Environmental Education in Gauteng High Schools

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Declaration

I declare that this Dissertation is my own, unaided work. It is being submitted for the Degree of Master of Science at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

(Signature of candidate)

5th day of October 2021in Bedfordview, Germiston

Abstract

Environmental education (EE) can be a possible avenue to enhance environmental awareness, foster pro-environmental attitudes and, ultimately, alter and eliminate unsustainable behaviours in human society. Formal schooling provides a good opportunity to implement EE, yet the effectiveness of school EE programmes and varying EE methods is not well understood. EE is included in South African policy and legislation, as well as in the South African formal syllabus. Little is known about the extent to which South African documentation and syllabus documents meet global standards and the effectiveness of EE in the South African formal education sector. This study was conducted in Gauteng and the aim was to evaluate the current state of EE in private schools and government schools in the province (across the different quintiles) from the perspective of grade 11 learners, teachers and school management. The objectives of this study were divided into three sections. The first objective involved establishing the extent to which global EE legislation and policies translate to South African policy, initiatives and curricula. The second objective involved evaluating the translation of EE documentation into the Gauteng schools and school EE programmes by determining extent to which EE is incorporated in Gauteng secondary schools, investigating the motivations for schools to implement EE in the manner that they do and evaluating the challenges that educators experience when implementing EE. The final objective involved evaluating the effectiveness of EE programmes in promoting environmental literacy in learners at Gauteng high schools. For the document analysis, selected global and local EE documents (including the South African syllabus documents for 13 subjects) were assessed and compared. For the Gauteng school analysis, 4 private, 4 upper quintile government and 3 lower quintile government schools were selected to participate in this study. Teacher interviews were conducted at each school with at least one educator, and questionnaires (assessing the learners' environmental literacy) were supplied to the grade 11 learners at each school. It was found that South African EE documentation and (more so) curricula met many of the criteria for EE set in global documents but fell short in terms of specific implementation steps, lacked mention of specific EE teaching methods and did not allow for learners or educators to provide feedback regarding their experiences with the implementation of the syllabus. It was found that EE was well implemented in most Gauteng schools included in this study; the educators followed the syllabus but also applied a variety of EE methods (both within and outside of the curriculum). While many of the educators stated that they implemented EE initiatives because of feeling that it was their moral duty, the educators from different socio-economic backgrounds had varying motivations to implement EE. The lower quintile government educators implemented EE as their learners experienced the effects of environmental degradation directly. In terms of challenges, educators from all three school types mentioned a lack of time and educators' knowledge regarding environmental current affairs and dynamics, educators from government schools mentioned a lack of funding and support from the Gauteng Department of Education (GDE) and upper quintile government educators mentioned disruptive learner behaviour and disinterest in EE. It was found that, although social media was the most prominent source for EE, school EE provided the greatest basis of reliable environmental information, but it was also found that when school EE was coupled with social media and news, the learners expressed higher pro-environmental attitudes. There was a variation in environmental knowledge and attitudes between learners from varying socio-economic backgrounds but there was no variation in sustainable behaviour. The schools' implementation of EE was found to enhance environmental

literacy in learners. Effective in-class EE was linked to enhanced environmental knowledge in learners and the use of a variety of extracurricular and practical EE methods was linked to enhanced pro-environmental attitudes and sustainable behaviours. The specific EE methods (such as habitual recycling) that enhanced sustainable behaviours were identified but it was found that EE methods such as gardening, school clean-ups and the use of an environmental committee proved to be most effective as these methods were linked to enhanced learner environmental knowledge, pro-environmental attitudes and sustainable behaviours.

Environmental education • Environmental awareness • Pro-environmental attitude •Sustainable behaviour

To my parents

Sudasha and Yulon Nair

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Chapter 1: Introduction

In 2000 the term Anthropocene was coined as the geological era that followed the Holocene and, since then, it has become a frequently used term defined as the era in which human activity has been the key driving factor of climatic and environmental changes (Ellis, 2018; Hamilton *et al.*, 2015). The Anthropocene is a powerful concept that has been felt and explored in a variety of disciplines and has therefore made its way from a scientific context into a social context (Hamilton *et al.*, 2015).

The Anthropocene began a long time ago and transition to the Anthropocene is apparent in global changes such as global environmental degradation, mass species extinctions, rising sea levels and climate change (Hamilton *et al.*, 2015; Zalasiewicz *et al.*, 2015; Ellis, 2018). In the past 150 years environmental degradation and destruction have been exponentially accelerated in comparison to the years prior and four (out of nine) earth systems have surpassed their sustainable boundaries (Ruddiman, 2013; Steffen *et al*., 2015). Humans have had a massive and far reaching impact on the earth by altering natural systems and exploiting natural resources for economic and social gain (Gifford and Nilsson, 2014; Hornborg, 2019).

Due to the adverse effects of environmental degradation on society and the economy, governmental agencies all over the world have been forced to become active in trying to find solutions to environmental issues and eliminating unsustainable behaviours through environmental policies (Dietz and Stern, 2002; Nightingale *et al.*, 2019; Chai, Zhang and Ge, 2020). Due to this, various governmental organisations utilised a number of tools, methods and policies to eliminate and discourage environmentally destructive behaviours. While these have not proven to be effective, with the current increase in environmental degradation and climate change impacts, more modern, holistic and long term tools are needed (Dietz and Stern, 2002; Rejeski and Salzman, 2002; Hanson, 2008; Jones and Dunlap, 2010; Barido *et al.*, 2020)).

Older policy tools (such as fining or jail time for environmentally irresponsible behaviours and restricting the use of certain resources) aimed to control behaviour but more modern tools focus on the source of behaviour so that the resulting behaviour is perceived as voluntary (Koger and Winter, 2004). One of these tools that policy makers have been focussing on is Environmental Education (EE) (Dietz and Stern, 2002; Læssøe *et al.*, 2013). It is now becoming clear that the current environmental crisis does not only concern pollution and species extinctions but rather what humanity has become and needs to become in order to secure a future for current and future generations (Koger and Winter, 2004). The environmental crisis can be seen as a psychological crisis where environmentally destructive behaviours are caused by beliefs, values, and views that humanity has acted on in the past and continues to act on (Koger and Winter, 2004). Therefore, environmental education (EE) is important in humanity's path to survival because it is through EE that these environmentally destructive values, beliefs and views can be altered to ensure that humanity and the natural environment can co-exist in harmony (Koger and Winter, 2004). While the definition of EE is often debated, the most durable definition was created by the International Union for the Conservation of Nature and Natural Resources (IUCN) and it stated that:

"*Environmental education is the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness among humans, their culture and biophysical surroundings. EE also entails practice in decision-making and self-formulation of a code of behaviours about issues concerning environmental quality.*" (IUCN, 1971)

There have been more recent definitions that state that EE is a process that is directed at the creation of understanding and awareness regarding environmental dynamics and issues that produce individual and collective sustainable behaviours (Mwendwa, 2018).

EE is important in promoting sustainability for a number of reasons. According to Luthra *et al.* (2015), the lack of understanding and awareness regarding the socio-economic needs and benefits of renewable energy technologies could be the downfall of their implementation in developing countries, therefore awareness regarding the need for and benefits of environmental policies and initiatives is vital for success. EE is also vital in promoting mindful decision making regarding the challenges of sustainability, equipping citizens with the necessary skills to think critically about environmental issues and solve them, as well as instilling pro-environmental attitudes, values and beliefs in citizens (Burek, 2012; Edsand and Broich, 2019). Citizens need EE to better evaluate and approach modern and interdisciplinary environmental issues with dimensions of increasing complexity (Ferkany and Whyte, 2011).

A key aim of EE is to promote environmental literacy, which refers to an individual's ability to understand and utilise environmental information in order to determine the capacity of human systems to manage environmental changes and to adapt accordingly (Scholz and Binder, 2011; Brereton, 2018). Therefore, EE and environmental literacy are vital in the movement towards a sustainable future, through the alteration of values, beliefs, attitudes and behaviours (Hines *et al*. 1987; Brereton, 2018). The environmental literacy level of an individual can be assessed by focusing on three components: environmental knowledge, environmental attitude or concern and sustainable behaviour (Scholz and Binder, 2011). The behavioural pathway is not well defined, therefore it is unknown if EE is targeting the appropriate psychological aspects of a child's learning experience to promote environmental knowledge, pro-environmental attitudes and sustainable behaviours, thus promoting environmental literacy (Hallfreðsdóttir, 2011). Further research is needed regarding how sustainable behaviours are created and nurtured in order to promote the effectiveness of EE programmes (McGuire, 2015). Gaining a better understanding of which (and how) school and learner factors influence learner environmental literacy could also aid in the creation and improvement of educational programmes, policies and practices to promote sustainable development (Lin and Shi, 2013).

There is a variety of research available regarding advancements in EE techniques which make it difficult for educators to keep up with the current trends and techniques, and conflicting outcomes become confusing when deciding which methods to implement (which will be further discussed in chapter 2, section 3 and 4 ;Ardoin *et al*., 2018). The same can be said regarding the effectiveness of varying EE techniques and tools in promoting environmental literacy because it is often found that the research regarding the effectiveness of EE methods is varying and methods of assessing the effectiveness of EE methods are inconsistent (Sharp *et al.*, 2017; Briggs *et al.*, 2019). According to Edsand and Broich (2019), while the effectiveness of EE in promoting environmental literacy is unclear and it is unknown if EE should be considered the cornerstone to promoting environmental

literacy, EE should not be reduced at school level or discarded but further explored. EE has received extensive criticism regarding the lack of research assessing the effectiveness and outcomes of specific approaches of EE, as well as the effects of various cultural and socio-demographic factors on the implementation and reception of EE (Briggs *et al.,* 2019). Further exploration is also needed in relation to the effectiveness of environmental education and school curricula in promoting environmental literacy in learner.

South Africa is a developing country located on the southern tip of Africa. As with many other third world countries, the South African society and economy places pressure on the natural environment because of the increasing rate of poverty and the need for infrastructure, housing, natural resources and waste management (Ogilvie, 2012; Rao & Min, 2017). EE first appeared in the South African formal schooling curriculum as the topic of "conservation education" and later as "environmental studies" (Irwin and Lotz-Sisitka, 2014). Curriculum-2005 saw EE integrated across the formal schooling curriculum as a theme, rather than just a topic. Since the creation of the White Paper on Environmental Education (1989) and the Environment Education Policy Initiative (1992) (both will be discussed later). There have been numerous EE policies and frameworks created to implement EE in the formal South African schooling curriculum (DoE (a), 1995; DoE, 1997; Department of Environment Affairs and Tourism, 1997; Irwin and Lotz-Sisitka, 2014).

South Africa has two examination boards: the Department of Education (DoE) and the Independent Examination Board (IEB) (Berger *et al.,* 2010). The public schools write DoE examinations while the private schools write IEB examinations, but learners from both schools still receive the same matric certification, the educators both utilise the Curriculum and Assessment Policy Statement (CAPS) curriculum and both are accredited and monitored by the General and Further Education and Training Quality Assurance Authority (Umalasi) (Berger *et al.,* 2010; Daniel, 2020). In South Africa, the DoE operates at national level while the Gauteng Department of Education (GDE) was tasked with supporting, monitoring and directing the performance of the Gauteng public education system (Maringe *et al.,* 2014).There is a variety of small differences between the IEB and GDE schools; as the IEB schools request a more expensive school fee, the classes are smaller in size, the examinations and assessments are believed to be more difficult, the assessments tend to be marked more strictly and the education methods are more hands-on (Daniel, 2020). The DoE classified public schools into one of five quintiles so that the appropriate funds will allocated to each school; schools placed in quintile one are the poorest schools and receive more government funding than the rest, while schools placed in quintile five are the best resourced and will receive less government funding (Bisschoff and Mestry, 2009).

