a developed country such as South Korea; a developing country such as Botswana or indeed the country in question, South Africa, recommendations for improvement which have emerged from this research are presented below.

5.2.1 Communication Between Governmental Bodies and Educators

There is a grave need for increase communication between governmental/educational bodies and educators has been acknowledged in numerous instances. Such instances include the fact that only 77% of the educators in the sample are aware of certain curriculum requirements (such as the inclusion of GIS in the Geography curricula of the FET phase) that they are expected to teach. Furthermore, this research has shown that educators are unaware of the enormous quantities of resources available to them for their own development, as well as for use in their classrooms. Thus, it is necessary for educators to be made aware of the wide range of resources available to them through improved communication amongst the different support bodies, such as the Environmental Education Association of Southern Africa and the DBE which are there for the benefit of the educators. It should be noted that these bodies are not limited to the scope of EE.

The need for better communication between the governmental bodies and educators is linked to the urgent need for increased access by the educators to the resources required in the classroom environment.

5.2.2 Access to Resources

The issue of access to the necessary resources in the educational sector is one that is not limited to South Africa; it is one that is exacerbated by the sheer inequality which exists in the country (Isaacs, 2007). Respondents in this research study repeatedly identified the lack of access to resources as a major issue which they face in the classroom environment. Respondents more than once stated that they are forced to use paper-based GIS methods to teach their students GIS as they do not have access to computer labs or the software needed to use GIS at their respective schools. Furthermore, educators are severely restricted by the types of technologies to which they have access.

In cases where a school does not have a computer lab and access to the internet, or where the computers are seriously outdated, this restricts teachers in their use of ICTs and GIS to the benefit of their students. It should be noted, however, that the use of such technologies is mandated and encouraged by the DBE (2014). In fact, it is recommended that an audit should be undertaken to specifically focus on the state of the infrastructure in the government school system. Such an audit would allow for the relevant bodies to decide which schools are in the greatest, most urgent need of the upgrading of their existing infrastructure, as well as in respect of the construction of new infrastructural developments such as computer labs of establishing internet connections. Such a process, while expensive and time-consuming, would greatly alleviate the serious issue of a lack of access to resources, which many of the respondents expressed as a significant issue in the implementation of both EE and technologies such as ICTs and GIS in the school system.

5.2.3 Development of Educators

Educators are continuously required to develop themselves by attending programmes and short courses, as well as through the ‘informal research’, as encouraged by the DBE (2018). This is necessary so that educators can keep up-to-date with new developments in teaching methodologies; be able to use new technologies, such as GIS; which are developed over time; and be able to keep up-to-date with changes in

or modifications to subject curricula. In addition, educators need to keep up-to-date with current events, especially those regarding the environment and geographical occurrences, since questions in the exams often relate to current events.

As a result of the above, it is necessary for educators to be made aware of these expectations and how to meet them. Educators need to be made aware of such by educational boards; branches of the DBE, and relevant non-governmental organisations. Furthermore, support structures need to be provided and made known to the educators of courses for their development. It is to be recommended that the state should sponsor the financial costs of such courses and programmes in order to provide educators with an added incentive to attend in order to develop individually as educators.

While this research study has attempted to reveal the current state of EE within the FET phase of the South African education system and how technology can be used for EE purposes, further research studies should be undertaken.

5.2.4 Need for Future Studies

There is a strong need for future studies regarding EE within the context of South Africa to be conducted on a regular basis and also to assess whether the state of EE in South Africa is improving or not. This stems from the need for large-scale or regional studies, which are sponsored either by the state or by educational bodies, to be undertaken. Such studies are required in cases where large percentages of educators who are required to teach EE-related content in their classes, are used as a sample group for a study. This group would be interviewed and subjected to comprehensive surveys so that a holistic perspective concerning the state of EE in South Africa can be obtained at a regional level.

Furthermore, studies directly addressing the specific type of training that the educators would require would be of great benefit to the overall state of the South African educational system. Such a study would allow for programmes to be created in order to address the specific areas in which the educators require training. This need for training was identified and acknowledged on numerous occasions by the respondents during the research study. However, the specific type of training which educators require falls outside the scope of this research study.

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APPENDIX A:

Section A: General and demographic information

1. Please indicate your gender:

   ☐ Female
   ☐ Male

2. Please indicate your age group:

   ☐ 20 – 29
   ☐ 30 – 39
   ☐ 40 – 49
   ☐ 50 – 59
   ☐ 60 – 69

3. Please indicate the number of years you have taught Geography?

   _____

4. What subject(s) do you teach?

   _____

5. Please indicate your highest educational qualification?

   ☐ Certificate
   ☐ Diploma
   ☐ Baccalaureate Degree (BEd, BA, etc.)
   ☐ Honours degree
   ☐ Master's degree
   ☐ PhD
   ☐ Other form of Qualification (If so please specify below)

   _____

6. In what school district do you teach?

   _____

7. In which residential area is the school?

   _____

8. What are the sizes of your geography classes for 2018?

   Grade 10: _____

Grade 11: _____

Grade 12: _____

Section B: Environmental Education in Geography

1. In your opinion is it important to have environmental education included within school curriculums? (please give a reason for your answer below)

   ☐ Yes
   ☐ No
   ☐ I don't know

_____

_____

_____

2. Do you agree with the inclusion of environmental education being integrated into multiple subject curriculums?

   ☐ Yes
   ☐ No, it should be taught in one subject alone such as Geography
   ☐ It should be a subject on its own
   ☐ I don't know

3. What, in your opinion, is your level of knowledge of environmental issues that exist today?

Little to No knowledge	Some knowledge	An Average understanding	A Good Understanding	Excellent knowledge

4. Do you have enough knowledge about environmental education to teach it effectively?

   ☐ Yes
   ☐ No
   ☐ I don't know

5. Do you teach environmental education content in your classes?

   ☐ Yes
   ☐ No

6. In your opinion, what part of the Geography curriculum includes environmental education for each of the senior grades?