1.1. Problem statement:

Even with the creation of numerous policies and frameworks, a common South African EE barrier found by researchers is that EE policy has not translated well into implementation (Elmore and Sykes, 1992; Garn, 1999; Allington, 2000; Fullan, 2001; Jansen, 2002). Jansen (2002) stated that these South African policies are more symbolic than realistic or practical and despite policy creation there is little change in the implementation or outcome of EE in South African schools. Researchers have also felt that policy is not easily implemented in a classroom situation and the

intention of the policy could be easily altered during the implementation process, resulting in an unforeseen outcome (Elmore and Sykes, 1992; Garn, 1999; Viennet and Pont, 2017). It has also been observed that the intention (thus the implementation) of policy can be altered by the beliefs and the values of the educators who implement policy (Allington, 2000; Fullan, 2001; Maass, 2011). In a 2013 report assessing South Africa's performance and advancements during the United Nation's Decade of Education for Sustainable Development, it was often stated that, even though South Africa had done a great job of implementing EE programmes, further emphasis is needed on monitoring and creating systems to establish the effectiveness of EE initiatives and methods (Ramsarup, 2013).

1.2. Aim and Objectives

Aim:

South African and Gauteng schools implement a variety of EE methods at varying levels of commitment and yet the reasons for these schools' choices of methods and the effectiveness of these methods in promoting environmental literacy in learners are unclear. Therefore, the aim of this study was to evaluate the current state of EE in a selection of four IEB schools and seven GDE Gauteng schools (across the different quintiles) from the perspective of grade 11 learners, teachers, and school management.

Objectives:

1. To determine the extent to which global EE legislation and policies are incorporated at a South African level in South African policy, initiatives, and curricula;
2. To determine to what extent EE is incorporated in Gauteng secondary schools (grade 8-12) by assessing the grade 10-12 syllabus and engaging with grade 11 learners;
3. To investigate the motivations for schools to choose to implement EE in the manner that they do;
4. To identify challenges associated with EE and various EE methods in terms of teaching practices and school management protocols;
5. To determine the effectiveness of EE programmes in promoting environmental literacy in learners at Gauteng high schools.

1.3. Layout of dissertation

This dissertation consists of six chapters, 53 figures, 17 tables and four appendices. Firstly the *Introduction (chapter 1)* briefly introduces the concept and nature of EE and discusses the structure of the education system in Gauteng. The problem statement, the aim and the objectives of this study are also provided in this chapter.

The Introduction is followed by the *Literature Review (chapter 2)* which provides insights into the state of EE research, and covers South Africa EE policy, the concept of environmental literacy and behavioural drivers, EE learning paradigms, EE teaching methods and factors that influence teacher commitment to implementing EE. The *Methodology (chapter 3)* details the methodology adopted for this study, and *chapter 4 (Results)* presents the findings under three subheadings: document analysis, syllabus analysis, teacher interview analysis, learner questionnaire analysis and school EE program versus learner environmental literacy. The *Discussion (chapter 5)* explores the findings of this study and past studies with regards to the flow of EE in Gauteng (from global and national policy to educator implementation and learner reception of EE), socio-economic influences of EE implementation and learner reception, source of environmental knowledge, EE methods, drivers of sustainable behaviours and EE in COVID-19. The final chapter of this dissertation is the *Conclusion (chapter 6)* which details the limitations of this study, the key findings and opportunities for future studies.

This dissertation ends with a reference list as well as appendices to the study. Tables and Figures are numbered continuously.

Chapter 2: Literature review

Environmental Education (EE) is seen as a vital aspect in negating an individual's susceptibility to environmental misconceptions (Treen *et al*., 2020). Claims regarding climate change are often under- or over- exaggerated and this leads to climate scepticism or climate alarmism (Treen *et al*., 2020). Climate scepticism deals with doubts regarding climate change and the down-playing of climate change trends, impacts and anthropogenic causes, while climate alarmism is the over-exaggeration of climate change trends, facts, causes and outcomes (Rahmstorf, 2004; Treen *et al*., 2020). This misinformation is often created by both philanthropic and corporate groups, then repeated and spread by politicians, the media and internet bloggers (Björnberg *et al.,* 2017). The spread of misinformation is further exaggerated by algorithmic bias (in which internet sites promote information that aligns with their previous posts) and confirmation bias (in which the public prefer to subscribe to information that agrees with their current beliefs) (Bessi *et al.,* 2016; Sîrbu *et al.,* 2019). The danger of misinformation is that it creates doubt regarding the authenticity of climate change, urgency of taking action and the credentials of scientists and can therefore lead to public confusion, rejection of mitigation policies, reduced sustainable actions and individual suspicion, anxiety and panic (Boussalis and Coan, 2017; Treen *et al*., 2020).

The need for effective EE is greater than ever before due to increasing and far-reaching impacts of environmental issues (McGuire, 2015). Schools provide one of the largest and most structured bases for EE (Nagra, 2010). During the early years of schooling the human mind is the most plastic, therefore making schools an ideal instrument to create sustainable beliefs and values (Nagra, 2010). EE is a key element in empowering youth by equipping them with the knowledge and skills to solve problems, contribute meaningfully and make informed decisions regarding environmental issues and future plans (Obasoro *et al*., 2013). This being said, it has been found in a variety of literature that there are inconsistencies between the theory of EE and the implementation and portrayal of EE in schools (Cotton, 2006).

The most notable and impactful organisations to promote environmental education (EE) on a global scale are the International Union for the Conservation of Nature and Natural Resources (IUCN), the World Wildlife Fund (WWF) and the United Nations Education, Scientific and Cultural Organisation (UNESCO) (Irwin and Lotz-Sisitka, 2014). At the 1972 United Nations Conference on the Human Environment, the United Nations Environment Programme (UNEP) was established and was tasked to clearly define EE as a globally recognised term (UNEP, 1972). Thereafter UNEP partnered with UNESCO to host the International Workshop on Environmental Education (1975) and the International Governmental Conference on Environmental Education (1977) in which the Tbilisi Principles of Environmental Education were drawn up to form a guide and framework for EE (UNESCO-UNEP, 1976; UNESCO, 1978).

There are 12 Tbilisi Principles of Environmental Education: the Tbilisi Principles state that EE should (UNESCO, 1978):

1. Examine the environment holistically;
2. Be a lifelong pursuit;
3. Examine environmental issues across different temporal scales (past, present and future);

4. Examine environmental issues across a variety of geographical scales (community, regional, national and global);
5. Include environmental issues, considerations and dynamics across all disciplines;
6. Progress in complexity as learners age;
7. See that the environment is incorporated in all future planning and development;
8. Promote the value of team work and community co-operation in solving environmental problems;
9. Highlight the root causes and symptoms of environmental issues;
10. Fully emphasize the complexity of environmental issues and therefore promoting problem solving and critical thinking skills in learners;
11. Involve a variety of environments, teaching methods and approaches;
12. Allow learners to play a role in the planning of their lessons and learning experiences.

In the 1980s a variety of reports such as the Global 2000 Report to the President of the United States (1980), the Brundtland Report (1983) and Our Common Future (1987) were drawn up to promote an integrated and holistic form of EE (Barney, 1980; Brandt, 1983; WCED, 1987). The major drivers of global EE in the 21st century came in the form of Agenda 21 and the Plan of Implementation of the World Summit on Sustainable Development. Agenda 21 was drawn up during the 1992 Rio de Janeiro Earth Summit and the Plan of Implementation of the World Summit on Sustainable Development was created during the 2002 Earth Summit (UNCED, 1992; WSSD, 2002). Both documents advocated that global EE is vital to achieve environmental awareness, pro-environmental attitudes, beliefs and behaviours for sustainable development (UNCED, 1992; WSSD, 2002; Wenden, 2004).

Education for a Sustainable Future: a transdisciplinary vision of concerted action is a document published by UNESCO (1997) that, again, emphasised the importance of EE in achieving sustainability, the need for reorientation of education systems and the significance of EE action at both local and international levels (Irwin and Lotz-Sisitka, 2014). The field of EE is closely related to sustainable development and many educators feel that EE should focus on achieving the goals of sustainable development (WCED, 1987; Irwin and Lotz-Sisitka, 2014). This gave rise to the UN declaring the years 2005 to 2014 the Decade of Education for Sustainable Development which aimed to integrate sustainable development principles into all aspects of learning and education worldwide and involve a wide range of stakeholders in the education process (UNESCO, 2005).

2.1. EE in South Africa

As with the rest of the world, the citizens of South Africa and the South African government became increasingly aware of the devastating effects of climate change and began to place a greater focus on the development of EE in a South African context. Environmental degradation was first documented in South Africa in the form of soil erosion, therefore before the mid-1970s South African EE focused on soil erosion and "conservation education", which emphasised the wise use and conservation of natural resources (which today forms an important component of EE)(Irwin and Lotz-Sisitka, 2014). Since its establishment in southern Africa (including South Africa), EE had

always been a holistic concept that included economic, social, political, cultural and environmental issues (Irwin and Lotz-Sisitka, 2014). The Environment Education Association of Southern Africa (EEASA) was established in 1982 during the first international EE conference held in South Africa (Janse van Rensburg, 2002). The EEASA played a significant role in the development of EE in South Africa by co-ordinating EE workshops, conferences and seminars, publishing EE papers and working alongside government, non-governmental organisations (NGOs) and conservation agencies to further develop South African EE in order to co-ordinate EE efforts (Janse van Rensburg, 2002). NGOs such as the Wildlife and Environmental Society of South Africa (WESSA) and the Wilderness Leadership School also played an important role in the establishment of EE in South Africa (Irwin and Lotz-Sisitka, 2014).

EE did not receive much governmental support until the White Paper on Environmental Education (1989) and the White Paper on Education and Training (1995) were released (Department of Environment Affairs and Tourism, 1997; Irwin and Lotz-Sisitka, 2014). The White Papers incorporated EE into the formal education sector and adopted the Tbilisi Principles but had little impact at the time because of political changes in South Africa and a lack of wide-spread input (Department of Environment Affairs and Tourism, 1997; Irwin and Lotz-Sisitka, 2014). Later, the White Paper on Environmental Education did influence the creation of the 1992 Environment Education Policy Initiative (EEPI) which allowed for EE to be formally recognised in the South African formal education sector (DoE, 1995a; DoE, 1997). The words of the EEPI on EE were quoted in the 1994 ANC Framework for Education (DoE, 1995a).

The EEPI made the transition to EE curriculum planning and policy making by becoming the Environment Education Curriculum Initiative (EECI) and creating Curriculum 2005 (later revised to the National Curriculum Statement for General Education and Training) which included educators in the creation process of a new outcome-based and interdisciplinary EE curriculum (DoE, 1997; Irwin and Lotz-Sisitka, 2014). At this time the Department of Education utilised the Outcomes Based Education (OBE) approach, which focused more on education methods than curriculum (Dreyer and Loubser, 2014). Curriculum 2005 was revised to become the Revised National Curriculum Statement (RNCS), which placed somewhat less emphasis on EE as a theme and rather sought to combine it with social justice and integrate it across the curriculum (DoE, 2002). The principles of the Revised National Curriculum Statement called for a schooling curriculum that supports social and environmental justice, critical and active learning, progressive and quality education, high standards of education and South African heritage (DoE, 2002). The National Curriculum Statement, together with the National Environmental Management Act of 1998, stipulated that EE needed to be integrated into all areas of learning which was one of the main reasons for the incorporation of EE into the schooling curriculum (Irwin and Lotz-Sisitka, 2014). During the same time that the National Curriculum was being revised, the Department of Education established the National Environment Education Project for General Education and Training (NEEP-GET) in 2000 (Wilmot *et al*., 2017). The NEEP-GET aimed to promote environmental knowledge in teachers. It also had a significant effect on curriculum policy and ensured that EE became a key part of the formal schooling curriculum (Wilmot *et al.*, 2017).

In 2011 the Outcome Based Education approach to curriculum and RNCS was replaced by the Curriculum and Assessment Policy Statement (CAPS) curriculum due to underperformance of learners (Pinnock, 2011). The CAPS curriculum was included in the National Curriculum

Statements (NCS) which was a term-by-term, grade-by-grade guide of what schools should teach and consisted of national policy regarding the programme, the requirements of promotion and the national protocol for assessment 12 (Department of Basic Education, 2011). The aim of the NCS is to provide unbiased education to all learners so that they might have the skills, values and knowledge to make a meaningful contribution to society, gain access to tertiary institutions of education and prepare them for entry into the workforce (Department of Basic Education, 2011).

The NSC was necessary because previous National Curricula (grade R to 9 and grade 10 to 12) were problematic and the main areas of concern were the implementation of the NCS, educators feeling overwhelmed and overburdened by administration, the curriculum requirements being open to too many forms of interpretation and feeling that the learners were underperforming (Department of Basic Education, 2009; du Plessis and Marais, 2015). Based on these problem areas, the DoE re-evaluated and created a clear five year plan to efficiently implement the NCS in schools (Department of Basic Education, 2009). On assessment of the NCS CAPS; it was concluded that the teaching guide needed to correlate to what is assessed (du Plessis and Marais, 2015). After evaluation it was found that the NCS were compiled and structured well because they cover all necessary topics, include a complete and comprehensive annual and lesson plan for the educator, include examples, a resource and assessment guide. It was further noted, however, that the precision of the NCS could make the more creative educators feel restricted and limit their personal input and might hamper any forward-thinking and modern schools. An issue that was still present in the new curriculum was the lack of resources and textbooks available (du Plessis and Marais, 2015).

OBE had a focus on how teaching is done while the current South African CAPS curriculum additionally integrates what is taught (i.e. CAPS has a focus on the curriculum in addition to the learning outcomes that need to be met) (Harber, 2013). This means that the CAPS documents are written in a content-format rather than an outcomes format (Harber, 2013). Under CAPS teachers are expected to choose suitable environmental topics that fit into the set curriculum of each subject at each stage of learning, from foundation phase (grade r-3) to senior phase (grade 7-9) to Further Education and Training (FET)(grade 10-12) (Dreyer and Loubser, 2014). In this regard, South African EE in schools differs from that offered by other EE programmes as teachers have to integrate EE topics into the prescribed curriculum, and have not necessarily been provided with ways in which this can be done, or been given the resources to accomplish this task (Mwendwa, 2018). This being said, taking an integrated approach to EE by including it in the schooling curriculum could aid learners in creating a holistic outlook of the world and giving their education and knowledge more meaning. (Baxte and Jack, 2015)

Other important frameworks, acts and documents included the National Environmental Management Act (NEMA) (1998), National Environmental Education Project for General Education and Training (NEEP-GET) (2000), the National Framework for Sustainable Development (NFSD) (2008) and National Strategy for Sustainable Development and Action Plan (NSSD1)(2011). NEMA was an act generated to guide and aid decision making at governmental, institutional and individual scales and acts as the guide to implement Section 24 of the South African Constitution (NEMA, 1998) which states that all citizens have the right to a safe environment and that the environment needs to be protected to benefit present and future generations, relating to the common definition of sustainable development as stated in the

Brundtland Report; NEMA, 1998). NEMA also states that the South African public education needs to be revised in accordance with the objectives set out in Agenda 21 (NEMA, 1998).

The NEEP-GET was established to enhance EE in school curriculum and is the strongest EE driving force in South Africa (NEEP-GET, 2005). The efforts made through the NEEP-GET had a significant impact and pushed for EE in the creation of the NCS (NEEP-GET, 2005). NFSD was a framework that suggested interventions that could be applied to see that South African development and growth ran parallel to the country's sustainable development goals (Department of Environmental Affairs and Tourism, 2008). NSSD1 then built on this through collaboration between businesses, NGOs, government, academia and other stakeholders to establish interdisciplinary action plans that take into account the needs of society, the economy and the environment for overall success (Department of Environmental Affairs, 2011).

Even with the establishment of EE in South Africa, citizens and Government continue to feel the effects of human destruction and disturbance of the natural environment at various scales. In 2012 the South African Department of Environmental Affairs released the 2nd South Africa Environment Outlook which provided a detailed analysis of the state of various environmental issues that have arisen at different scales in South Africa. The report covers environmental issues relating to inland water, coastal areas and oceans, biodiversity, energy use, air quality, land and waste management. The key environmental issues noted were the increase in degradation of natural habitats and ecosystems, soil erosion, biodiversity loss, decreased water availability and quality, coastal land transformations, increased discharge of water waste and increased vehicle emissions, biomass burning, pesticides and greenhouse gas emissions (Department of Environmental Affairs, 2012).

In terms of climate change, the average temperatures in South Africa have increased and according to Allen *et al.* (2018) the temperature in most parts of South Africa is close to exceeding 1.5 °C above pre-industrial levels. Severe drought conditions have also been experienced (IPCC, 2014). The impacts of climate change are not uniform across South Africa, making adaptation strategies location and context specific (Gbetibouo and Hassan, 2005). This can be seen in a study conducted by Gbetibouo and Hassan (2005), in which the effects of climate change on the agricultural sector (which is seen as one of the most vulnerable sectors to climate change) was assessed. It was found that, although crops react positively to the increase in temperature, they respond negatively to a decrease in precipitation which varies across South Africa (Gbetibouo and Hassan, 2005). Therefore environmental degradation coupled with the effects of climate change leave South Africa facing the possibility of increased premature deaths, malnourishment, air pollution, water deficit, poverty and economic decline (Hossain and Pielke, 2013). In the wake of climate change, environmental degradation and their socio-economic impacts, the need for effective and mainstreamed EE in South African schools is essential.

2.2. Environmental literacy

Environmental literacy concerns the promotion of environmental knowledge, pro-environmental attitudes and sustainable behaviour (Scholz and Binder, 2011). Therefore in order to assess the environmental literacy level of an individual, one would assess the individual's environmental

knowledge, attitudes and behaviours (Scholz and Binder, 2011). The promotion of environmental literacy tends to be more problematic as the behavioural pathway (that involves knowledge, attitude and behaviour) is complicated and often disputed (Hines *et al*. 1987).

A study done by Edsand and Broich (2019) in Columbia examined the relationship between in-school EE and environmental literacy (focusing on awareness, perceptions and optimism) for 15-year old school learners. It was found that in-school EE did have a strong positive correlation with learner environmental awareness but a negative correlation with learner optimism (suggesting that learners exposed to EE were less optimistic and more realistic regarding environmental issues) (Edsand and Broich, 2019). The extent to which learner-level variables, parent-level variables and school-level variables affects environmental awareness and literacy was also assessed (Edsand and Broich, 2019). Learner variables included gender, social status, economic status, cultural status, immigration status and learner science ability; parental variables included parental perceptions and optimism regarding environmental issues and parents' scientific values and acknowledgement of the importance of science and school variables included private or public, school size, class size, teacher qualification, proportion of highly qualified teachers and quality of resources. It was found that learner, parent, and school factors had a greater influence on learner awareness, optimism, and perceptions than in-school EE (Edsand and Broich, 2019). This result does not mean that school-level EE is ineffective or should be discarded but rather that EE educators need to be mindful of the variety of factors that influence a learner's environmental literacy and that there is no single path to promoting environmental literacy.

Past EE models were based on the premise that information regarding the cause and effect of environmental and social issues would lead to sustainable behaviour and this has led to a heavy reliance on knowledge delivery as the primary tool to alter behaviour and environmental literacy, but that is not the case (Thapa, 2010; McGuire, 2015). Osbaldiston and Schott (2012) reviewed 87 publications regarding ways to promote sustainable behaviour and found that, while enhancing information delivery was only marginally effective, approaches that utilised a variety of methods proved to be most successful and that different methods tended to be more effective in promoting different behaviours. This study also highlighted an overall gap in knowledge regarding methods to promote sustainable behaviour (Osbaldiston and Schott, 2012). This is not to say that knowledge and education are not important drivers of sustainable education as there are numerous of studies showing that the level of environmental knowledge of an individual could be used as an indicator for level of environmental concern and prevalence of sustainable behaviour (Hines *et al*., 1987; Lyons and Breakwell, 1994; Levine and Strube, 2012).

Other researchers have attempted to view environmental attitudes as a precursor for sustainable behaviours and while this seems to be more promising than utilising information as a predictor, the reliability of the results is questionable due to "attitude" being a psychological term which is difficult to gauge, control and compare (McGuire, 2015). Another reason why using attitude as an indicator for sustainable behaviour tends to be problematic is that attitudes tend to vary from one situation to another, therefore in certain situations attitudes regarding a specific behaviour could become dormant even though they are present in an individual (Thapa, 2010). Ajzen and Fishbein (1980) also stated that, while attitudes could be used to predict behaviour, the effects of attitude on behaviour could easily be overshadowed by social norms, material limitations and other external factors.

The pathway between knowledge, attitude and behaviour is not unidirectional or simple but rather consists of a variety of possible behavioural drivers that act both directly and indirectly (through behavioural intention) on behaviour (Hines *et al*. 1987; de Groot and Steg, 2009; Hallfreðsdóttir, 2011). Information is easily ignored and an individual is exposed to a variety of internal and external behavioural drivers, therefore a range of methods to enhance environmental literacy and prevent cognitive dissonance (through an agreement of knowledge, attitudes and behaviours) are needed (McGuire, 2015). Gifford and Nilsson (2014) reviewed past research papers pertaining to the drivers behind sustainable behaviour and environmental concerns and found 17 commonly mentioned categories of behavioural influencers (consisting of both personal and social influencers). The 17 categories included knowledge, childhood experiences, personality traits, perceived control, political outlook, values, perceived responsibility, gender, age, social class and norms, religion and cultural variations, proximity to environmental issues and rural-urban differences. Gifford and Nilsson (2014) also found that the expression of sustainable behaviour may not stem from any of the 17 categories but could be the product of "non-environmental goals" such as the drive to improve one's health or the want to save money which may coincidentally be beneficial to the environment.

Possible behavioural drivers include values, beliefs, knowledge, attitudes, perceived control, subjective norms, routines, habits and external drivers (such as time and money) (Ajzen and Fishbein, 1980; Ajzen, 1985; Hines *et al.*, 1987; Stern, 2000; de Groot and Steg, 2009). Routines and habits, perception of behavioural control and external forces act directly and indirectly on behaviour (Ajzen, 1985; Hines et al. 1987; Stern, 2000). The behavioural pathway is not unidirectional and a behavioural feedback loop is created by an individual's perception and experience with past behaviour influencing the individual's decision to repeat the behaviour (Albarracín and Wyer, 2000). This is because past behaviour has a feedback effect on knowledge, attitude and perception of behavioural control (Albarracín and Wyer, 2000).

Values are underlying and consistent principles that guide behaviour and the most commonly discussed values (in terms of sustainable behaviour) include egoistic, altruistic and biospheric (Axelrod and Lehman, 1993; Stern *et al*., 1993; De Young, 1996). Another value system that is less commonly discussed in terms of promoting sustainable behaviours is post-materialistic values which pertain to an orientation that prices quality of life above economic or physical well-being and security (Knutsen, 1990; Oreg and Katz-Gerro, 2006). Post-materialistic values are held by citizens with higher-level ambitions (such as personal freedom and self-improvement) and are most often held by citizens of a higher social and economic class (Gifford and Nilsson, 2014). An individual's value system is complex and difficult to use as a sole indicator for sustainable behaviour as an individual could have conflicting values (Howes and Gifford, 2008). **Beliefs** are concepts that an individual holds to be true. Knowledge shapes an individual's beliefs and values, which in turn influence attitudes and subjective norms, which then act indirectly on behaviour through behavioural intention (Stern, 2000; de Groot and Steg, 2009).

Perceived control is an individual's perception regarding whether their actions or external forces are most likely to influence/ encourage a particular outcome (Rotter, 1966). Individuals who believe that outcomes are due to their actions possess an "internal locus of control", while those believe that outcomes are because of external forces, rather than their own actions are said to possess an "external locus of control" (Reknes *et al.,* 2019). Individuals with an "internal locus of

control" tend to actively seek out information regarding the environment, are more likely to display sustainable behaviours, tend to be more optimistic and command their environment, while individuals with an external locus tend to feel helpless and pessimistic in their environment and avoid uncomfortable or stressful situations (Fielding and Head, 2012; Gianakos, 2002; Gore *et al*., 2016). Perceived control is indirectly influenced by values and knowledge through beliefs (as the individual needs to believe that their actions could be impactful) and directly influenced by the outcome of past behaviour. It has been found that a learner's perceived control over their behaviour and its outcome was strongly linked to the learner's sustainable behavioural intention (de Leeuw *et al*., 2014). Klöckner and Oppendal (2011) found that perceived control played a huge part in learners' intention to recycle as the learners consider the effectiveness of the recycling programme at various scales, the distance to the recycling site and the mode of transport that would be used to reach the recycling site prior to participating in the recycling programme.