Grade 10:

_____

_____

_____

Grade 11:

_____

_____

_____

Grade 12:

_____

_____

_____

7. Are you aware of any other subjects in the FET phase that address environmental education? (If yes please specify which subjects below).

☐ Yes
☐ No

_____

_____

8. Do you think there is enough environmental education content in the current curriculum?

☐ Yes
☐ No
☐ I don't know

9. What would you like to see included in the Geography curriculum regarding environmental education?

_____

_____

_____

10. Are you aware that South Africa is a signatory nation of environmental agreements such as Agenda 21, which require environmental education to be integrated at all levels of education?

☐ Yes

☐ No

☐ I don't know

11. Do you believe that including environmental education in school curriculums can help to develop students who are environmentally responsible and are responsible citizens?

☐ Yes

☐ No

☐ I don't know

12. Please give reasons for your answer in Question 11 above.

_____

_____

_____

_____

13. What strengths can you identify with regard to environmental education in South African secondary schools?

_____

_____

_____

_____

14. Does the current environmental education in South African schools help in producing more environmentally caring citizens?

☐ Yes

☐ No

☐ I don't know

15. Do you feel there is a need for further training which specifically addresses environmental education, for educators? (Please give a reason for your answer below).

☐ Yes

☐ No

☐ I don't know

_____

_____

_____

16. In your opinion can the current environmental education in South African schools be improved? (Please give a reason for your answer below)

- ☐ Yes
- ☐ No
- ☐ I don't know

_____

_____

_____

17. Referring to Question 16, what, in your opinion, are the biggest challenges in improving the current structures? of environmental education within secondary schooling in South Africa? (More than one option may be chosen).

- ☐ The lack of/inadequate resources available for environmental education
- ☐ Educators not having an adequate understanding of the importance of environmental issues around the world
- ☐ A lack of interest in environmental issues around the world
- ☐ Insufficient incentives from the government for teachers to champion environmental education in their schools
- ☐ A lack of awareness of the extent of environmental issues within South Africa and around the world
- ☐ Not enough content allocated for environmental education within the subject curriculum
- ☐ Other (please list below)

_____

_____

_____

18. Any further comments regarding environmental education within secondary schools, particularly within a South African context?

_____

_____

_____

_____

_____

Section C: Use of Technology for Environmental Education Purposes

1. Do you feel that there is a strong potential for technology such as Geographic Information Systems (GIS) and Information and Communication Technology (ICT) to be used in the classroom for environmental education?

   ☐ Yes
   ☐ No
   ☐ I don't know

2. What, in your opinion, is your level of knowledge of GIS and ICT?

Little to No knowledge	Some knowledge	An Average understanding	A Good Understanding	Excellent knowledge

3. Do you feel that technology such as GIS is relevant and should be taught in the classroom?

   ☐ Yes
   ☐ No (If no please state why below)
   ☐ I don't know

_____
_____
_____

4. In line with this what do you feel are the biggest barriers to using technology in the classroom for environmental education purposes? (More than one option may be chosen).

   ☐ The cost of the necessary technology needed (e.g. computers; software; projectors)
   ☐ The lack of training for educators to be able to use certain technologies
   ☐ A lack of awareness of the potential for technology to enhance learning in the classroom
   ☐ A lack of programmes specifically catering for environmental education
   ☐ Other (please state below)

_____
_____
_____

5. In your opinion should GIS be used in other subjects other than Geography?

- ☐ Yes
- ☐ No
- ☐ I don't know

6. Are you as a teacher aware of the curriculum requirements of GIS within the Geography CAPS curriculum?

- ☐ Yes
- ☐ Some idea
- ☐ No

7. How do you view GIS within a learning environment? (More than one option may be chosen)

- ☐ A tool that can be used to encourage critical thinking amongst students
- ☐ A tool that can be used in lessons when other work has been completed
- ☐ A fun way for students to use technology in a learning environment
- ☐ A tool that can be used in inquiry based learning scenarios and/or opportunities
- ☐ A tool that can be used to encourage students to interact with and question geographic information
- ☐ GIS is not a tool that should be used within a high school learning environment
- ☐ Other (If so, please specify below)

_____

8. Do you feel that students struggle to understand this part of the syllabus?

- ☐ Yes
- ☐ No
- ☐ I don't know

9. What do you feel are the biggest barriers in the implementation of GIS within high schools in South Africa? (Please indicate all you would consider to be the biggest obstacles)

- ☐ Complexity of the software
- ☐ The resources required for GIS (Hardware, software etc.) are not available at many schools due to the large financial requirements needed for such resources
- ☐ The training required to be able to teach GIS is not always available or accessible and is often expensive

- ☐ Time required to prepare GIS-orientated lessons
- ☐ There are no barriers in the implementation of GIS in high schools in South Africa

10. Do you feel that GIS encourages students to think critically, to question geographic data, and would be of benefit in real world scenarios if used in the classroom?

    - ☐ Yes
    - ☐ No
    - ☐ I don't know

11. What types of ICT do you utilise within your classes for the uses of Environmental Education? (e.g. internet & interactive whiteboards)

_____

_____

_____

12. Any other information you would like to share regarding the implementation of GIS within high schools in South Africa?

_____

_____

_____

_____

Thank you for completing the questionnaire!