Subjective norms refer to social pressure and influence that one feels from individuals (or groups) that they deem to be significant to conform to a certain behavioural standard. Subjective norms are inspired and influenced by an individual's beliefs regarding who they view as influential and what these people expect of them (Rivis and Sheeran, 2003). Studies have found that subjective norms are strong and reliable predictors of sustainable behaviour (De Groot and Steg, 2009; Matthies *et al*., 2012; Ham, 2015) and that individuals feeling social pressure to purchase "green" or sustainable foods are more likely to conform to this "norm" (Vermeir and Verbeke, 2006; Chen, 2007). In schools it can be said that a learner's subjective norm is influenced by the teachers and/or their peers (Andrews *et al.,* 2008). A 2019 study found that subjective norms strongly related to learner intention and willingness to separate solid waste on school premises (Liao and Li, 2019). Other studies suggest that, while subjective norm is a prominent behavioural driver, it is personal/ internal factors (attitudes and perceived control) that have a greater influence on behavioural intention (Ajzen, 1991; Krueger *et al*., 2000; Ajzen, 2002).

Habits and Routines often pertain to behaviours that do not need much effort or time and are initiated absent-mindedly by defining triggers or cues (Littleford *et al*., 2014; Abbaszadeh and Alavi 2017). Habits have the ability to override an individual's initial motivations and intentions as well as an individual's conscious decisions, therefore habits and routines are created free of knowledge and attitudes and can directly influence behaviour and behavioural intention (Michalek *et al.,* 2019). Habits and routines can be influenced by the subjective norm as seen in a study conducted by Matthies *et al*. (2012) where parental influence on children promoted recycling habits. Habits are effective and powerful drivers for sustainable behaviours as they do not need conscious decision making and they are relatively consistent, but this behavioural driver is only effective if cues or the environment were to remain consistent (Wood and Neal 2009; Orbell and Verplanken 2010). Context-specific behavioural links, repetition of behaviour and a satisfying behavioural outcome are the three conditions that are necessary to form habits (Wood and Rünger 2016).

The behavioural drivers and behavioural pathway discussed in the literature can be viewed in Figure 1 below.

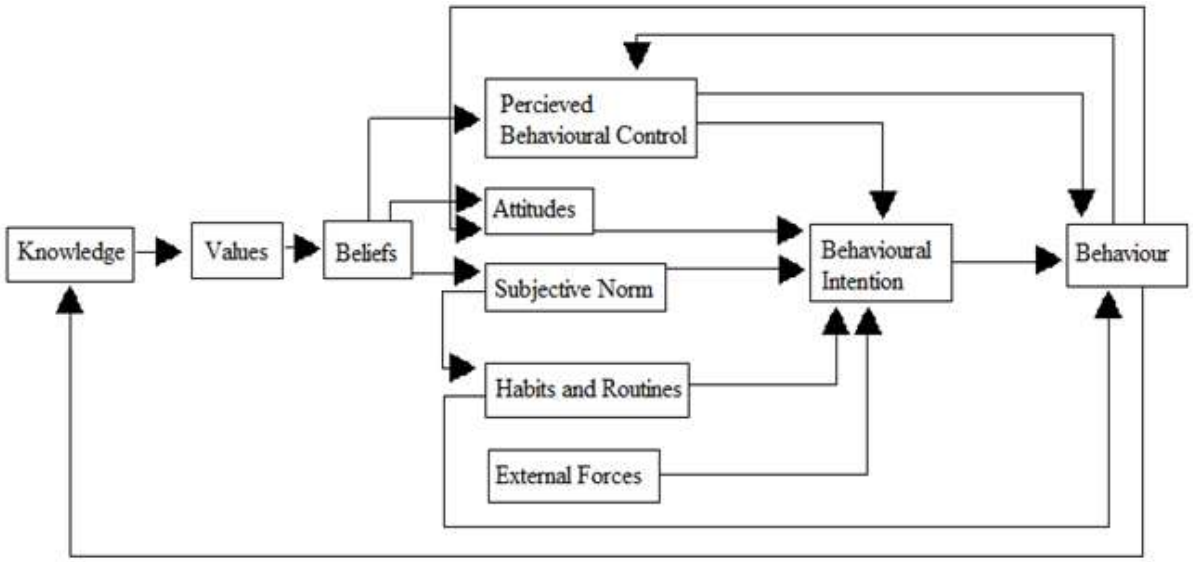


Figure 1: Summary of the behavioural pathway and behavioural drivers (sources: Ajzen and Fishbein, 1980; Ajzen, 1985; Hines *et al.*,1987; Stern,2000; Albarracín and Wyer, 2000; de Groot and Steg, 2009 and Matthies *et al.*, 2012;)

While the complexity of the behavioural pathway makes it difficult to identify a single method that holistically promotes environmental knowledge, pro-environmental attitudes and sustainable behaviours and makes it clear that it is possible to promote one without the other, it creates a range of educational opportunities. There are varying perspectives on how best to promote environmental literacy, with this comes a variety of EE methods that attempt to target various aspects of the behavioural pathway.

2.3. EE methods

While fully exploiting a single education viewpoint has advantages, it is possible and beneficial to work across multiple paradigms, utilising methods from each and selectively choosing what is relevant to create a holistic plan and solution (Schulze, 2014). According to Higgs (1998), an environmental educator needs to appreciate the abundance of knowledge and EE methods that stem from a variety of paradigms and perspectives.

The Tbilisi Principles of EE developed in 1978 provide a comprehensive guide to EE curriculum planning and implementation (UNESCO, 1978). There are a wide variety of methods and approaches that can be utilised to incorporate EE into a school's curriculum and routines. EE should be implemented using a variety and a combination of methods such as lecture style learning, questioning and examining learners on course work, discussions amongst learners and with teachers, investigation and problem solving activities, group work activities, demonstrations, outdoor education and experimental activities (Dreyer and Loubser, 2014). Stern *et al*. (2013) conducted a review of literature regarding EE methods and found that the traditional teacher driven/ lecture/ indoor style EE methods tend to be less popular and less favoured in EE literature. The

common EE methods mentioned were active participation, first hand exploration and discovery, project learning, place-based learning, cooperative learning, outdoor education, play-based learning, investigation learning, data collection, field learning, issue-based learning, reflection, relevance, multimedia content delivery and acknowledgment of varying points of view (Table 1) (Stern et al., 2013).

Table 1: Effective EE programme characteristics and definitions (Hungerford and Volk 1990; Hungerford *et al.*, 2001; Hungerford *et al.*, 2003; Jacobson *et al.*, 2007; Louv, 2008).

Methods	***Definition***
Active participation	learners are actively involved in learning and able to communicate rather passively learning and absorbing information
First-hand exploration and discovery, project learning, investigation learning, data collection and field learning	learners independently explore and discover the topic at hand with real-life experience
Cooperative learning	learners work together in group discussions, projects or investigations
Outdoor education	education outside of the classroom
Issue-based learning	utilising real world issues and scenarios to allow learners to explore consequences and possible solutions
Place-based learning	utilising particular places, systems or themes as context for a topic (such as a community system or place)
Play-based learning	using competitions and games to engage and involve learners and create a memorable learning experience
Reflection	utilising discussions or journaling to allow learners to reflect on past knowledge and new experiences
Relevance	linking content to learners' everyday lives and practical application
Multimedia content delivery	utilising a range of media (videos, lectures, pictures, etc.) and senses to engage learners

Methods	***Definition***
Acknowledgement of varying points of views	acknowledging and presenting varying points of view through class debates, discussions and introducing new scenarios and case studies

Traditional education was rooted mainly in the behavioural and teacher-directed paradigm which consisted mainly of information transfer, classroom learning (keeping the learners separate from the natural environment) and educating learners on subjects that concerned the natural environment and ecosystem dynamics (Stelljes and Allen-Gil, 2009). While this is a potential avenue to enhance learner's sustainable behaviours, a focus on constructivism and social critical learning is highly important. A constructivist approach is relevant to EE as it relates to the learner's past experiences and to their home lives (Stern *et al*., 2013). This involves practical and active learning opportunities to equip learners with adequate information regarding current environmental affairs, the socio-economic ripple effects caused by environmental issues, the root cause of environmental issues and possible solutions to environmental issues. This approach is heavily focused on the learner as a part of the environment (Stelljes and Allen-Gil, 2009). Therefore EE needs to incorporate a combination of education methods, make use of the environment and be learner-orientated, activity based, relevant to the learners' context and cross-curricular in order to target a variety of behavioural drivers (Dreyer and Loubser, 2014).

Johnson and Manoli (2011) assessed the variation in environmental attitudes of middle to lower class North American and Czech learners aged nine to twelve whose schools took part in one of two external EE programmes (Sunship Earth and Earthkeepers). Both programmes targeted behaviour and attitudes of the learners by allowing the learners to visit natural areas, reflect and make adjustments to their impacts and habits (Johnson and Manoli, 2011). It was found that, while the learners who participated in either environmental programme already had a pro-environmental attitude prior to participating in each programme, the learners that participated in either programme had a significantly higher attitude score after participation, while the attitude scores of the control group (learners that were not involved in external EE programmes) remained consistent (Johnson and Manoli, 2011). Another study on sustainable behaviour and factors that influence children's involvement in community projects involving of children ages nine to twelve applied participatory methods such as photography, drama, storytelling, and problem-solving activities, as well as activities in which the learners had to select a community issue, collected data, analysed the data in order to critical assess the issue and create solutions (Tsevreni, 2011). At the beginning of the study it was reported that learners felt that as children they had no part to play in community initiatives and their participation was unnecessary, but after a year-long programme the learners felt that they had a vital part to play in environmental planning and maintenance for the sake of their future and had a responsibility to the environment, therefore displaying increased confidence in community participation (Tsevreni, 2011).

In terms of EE initiatives and outcomes in South Africa, a 2019 study conducted in a rural village in KwaZulu-Natal determined the effectiveness of a local EE upliftment programme (titled the Ndumo Environmental Education Centre (NEEC)) which offered 15 EE sessions to schools for grade three,

grade seven and grade eight learners (Ogilvie, 2019). It was found that previous initiatives in the area had only been successful to an extent because programmes failed to consider the unique socio-economic and cultural context of the area. The NEEC integrated EE into the participant school's existing CAPs curriculum while utilising a variety of EE methods (both in-class and outdoor) such as card games, art/ creative sessions, music, class discussions, posters, and class demonstrations. After exposure to the programme, the grade three learners' knowledge of animals, their habitats and their diets was tested and the grade seven and eight learners' cognitive knowledge was tested. It was found that there was an increase in learner knowledge of environmental dynamics and concepts, an increase in sustainable behaviours (due to an increase participation in environmental initiatives) and in environmental awareness. The programme placed a lot of emphasis on tailoring the EE programme to specific socio-economic and cultural backgrounds as well as to specific age groups (Ogilvie, 2019). Apart from this report there was a scarcity of South African research regarding the effectiveness of EE and EE methods in a South African context.

A variety of EE methods is necessary not only to target a variety of behavioural drivers but also to target a wide range of learners with varying learning strategies (Dreyer and Loubser, 2014). Learning strategies are approaches that learners would use to effectively understand, sort, store and utilise information (Aydın and Kecici, 2019). Four learning strategies most appropriate for EE are authentic learning, active learning, problem solving and critical thinking (Dreyer and Loubser, 2014). These four learning strategies overlap and should all be utilised in EE (Dreyer and Loubser, 2014). Authentic learning involves learners applying the knowledge and skills that they have learnt to real world situations and environmental issues (Zwahlen, 2018). Active learning involves learners actively participating in the lesson by being able to be creative and apply the knowledge they have gained to different situations (Demirci, 2017). Problem solving occurs when learners investigate a certain environmental issue with a focus on solving it (Klasander *et al*., 2017). The critical thinking approach invites learners to engage fully with a specific environmental problem and to combine knowledge and skills from a variety of disciplines or subjects to view the full complexity of the problem (Klasander *et al*., 2017).

The need to incorporate more EE methods that fall outside the behaviourism paradigm and more into the constructivist paradigm is supported by a study conducted by Wardani *et al.* (2018) in Indonesia with 10^{th}, 11^{th} and 12^{th} grade learners. The learners were provided with in-class EE that provided them with information regarding environmental dynamics and natural sciences. It was found that the learners displayed no significant increase in environmental literacy (when compared to their "pre-environmental education" environmental literacy) and it was stated that this was likely because of the lack of demonstrations during lessons, lack of application of knowledge and lack of integration of EE throughout the curriculum (Wardani *et al*., 2018).

Another study conducted in Turkey by Ozsoy *et al*. (2012) focusing on eco-schools, showed that the eco-schools programme (which consists of forming an eco-committee with teachers and learners, incorporating EE throughout the schooling curriculum, formulating action plans and implementing environmental initiatives) effectively increased environmental literacy in learners (WESSA, 2013). Therefore this study demonstrated that learners' environmental literacy level can be effectively enhanced by implementing a variety of EE methods. However, in this study a regular school was transformed into an eco-school for the sake of the investigation. Other studies on pre-existing eco-schools showed no difference in environmental literacy of learners from eco-schools and learners

from non-eco-schools (Krnel and Naglič, 2009; Hallfreðsdóttir, 2011; Pauw and Petegem, 2013). It can be assumed that more effort and commitment went into transforming a standard school into an eco-school for the sake of the Ozsoy *et al.* (2012) study than in reality. Comparing the results from these investigations suggests that enhancing environmental literacy of learners is also dependent on the level of commitment that the teachers and schools have to implementing environmental education.

2.4. Factors that influence teacher EE commitment

In the EE process teachers play a vital part in planning lessons and presenting the learners with quality and appropriate environmental knowledge that can be linked to environmental issues and associated solutions (Pontes-Pedrajas and Varo-Martínez, 2014). A variety of studies has found that the educator's passion for environmental topics, enthusiasm and genuine concern and care for learners play a vital role in producing a positive learner outcome (Stern *et al*., 2013). Currently EE is faced with a variety of limitations that relate to the proper implementation of EE in formal schooling curricula (Nagra, 2010; Dreyer and Loubser, 2014). There are many studies that explore the challenges and barriers that teachers perceive in relation to EE and its methods but there is a general lack of research evaluating teachers' perceptions in developing countries (Anderson and Jacobson, 2018). Therefore further exploration is needed with regards to the motivations behind teachers choosing to (or choosing to not) utilise certain EE methods in schools. There are a variety of factors that determine teacher and school commitment to EE and these factors differ due to a multitude of contextual reasons that operate over a variety of scales (Anderson and Jacobson, 2018). Understanding these factors is vital for the future of EE, in order to identify the gap between environmental concerns and sustainable actions (Sosu *et al*., 2008).

The primary reasons for teacher commitment to EE are biospheric and intrinsic because teachers see that EE promotes sustainable development and it is the morally correct thing to do because, as educators, it is the teachers' duty to equip learners with the knowledge, skills and attitudes that they would need to live a sustainable life (Smith-Sebasto, 2007). In turn, some teachers feel that outdoor EE enhances and connects with the curriculum by providing the learners with practical experience of what they learn in the class room, encouraging interest in the topic and giving meaning to what they have learnt (Waite, 2011; Behrendt and Franklin, 2014). Teachers could also choose to include outdoor EE in their lessons to encourage experiential learning that will allow the learners to demonstrate the skills that they have learnt in a way that the classroom would not allow, thus expanding their knowledge (Kisiel, 2005; O'Brien, 2009; Knight, 2011; Fagerstam, 2014). EE is also perceived by teachers to encourage learner-teacher and learner-learner bonding that build communication skills, self-esteem, and confidence (O'Brien, 2009; Blanchet-Cohen & Elliot, 2011; Knight, 2011; Fagerstam, 2014). Teachers also choose to utilise EE methods to encourage creativity, independent decision making, leadership and critical thinking (Louv, 2008; Blanchet-Cohen & Elliot, 2011). Others make use of outdoor EE methods to improve the physical health of their learners (O'Brien, 2009; Knight, 2011; Ray, 2018).

According to studies conducted in China by Lee, Au, and Ma (2009), the most prominent barriers faced by teachers in terms of implementing EE are lack of funding, time and support from

communities and government. Teachers perceive EE lessons, lesson planning and administrative details to be time consuming (Carrier *et al*., 2013; Anderson and Jacobson, 2018) and often see outdoor education as a disturbance to their curriculum as it disrupts regular patterns and routines of classes, and learners are often distracted and disorderly outdoors (Graham, 2013; Fagerstam, 2014). Some teachers struggle to formulate lesson plans that incorporate EE because most teachers rely on traditional, uni-disciplinary and classroom methods of teaching (González-Gaudiano 2007; Campbell *et al*. 2010). Other barriers that could deter teachers and schools from incorporating EE into the schooling curriculum are a teacher's lack of environmental knowledge, EE training and experience, which could lead to a teacher being unable to see the importance of environmental education, not having the confidence to teach it or not being able to effectively incorporate EE into lesson plans (Ernst, 2007; González-Gaudiano, 2007; Tan and Pedretti, 2010; Graham, 2013; McGee *et al*., 2017; Anderson and Jacobson, 2018).

Another challenge often reported by teachers is the financial cost of EE (travel expenses, entrance charges, experimental equipment and extra assistance), especially in underprivileged schools (Ernst, 2007). In a study conducted in Botswana by Ketlhoilwe (2007) it was found that the most prominent barrier teachers noted, in terms of environmental education, is lack of funding and resources. Having to employ additional help during EE lessons is another commonly reported factor that lowers teachers' commitment to EE (Ernst, 2007). Outdoor EE poses a perceived safety risk to the learners, which often leads to parents being against outdoor education and teachers fearing the legal consequences should something go wrong (Ernst, 2007; Blanchet-Cohen & Elliot, 2011; Carrier *et al*., 2013).

In a study conducted by Blanchet-Cohen and Reilly (2013) it was found that a common barrier teachers find when implementing EE is a lack of common experience of learners and contradiction of learner values in culturally diverse classrooms; this is particularly relevant to South Africa because South Africa is an extremely culturally and socio-economically diverse country. Fourie (2018) stated that as climate change is a global problem, the solution (being sustainable development) should also be one that is universal. This is problematic as "sustainable development" often sees developing communities constantly changing and struggle to keep up with the global and national terms of sustainable development, when in truth sustainable development looks different in different socio-economic contexts (Fourie, 2018). Therefore the manner, content and methods that educators utilise should vary to so that learners will be able to use what they have learnt to implement sustainable development practices and sustainable behaviours in their own contexts.

Given the amount of literature available regarding EE it is concerning that most of the available research is old. It can be seen that few reviews of EE programmes and EE advancements have been made in the last 15 years. Therefore a review of the current state of EE in Gauteng schools highly necessary although there is few recent studies to compare to.

Chapter 3: Theoretical Framework

There are a variety of philosophical views and concepts in EE that have given rise to a variety of EE tools and techniques (Schulze, 2014).

3.1. Behaviourism

Behaviourism is observation of behaviour in order to create behavioural laws (Schulze, 2014). This learning philosophy stems from Pavlov's "1927" findings that animals could be "conditioned" to how they react to certain stimuli, his work was further applied to human studies by Skinner (1938) and Watson (1930). Behaviourism focuses on the relationship between a stimulus and its reaction in the presence of reinforcement in order to assess observable behaviour and behavioural changes due to conditioning (van den Aardweg and van den Aardweg, 1988; Mwamwenda, 1995). This philosophy focuses primarily on the learner's behaviour and how this behaviour is altered by external factors (Engleson, 1991). Reinforcement and conditioning are important because reinforcement could increase the probability of a behaviour re-occurring and conditioning could create good attitudes towards a behaviour (Mwamwenda, 1995; Schulze, 2014). When applying this philosophy to education, methods include, for example, a teacher being friendly and enthusiastic in order to condition the learners to be excited about class and develop good attitudes towards the subject and curriculum, or a teacher praising the learners for certain behaviour in order to reinforce that behaviour (Mwamwenda, 1995). This is done through teachers transferring quality and accurate information to learners and reinforcing sustainable behaviour.

Throughout the years behaviourist learning has received a share of criticism, a common criticism of behaviourist learning is that it reduces behaviour to a simple association between an exterior stimulus and an interior response when in fact behaviour is more complex than that (Myers, 1988; Peel, 2005). The behaviourism learning theory emphasises observable behaviour outputs but places little emphasis on meaning and cognitive processes and does not allow the subject/ learner to develop their own understanding, associations and emotional connections (Fosnot, 1996; Peel, 2005). This criticism is realised in the manner in which behaviourism is implemented through association with the traditional teacher-directed methods of teaching in which the teacher provides the learners with information while the learners passively listen and absorb information and then reproduce the contents in order to achieve a good grade (Richmond, 1993), thereby often neglecting cognitive ability, development of the subject (or learner) and the creation of meaning by taking a simple stimulus-response approach (Peel, 2005). Another criticism regarding the behaviourist learning theory is that it suppresses the learner's identity as it overlooks their social or cultural background and historical knowledge (Raina, 2011).

3.2. Constructivism

The constructivist philosophical paradigm in turn focuses on how the learner learns, acquires knowledge and, thereafter, processes this knowledge to construct a picture of the world around them (Steffe and Gale, 2012). Piaget (1932) was one of the first to make reference to constructivism by hypothesising that a child's knowledge base is not a product of external stimuli but rather a

construction of how the child interprets external stimuli and therefore viewed cognitive development as a form of "adaptation" to the external world and various stimuli. When a learner is presented with a new set of information that is in contradiction to prior information, the learner will either choose to dismiss this new information or process it and try to understand how it may fit in with or alter their existing knowledge base (Steffe and Gale, 2012). Constructivist education methods require more active engagement than those of behaviourism, therefore instead of the learner passively listening and reading, they are encouraged to actively participate in lessons, interact with the topic at hand, solve problems and apply critical thinking (Steffe and Gale, 2012).

A variety of studies have concluded that the constructivist learning approach has resulted in a significant increase in academic performance of school learners (Ayaz and Şekerci, 2015; Semerci and Batdi, 2015; Ural and Bümen, 2016). Implementation/ teaching methods associated with the constructivist learning approach include co-operative learning, problem solving activities, computer-assisted learning activities, use of mind-maps and case studies, discovery learning, outdoor education and project-based learning (Arik and Yilmaz, 2020). In this paradigm more emphasis is placed on the learner being active in their own learning experience and less reliant on the teacher in the meaning-making process (Schulze, 2014). This paradigm is connected to the more novel learner-directed method of teaching in which the teacher plants the seed and provides the adequate learning environment to start the learning process and thereafter allows the learner to construct and reconstruct their knowledge for themselves (Jaquith and Hathaway, 2012). This being said, the constructivist learning theory has often been criticised on the notion that it places too high expectations on the learners and this often leads to gaps in their learning (Hodson and Hodson, 1998).

The constructivist approach to learning has often been associated with EE and addresses the objectives of EE that relate to the creation of active citizens who possess critical thinking and problem solving skills (Burek, 2012). Outdoor education, garden education, field trips/ camps, project-based learning, co-operative learning and computer-assisted learning are constructivist approaches/ methods that are often utilised and associated with EE (Aslan Efe, 2015; Rodrigues and Payne, 2015; Ürey *et al*., 2017; Topçu and Atabey, 2017; Oflaz, 2018).

Previous studies that compared the environmental knowledge and attitudes of learners exposed to constructivist learning methods and learners exposed to traditional learning methods have been controversial with some finding that constructivist methods have a positive effect (Gnanalet and Ramakrishnan, 2010; Hsiao *et al*., 2010; Sağlamer Yazgan, 2013; Güven, 2014; Nkire, 2014), while others stated that there was no effect (Skaza, 2010; Broyles, 2011; Burek, 2012; Öztürk, 2013; Aslan Efe, 2015 in Efe and Efe, 2018) Arik and Yilmaz (2020) conducted a study involving 6 237 learners to determine the effect of active and constructivist learning on EE by assessing the learner's academic achievements (knowledge) and environmental attitudes. The study was conducted over a 15 year period (2000 to 2015) and the end result showed that there was a positive and significant difference in the effect of active and constructivist EE practices compared to more traditional practices (Arik and Yilmaz, 2020).

A variety of issues have been identified with regards to constructivist teaching, in general, that relate to difficulty translating the theory of constructivist learning into a practice of teaching (Richardson, 2003). After an analysis of various constructivist case studies, Richardson (2003)

identified four issues that related to the implementation of constructivist practices which included (1) the aim and impacts of constructivist practices on learners being unclear, (2) the practices/ methods of constructivist teaching being indecisive, (3) teacher lack of understanding of subject matter which could lead to ineffective and counterproductive constructivist practices and (4) a concern that constructivist practices leave minority learners from different social/ cultural backgrounds behind. With regards to inclusion of social context, this is where constructivism is transformed into social constructivism, defined by Vygotsky *et al.* (1978) who believed that learning in an integrative process that heavily relies on social context of learners.

3.3. Vygotsky's zone of proximal development (ZPD)

Vygotsky's zone of proximal development (ZPD) is a concept associated with constructivism and is defined as the difference between an individual's actual level of development through independent means and their potential level of development when receiving help from a more competent and knowledgeable individual and utilising environmental tools (Vygotskij and Cole, 1981; Daniels, 2008). In order to determine the ZPD, three aspects need to be established: what the individual can achieve independently, can achieve with help, and cannot achieve (Kozulin *et al*., 2003). Providing the appropriate level of assistance and guidance when an individual is within their personal ZPD will enable the individual to achieve the task and allow them to achieve the task independently in the future, thus increasing their ZPD (Kozulin *et al*., 2003). An increased ZDP enables an individual to tackle more challenging tasks and thereafter shrinking their ZPD (meaning the gap between what they can achieve alone and what they can achieve with assistance shrinks) (Shabani *et al*., 2010).

In terms of the use of the ZDP in education and learning techniques, the aim of education, from a Vygotskian perspective, should be to see that learners are kept within their personal ZPD (Roosevelt, 2008). This is done by supplying learners with materials and activities that are culturally significant and interesting to the learner, as well as including problem solving tasks that require that the learner seek the help of more experienced learners or adults (Roosevelt, 2008). The concept of "scaffolding" plays a major role in assisting an individual to move through their ZPD (Berk and Winsler, 2002). "Scaffolding" is the points of support that aids an individual in achieving a task and thereafter can be removed (Berk and Winsler, 2002; Kozulin *et al*., 2003). The three characteristics that make "scaffolding" effective in promoting learning and unique are (1) the collaborative interaction between the learner and the knowledgeable or experienced individual, (2) the learner's current ZPD and knowledge level and (3) the adjustability of support provided by the "scaffolding" (Wells, 2006). Therefore the type of "scaffolding" should be unique to the learner and communication is needed between the learner and the teacher in order to adjust the "scaffolding" as necessary throughout the learning process until they are unnecessary (Berk and Winsler, 2002; Kozulin *et al*., 2003).

When Vygotsky's zone of proximal development (ZPD) is applied in a school setting, as well as in EE, there are many ways in which a learner may be assisted in moving through their ZPD (Armstrong, 2015). The teacher's role is to establish the learner's current knowledge base, relate the current task to the learner's knowledge base, break up the task into smaller manageable tasks and thereafter assist the learners in achieving the task with the goal of enabling the learner to complete the task independently in the future (Kozulin *et al*., 2003).This relates to the planning of the schooling EE curriculum as teachers need to build on learners' current knowledge base, develop a

concept at an appropriate pace, understand that learners develop at different paces and allow themselves the time to assist learners. Cooperative learning/ group learning is also an effective method in which learners are put into groups and the more advanced learners may aid and assist less competent learners (Daniels, 2008).

Chapter 4: Methodology

The global and South African legislation, policies and frameworks for EE were analysed along with evaluation reports on the implementation of global policies at South African level. Furthermore, the CAPS syllabus for each subject (grades 10 to 12) was analysed in accordance with the global and local requirements of EE. The focus of this analysis was on the language and content of the documents, the extensiveness and comprehensiveness of the guidelines and the feasibility and achievability of what is required. The documents were also compared and analysed in order to determine the extent to which there is alignment between international documentation and South African documentation and implementation of environmental education.

The study group consisted of teachers and learners from 12 high schools in Gauteng province, South Africa. Four private (IEB) schools and seven public (GDE) schools participated in this study and all participant schools were co-ed high schools. The seven GDE schools in this study were separated into three schools that belong to quintile one, two or three (referred to in this study as GDE-L) and four schools that belong to quintile four or five (referred to in this study as GDE-U). Rural schools were excluded from this study due to time constraints as this would have entailed having to commute long distances to reach these schools.

To assess the level of implementation of environmental education and commitment to environmental education of Gauteng schools, interviews were conducted with teachers from the various schools. This was done through purposive sampling of at least one teacher per school who is most involved in and knowledgeable of the school's environmental education programme. The teacher sample group consisted of the head of the high school, life science teachers, life orientation teachers, a religious education teacher, a physical science/ chemistry teacher and the head of the environmental committee.

A teacher interview schedule and a learner questionnaire were created once the schools were selected and consented to participate in the study. The teacher interviews were conducted in person at the schools, the questions were provided before the interview and the interviews were recorded using a voice recorder. Prior to distribution, the interview schedule was piloted on a select group of 10 people in order to determine if the language and questions were clear, thus promoting credibility of the tools.

In order to determine the effectiveness of Gauteng schools' environmental education programmes, the level of environmental literacy of learners at each of the chosen schools was assessed. This was done through purposive sampling of the grade 11 learners at each school. For the purpose of this study, the grade 11 group was selected because at grade 11 the learners have been exposed to the school's value system and routines for a minimum of 3 years and are not preoccupied with university applications, future planning or matric examinations.

Two study tools were created for this study: a teacher interview and learner questionnaire (appendix 1 and 2). As there were minors involved in this study, a consent form (that was signed by their parents) and an assent form (that was signed by the learner) were provided with the learner questionnaires. Human (non-medical) ethics clearance from the University of Witwatersrand (protocol number: H19/06/26), GDE permission (protocol number: 8/4/4/1/2) and permission from

each school was received before the study could commence with teacher interviews and learner questionnaires.

The four main components of this study are EE document analysis, analysis of EE in the formal South African syllabus, teacher interviews and learner questionnaires. Figure 2 displays the connectivity and the flow of the four components of the methodology of this study.

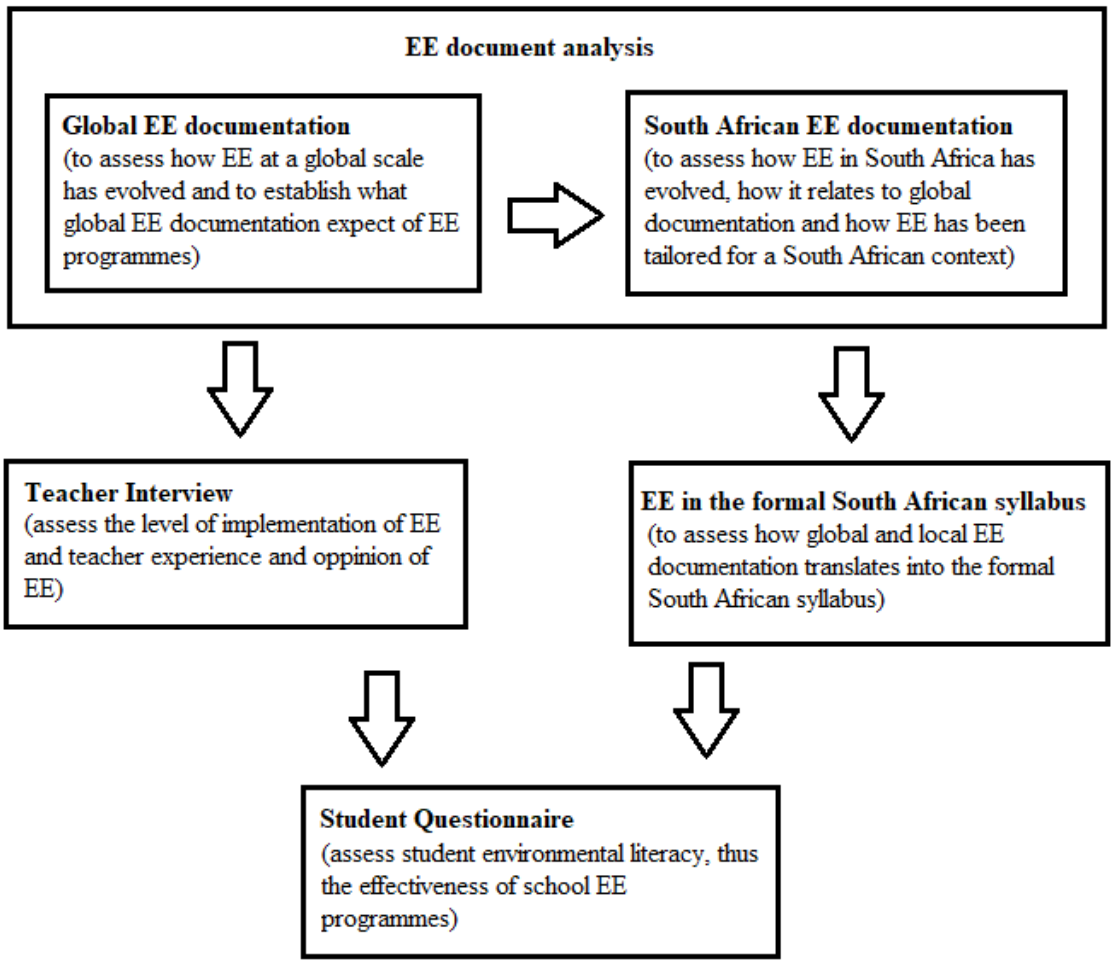


Figure 2: Flowchart showing the relationship between the four components (document analysis, EE in the formal South African syllabus, teacher interview and learner questionnaire) of this study.

4.1. Document analysis

First the key global declarations and documents that contained EE guidelines and implementation were analysed. The basis of international EE was rooted in three conferences and the three declarations that they produced; the Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration), the Belgrade Charter and the Tbilisi Declaration. Therefore, these three documents were analysed to understand the foundation of and basic requirements for EE. The next document that was analysed was Agenda 21 which was drawn up after the 1992

United Nations Conference on Environment and Education which had a major focus on sustainable development. Agenda 21 provides guidance for the actual implementation of EE at various geographic scales. The framework and the guidelines for the Decade of Education for Sustainable development (ESD) (2005-2014) as well as the Global Action Plan (GAP) for ESD (2015-2019) were also analysed.

Next the South African documents that related to EE guidelines and implementation were analysed. The Environmental Education Policy Initiative (EEPI) (1992), the White Paper on Education and Training (1995),the White Paper on Environmental Management (1997) were first analysed as the foundation of formal EE in South Africa. Then the National Environmental Management Act of 1998, the National Environmental Education Project for General Education and Training (NEEP-GET) and the National Framework for Sustainable Development (NFSD) (2008) along with the National Stratify for Sustainable Development and Action Plan (NSSD1) (2011) were assessed. Lastly the Revised National Statements aims, objectives, principles and components were assessed.

In order to assess and compare the international and local documents, the documents were evaluated under three categories: the EE aims, the role of government and organisations in EE and specific duties of the EE programme. Under each category it was noted what each document prescribed. The criteria met by the international documents were compared to the criteria met by the local (South African) documents to determine if there was continuity or discrepancies between the international and local EE documents.

4.2. Syllabus analysis

To assess the implementation of EE in the South African formal education sector, the CAPS curriculum documents of 17 grade 10-12 subjects were assessed. The grade 10-12 subjects assessed included:

- mathematics,
- mathematics literature,
- English,
- life orientation (LO),
- life sciences,
- geography,
- physical sciences,
- history,
- economics,
- business studies,
- accounting,
- computer applications technology (CAT),
- information technology (IT),
- engineering, graphics and design (EGD),
- visual arts,

- consumer studies and
- tourism.

Each subject was assessed under three main categories: the presence of EE in the subject, the content ("the what") of EE in the subject and the implementation methods/ procedures ("the how") of EE in the subject (Table 2). Under the first category, the subjects were given points if EE was included as its own topic/ strand (one point), if EE was integrated across a range of topics/ strands (one point) or if EE was touched on under one or two topics (half point), while no points were awarded if EE was not present in the curriculum at all. Integrating EE in a subject in a variety of strands implied that EE in the subject took an interdisciplinary approach. With regards to the remaining two categories, the information attained from the national and international EE documents (under the categories of EE aims and specific duties of the EE programme) were used to create criteria for which the subjects were scored to assess the EE contents and EE implementation methods. This was done to evaluate whether the schooling curriculum was in agreement with EE national and international documentation. Under the category of EE contents the criteria related to the substance and message of the subject's EE while the criteria under the category of EE implementation methods related to teaching approaches and outcomes.

Table 2: The criteria and point allocation to assess the EE programme included in the CAPS syllabus (grade 10-12) of each subject (based on the criteria set by Stockholm Declaration, Belgrade Charter, Tbilisi Declaration, Agenda 21, UN decade of ESD, GAP in ESD, EEPI, White Paper on Education and Training, White Paper on Environmental Management, NEMA, NEEP-GET, NFSD and NSSD1)

Category	***The inclusion of EE***	***The content of EE (each for 1 point) ("the what")***	***The implementation of EE (each for 1 point) ("the how")***
Criteria	Included as its own topic / strand (1 examine cause, effect, solutions and complexity of issues) point)	Holistic coverage • economic dimensions (1/6 point) • social dimensions (1/6 point) • environmental dimensions (1/6 point) • concept of sustainability (1/6 point) • inclusion of technology (1/6 point) • including the interests of the environment and society when discussing developmental plans (1/6 point)	Utilises a variety of methods

Category	*The inclusion of EE*	*The content of EE (each for 1 point) ("the what")*	*The implementation of EE (each for 1 point) ("the how")*
	Integrated across a range of topics (1 point)	Creative content	Incorporated in every grade
	Mentioned in another topic (0.5 point)	Evolves in difficulty as learner ages	Encourages action
	Not included	Touches on environmental legislation • global/ local (0,5 point) • both (1 points)	Enhances practical skills
		Use of examples • provides specific examples(1/4 point) • covers South Africa issues(1/4 point) • covers global issues (1/4 point) • covers various temporal scales (1/4 point)	Encourages critical thinking skills
		Explores issues in its entirety • explores causes (1/4 point) • explores effects (1/4 point) • explores solutions (1/4 point) • emphasis complexity (1/4 point)	Encourages problem solving skills
		Encourages inclusion of current affairs	
		Allows teachers to make topics relevant/ relatable to learners	
		Informative for teachers from different backgrounds to follow	
Maximum points	2	9	6
Total	17		

4.3. Teacher interviews

The teacher interview schedule was semi-structured, meaning that it consisted of open-ended questions and allowed the participant and interviewer to deviate from the guide if necessary (as per Newcomer, Hatry and Wholey, 2010; appendix 1). Including open-ended questions in the teacher interview avoided leading the participant to a desired answer, thus increasing the trustworthiness and validity of the participant's answers. The benefits of a semi-structured interview are that the researcher is able to find new ways of viewing the topic and is allowed to develop a complete understanding of the topic at hand while still retrieving comparable qualitative data (Newcomer, Hatry and Wholey, 2010).

The teacher interview consisted of two sections. Part one covered school environmental education content and teaching methods to determine how many of the 12 Tbilisi Principles (UNESCO, 1978) a school follows and the various manners in which the school implements environmental education. In this section the teacher was asked to describe the environmental education programmes (both curricular and extracurricular) implemented by their school and to provide examples of resources that they use to implement environmental education.

Part two of the interview dealt with teacher and school environmental education perspectives and commitment, including why the educators and schools choose to implement environmental education in the manner that they do, and allowed the teachers to explain the answers received in section 1 of the interview. These questions aimed to determine barriers that Gauteng schools face in terms of implementing environmental education and what affects schools' and educators' perceptions and commitment regarding environmental education.

The interviews were conducted by scheduling interview times with the consenting educators and then visiting their school at the desired time.

Once all interviews were conducted, the interview data were transcribed. A distinction was made between the in-class EE and the extra-curricular EE. In-class EE takes place during formal class time and relates to the syllabus, while extracurricular EE includes additional activities or EE initiatives that the school partakes in outside of the curriculum or the set school day. Extracurricular EE methods include having a learner environmental committee, placing recycling bins throughout the school and carrying out a school-wide environmental campaign. The teacher interview was assessed qualitatively.

The content of the lesson depended on the GDE/ IEB set curriculum, therefore the in-class EE was not assessed by overall content but rather by EE lesson planning, environmental topic selection and EE methods utilised by the educators. The lesson planning was assessed using six criteria:

1. the educator's acknowledgment of the importance of in-class EE;
2. the educator's knowledge of current environmental issues based on their choice of environmental examples (section A question 3 of interview; appendix 1);
3. the educator's ability to relate in-class EE to learners' home lives;
4. the educators' creativity in lesson planning (based on section A, question 5 of the teacher interview; appendix 1);
5. the educator's tendency to conduct extra research prior to environmental lessons and

6. the educator's tendency to take a cross disciplinary approach to EE (based on section A question 1 of the questionnaire; appendix 1).

Based on the answers the teachers gave during the teacher interviews and the teacher's attitudes regarding EE, one point was awarded if a criterion was fully achieved, half a point if it was attempted and no points if the criterion was not attempted.

The number of in-class EE methods and extra-curricular EE methods mentioned by each educator were tallied for each school and each school type. Methods that were mentioned to have been implemented sporadically or methods that were not well received by learners were represented as a half and not a full method when tallied. This was done to find any patterns in the frequency of use of certain EE methods, see if schools rely more heavily on in-class EE or extra-curricular EE and to see if the use of EE methods varied amongst school types. The reasons for the educator's choice of EE methods were also note and compared.

The factors that attracted educators to implementing EE and deterred educators from implementing EE was assessed for each school and school type. The factors that attracted educators to implementing EE were split into six categories (which were established after the data was collected):

1. Effective methods
2. Teacher push to implement EE
3. Learner push to implement EE
4. School push to implement EE
5. Positive learner outcome
6. Positive community outcome

The factors that deterred educators from implementing EE were split into two categories: barrier to outcome and barrier to implementation (which were established after the data was collected). Under each category e factors that deterred educators from implementing EE were further split (Table 3).

Table 3: The categories and subcategories into which the factors that deter educators from EE were spilt.

Category	***Subcategory***
Barrier to implementation of EE	Lack of support from school or GDE/IEB
	Time constraints
	Lack of resources to implement EE methods
	Lesson planning and content issues
	Issues implementing certain methods
Barrier to desired outcomes of EE	Environmental knowledge
	Pro-environmental attitudes
	Sustainable behaviours

4.4. Learner questionnaires

The learner questionnaire was designed to evaluate the learner's perspective of their school's environmental education programme and the learner's environmental literacy (appendix 2). The questionnaire consisted of four sections:

i. Personal section

In this section the participants were asked demographic questions and questions that relate to their background, subject choice and possible career choices. The learners were also asked about their perception of environmental education at their school and their awareness of the environmental education methods utilised by their schools. In this section the participants were asked if they have ever received external environmental education or been part of external environmental initiatives in order to determine if a learner's environmental literacy level was because of the school's environmental education programme or was possibly influenced by external education.

ii. Knowledge, attitude, and behaviour section

The knowledge section included a series of questions to determine the participants' knowledge and understanding of environmental dynamics and issues. In this section the participants were also asked to state their primary source of environmental information. The attitude section was focused on the emotional connection and relationship that the participant has with their environment by asking how they feel about current environmental issues and the environment. Finally, the behaviour section aimed to determine how the participants interact with their environment and the extent to which they display environmentally responsible behaviour.

The New Ecological Paradigm (NEP) scale consists of 15 questions that work on a five-point Likert scale (strongly disagree, disagree, neutral, agree and strongly agree) in order to evaluate an individual's environmental attitudes and ideologies (Dunlap *et al.,* 2000). The NEP scale can be adjusted and tailored to be used in a variety of different counties and socio-demographic settings (Ntanos *et al*., 2019). The environmental knowledge and attitude sections of the questionnaire formulated for this study included adapted questions from the NEP Scale, thus increasing the validity of the study tool developed for this study.

In order to assess the validity of the data that were retrieved during the teacher interview, the learners at each school were asked if and how their school implements environmental education, and this answer was then compared to the answers that the teachers gave. In order to assess the validity of the answers from the learner questionnaire, some questions aligned across the knowledge, attitude and behaviour sections; if the learner answered the questions truthfully, these answers should correlate. The honesty and reliability of the teacher and learner answers were enhanced by assuring the participants (in the teacher and learner information sheet) that they will remain anonymous and the name of their school will not appear in the final report. The answers to question two and question six of the attitude section, question five of the attitude section and question three of the behaviour section related to each other and could therefore be used as a means to cross-reference answers in order to detect if participants only attempted to appear more environmentally literate. The large sample group of grade 11 learners (N=380) allowed for a greater sample of valid data.

The wording in the questionnaire and the interview was carefully chosen so that learners and teachers from different socio-demographic backgrounds and specialities could understand all of the questions. The length of both study tools (specifically the learner questionnaire) was limited in order to allow the participants to complete these within a single school period (approximately 30-40 minutes) to avoid mental fatigue of participants and to receive reliable data. The learner questionnaires were physically delivered to each school for teachers to distribute during class time and collected again after completion.

The answers from the learner questionnaire were displayed as scores to allow the scores of the knowledge, attitude, and behaviour sections of each learner's questionnaire to be totalled. Independent variables included:

- schools,
- quintiles,
- public/IEB,
- learner subject choice
- learner sources of environmental knowledge
- EE methods in schools (both extracurricular and in-class)
- school encouragement
- learner reward
- gender
- future career aspirations
- external EE programmes

The learner questionnaire data were analysed using R-Studio (version 1.2.5033) with a p-value of 0.05. First, a Shapiro Wilks normality test was conducted to determine if the data were normally distributed. Then a Pearson's Rank test was done (as the data were not normally distributed) to determine if there was a correlation between the knowledge, attitude and behaviour sections for the entire sample group, the IEB school type, the GDE-U school type and the GDE-L school type. A Pearson's Rank test was also done to determine if there was a correlation between the questions that related to one another across the sections.

Thereafter a Generalised Linear Model (GMZ) was used to determine if there was a significant difference in knowledge, attitude, behaviour and, therefore, environmental literacy between learners from different schools and three school types (IEB, GDE-U and GDE-L). A GMZ was also used to determine if there was a significant difference in knowledge, attitude and behaviour with regards to learners' perception of their school's EE programme and methods, learner subject choice, learners' source of environmental information, whether the schools rewarded and/or encouraged sustainable behaviour and learner demographics.

4.5. School EE programme vs learner environmental literacy

In order to determine the effectiveness of a school's environmental education programme in promoting environmental literacy, the answers given during teacher interviews were compared to

the learners' environmental literacy levels at the school. This was done by first assessing the EE programme at each school. In order to assess the EE programme of each school and school type, the school's EE programme was assessed based on 10 criteria (that were based on international and local documents, heavily taking from the Tbilisi principles).The criteria were as follows:

1. Holistic coverage: this principle determines if the school's EE programme covered more than the natural environment and eco-system dynamics in the face of environmental issues. The schools' EE programme needed to cover the natural and the man-made environment and needs to constantly relate to social issues, economic issues and technological developments in order to be awarded a maximum of five points.

2. Life-long pursue: this principle analysed how EE evolved throughout the learners education by assessing if EE was incorporated at every age and if EE progressed in complexity as the learner aged. two points were awarded for this principle.

3. Temporal scale: this principle analysed if the EE programme explored environmental issues at varying temporal scales. The educators needed to discuss past, present and future environmental issues to be awarded three points.

4. Geographic/ special scale: this principle examined the geographic scale and extent of the issues that the school selected. The educators needed to discuss environmental issues at varying scales (school level, community level, South African level and global level) to be awarded four points.

5. Multi-disciplinary: This principle explored if EE was looked at through a range of disciplines. In order to be awarded a maximum of three points the school needed to have incorporated EE across a range of subjects, the school needed to have conducted subject corroboration projects and the teachers needed to be aware of what other subjects covered.

6. Causes and symptoms: this principle assessed if the teacher allowed the learners to explore the causes and symptoms of environmental issues.

7. Complexity: this principle assessed if the educators and the school's EE programme fully communicated and demonstrated to learners the complexity of environmental issues. The educators had to have discussed the vast number of components involved in environmental issues (the drivers and the effects), explained how interconnected all components are, discussed existing solutions and experimental and "outside-the-box solutions" and encouraged and nurtured critical thinking skills to be awarded five points for this principle.

8. Methods: the EE methods were separated into 5 sub-categories and a point was given for each that the school utilised. The five sub-categories were visual aids, out-of-class education, peer education, practical individual education, and use of mixed media.

9. Learner input: here the schools were rated based on three criteria: whether the school had a platform for learner feedback, whether their platform was well utilised (if it was used on a continuous basis and the teachers adjusted their lessons accordingly) and if learners influenced topics that the teachers covered for a maximum of three points.

10. Future development: here the school was awarded a point if the teacher stated than in discussing developmental plans, community changes or new technologies, the theme of environmental health was discussed.

Each of the participant schools was allocated points under each principle based on number of criteria that they achieved to produce a total score of 32 points. A school was awarded one point if they fully met a criterion, half a point if they made an attempt and no points if they had not attempted or met a criterion.

To assess the effectiveness of the schools' EE programmes, the points for the ten principles were tallied for each school and compared to the average learner environmental literacy, knowledge, attitude and behaviour scores from each school and each school type. The data were analysed using R-studio with a p-value 0.05. A Shapiro Wilks normality test was conducted to determine if the data were normally distributed. Thereafter a correlation test was done to determine if there was a relationship between the school EE programme scores and the learner environmental literacy scores.

Chapter 5: Results

5.1. Document analysis

Six international documents that touched on EE creation and implementation were analysed and compared to seven South African documents that touched on EE. The six international documents evaluated were the Stockholm Declaration, the Belgrade Charter, the Tbilisi Declaration, Agenda 21, the UN Decade of Education for Sustainable Development (ESD) and the Global Action Plan (GAP) in ESD. The six South African documents evaluated were the Environmental Education Policy Initiative (EEPI), White Paper on Education and Training, White Paper on Environmental Management, National Environmental Management Act (NEMA), National Environmental Education Project for General Education and Training (NEEP-GET), the National Framework for Sustainable Development (NFSD) and National Strategy for Sustainable Development and Action Plan (NSSD1). The documents were assessed based on three categories of topics: EE aims, steps that government and organisations need to take to implement EE and criteria/ principles that EE programs should meet, the criteria under each category that the documents were assessed on can be viewed in Table 4.

Table 4: The EE criteria that was covered in the international and/or the South African EE documentation (Stockholm Declaration, Belgrade Charter, Tbilisi Declaration, Agenda 21, UN decade of ESD and GAP in ESD) and seven South African documents (EEPI, White Paper on Education and Training, White Paper on Environmental Management, NEMA, NEEP-GET, NFSD and NSSD1).

EE aims:	***To implement EE government and organisations need to:***	***EE programmes needs to:***
• Increasing environmental awareness/knowledge • Creating a variety platforms for RELIABLE information sharing • Promoting pro-environmental attitudes • Promoting sustainable behaviours • Enhancing skills • Encouraging participation • Creating a sense of responsibility and agency • Creating problem solving skills • Correcting past inequalities	• Focus on information collection and re-assessment of the current state of EE and the effectiveness of current methods and programmes • Place emphasis on the importance of information exchange • Enhance co-operation from all sectors • Encourage collaboration • Foster creation of new EE methods • Cater for all socio-economic backgrounds and create context specific programmes • Provide funding and technical support for programme creation	• Make apparent the large scale effect of small actions • Consider environment holistically and in its totality (not just natural and physical aspects) • See EE as a life-long pursuit • Examine issues at different geographic scales • Examine past, current and future issues • Emphasise the value of co-operation between global, national and local sectors • Include the environment in growth and development plans • Encourage learner input

EE aims:	*To implement EE government and organisations need to:*	*EE programmes needs to:*
	• Update strategies and policies • Make conference documents and policy documents openly available • Update curriculum to Include EE in the curriculum • Environmental training across all sectors • Provide professional training for EE implementation (e.g. for educators) • Observe environmental days	• Analyse symptoms and root causes • Emphasise and assess the complexity of environmental issues • Interdisciplinary approach • Inter-relationship of three dimensions and their issues • Discuss solutions that will enhance the wellbeing of all three dimensions • Relate EE to policies • Utilise a variety of learning methods

The comparison of the global and South African documents has been tabulated below (Table 5). There was little relationship between global documentation and South African documentation in terms of criteria/ principles that EE programs should meet. Many of the South African documents did not actually touch on what EE programmes should be doing in order to be effective but rather focused on outlining EE aims and steps that governments and organisations need to take to implement EE. In terms of EE aims and steps that government and organisations need to take to implement EE, South African documents did not specifically mention aiming to create a sense of responsibility or agency in citizen, training for EE practitioners, funding and technical support for EE programmes and celebration of world environmental days.

Table 5: Comparison of topics included in six global documents (Stockholm Declaration, Belgrade Charter, Tbilisi Declaration, Agenda 21, UN decade of ESD and GAP in ESD) and seven South African documents (EEPI, White Paper on Education and Training, White Paper on Environmental Management, NEMA, NEEP-GET, NFSD and NSSD1).

Topic	*Number of times mentioned in global documentation (out of six documents)*	*Number of times mentioned in South African documentation (out of seven documents)*
EE aims:	33	17
Increasing environmental awareness/knowledge	5	4
Creating a variety platforms for RELIABLE information sharing	4	1

Topic	*Number of times mentioned in global documentation (out of six documents)*	*Number of times mentioned in South African documentation (out of seven documents)*
Promoting pro-environmental attitudes	5	1
Promoting sustainable behaviours	4	1
Enhancing skills	5	2
Encouraging participation	2	1
Creating a sense of responsibility and agency	3	0
Creating problem solving skills	3	2
Correcting past inequalities	2	5
To implement EE government and organisations need to:	27	23
Focus on information collection and re-assessment of the current state of EE and the effectiveness of current methods and programmes	3	2
Place emphasis on the importance of information exchange	2	3
Enhance co-operation from all sectors	3	1
Encourage collaboration	2	4
Foster creation of new EE methods	2	2
Cater for all socio-economic backgrounds and create context specific programmes	3	3
Provide funding and technical support for programme creation	2	0
Update strategies and policies	2	3
Make conference documents and policy documents openly available	1	1
Update curriculum to Include EE in the curriculum	1	3
Environmental training across all sectors	3	1
Provide professional training for EE implementation (e.g. for educators)	2	0
Observe environmental days	1	0
EE programmes needs to:	29	8
Make apparent the large scale effect of small actions	1	0
Consider environment holistically and in its totality (not just natural and physical aspects)	3	1

Topic	*Number of times mentioned in global documentation (out of six documents)*	*Number of times mentioned in South African documentation (out of seven documents)*
See EE as a life-long pursuit	3	0
Examine issues at different geographic scales	2	0
Examine past, current and future issues	2	0
Emphasise the value of co-operation between global, national and local sectors	1	0
Include the environment in growth and development plans	2	0
Encourage learner input	1	0
Analyse symptoms and root causes	2	0
Emphasise and assess the complexity of environmental issues	2	1
Interdisciplinary approach	4	1
Inter-relationship of three dimensions and their issues	2	2
Discuss solutions that will enhance the wellbeing of all three dimensions	1	0
Relate EE to policies	1	1
Utilise a variety of learning methods	2	2

In terms of international documentation, the Stockholm Declaration focused on providing information regarding EE but did not set out aims/ criteria for EE programs and failed to address the gap between the developed and the developing world (UNEP, 1972). The Belgrade Charter outlined the environmental and environmental education goals, the objectives of EE, the designated audience and the 8 principles that should guide EE programmes (UNESCO-UNEP, 1976). Later the Tbilisi Declaration further built on these eight principles to create the 12 Tbilisi Principles but (similar to pervious documents) still did not touch on the socio-economic context of EE (UNESCO, 1978). Agenda 21 discussed EE in three main sections: restructuring education to focus on sustainable development, promoting public awareness and promoting education and training, and each section outlined the objectives and activities that need to be completed to achieve these objectives (UNCED, 1992).

Agenda 21 was the first of the international documents analysed that touched on the idea of designing and altering EE programmes and methods to cater for varying socio-economic backgrounds by conducting interviews (UNCED, 1992). Of all the international documents analysed, the Tbilisi document and Agenda 21 were the most informative and touched on the most EE topics, yet they differ in that the Tbilisi Declaration listed more guidelines that EE programmes should follow while Agenda 21 listed more steps that governments and NGOs need to take to implement EE. The Decade for ESD (2005-2014) had clear objectives and goals but the

implementation guidelines were broad as EE programmes and methods need to be tailored to be effective in specific socio-economic contexts (UNESCO, 2005). When re-evaluated in 2014 it was found that there had been a positive shift in terms of EE policy creation, curriculum formation and new partnerships and stakeholder collaborations, but challenges experienced included a need for alignment between sustainable development and education, a need for more research and innovation, a need for a better way to assess the effectiveness of EE methods and a need for a better way to institutionalise EE (Buckler and Creech, 2014). The Global Action Programme (GAP) on ESD (2015-2019) was focused on scaling up the actions of ESD and aimed to fast-track action taken towards ESD by multiplying the strength of initiatives (UNESCO, 2015).

In terms of South African documentation, the method of policy creation utilised by the EEPI (1992) suggests that South African EE policy not only meets international standards but is tailored to the needs of the South African context at all scales, therefore this process also not only sees that policy was interdisciplinary, applicable to all and realistic, but the policy would also be widely supported (Clacherty, 1993). The White Paper on Education and Training (1995) was not a plan of action but did set deadlines of future developments and stated that EE needed to take an active, interdisciplinary and integrated approach with that inter-departmental relationships being important to create effective EE (especially between the Department of Education and the Department of Environmental Affairs and Tourism; DoE, 1995b). The White Paper on Environmental Management (1997) went further regarding the aims and objectives of EE in South Africa as well as the steps that government needs to take to implement EE but (like the White Paper on Education and Training) it did not focus on specific criteria or principles that should be met by EE programmes (Department of Environmental Affairs, 1997). Similarly, NEMA briefly touched on EE but did acknowledge that the term "environment" did not only refer to the prestige natural environment, that an integrated approach to environmental management was needed and that the needs of the citizens are important factors to consider in environmental management (NEMA, 1998). This document also stated that South African public education needs to be revised in accordance to the objectives set out in Agenda 21 and that the Minister needs to see that an annual sustainable development performance report as well as an annual report regarding the government's performance as agreed upon in Agenda 21 are developed (NEMA, 1998). NEEP-GET paid special attention to curriculum development and EE methods and elected a team titled the National Environmental Education Project for Formative Monitoring and Evaluation (NEEP-FME) which was tasked with monitoring areas such as changes in learning ideology, contextual approaches and techniques for lesson planning, methods to promote and enhance active lessons, collaborative approaches to curriculum support and methods to enhance educators' professional development (NEEP-GET, 2005). In both the NFSD (2008) and the NSSD1(2011), EE is touched on as a key aspect of creating a green economy (Department of Environmental Affairs and Tourism, 2008; Department of Environmental Affairs, 2011). A common theme across all seven documents was that South African documentation aimed to correct past inequality that was created during the apartheid era and this theme applied to EE as well.

5.2. Syllabus analysis

After the international and national EE documents and guidelines were reviewed, a set of criteria was created based on the summation of all documents and common themes to assess the CAPS syllabus for grade 10 to grade 12 learners. This set of criteria was split into three categories: the presence of EE in a subject, the content of EE in a subject and the implementation methods of EE in a subject (Table 3, in chapter 3). The subjects were scored based on the number of criteria achieved under each category.

The scores for each of the three categories were calculated for each subject (Table 6) and the scores each subject that incorporated EE received for each of the criteria can be viewed in appendix 3. In terms of EE inclusion, six of the selected subjects (LO, life sciences, geography, economics, business, and tourism) had a strand dedicated to EE and incorporated EE across a range of topics. IT and CAT had a strand dedicated to EE but did not integrate EE with any other strands. Mathematics literacy and consumer studies incorporated EE across a range of strands rather than having a dedicated EE strand. The mathematics literacy syllabus did this through the inclusion of weather predictions, social issues, risk assessments and consumption rates in data handling, problem solving, measurement and graph assessment exercises. Consumer studies incorporated EE across strands by having overall aims of encouraging responsible consumerism and resource use and curbing global warming by educating learners about sustainable consumption patterns, responsible decision making, environmentally responsible housing, appliances and clothing, sustainable electricity and water consumption and environmental impacts of food related food issues. English, accounting, EGD and visual arts did not touch on any topics that related to EE. The English curriculum does provide an opportunity for EE as the reading materials provided for the learners could include themes that relate to sustainability.

Table 6: Percentage of criteria that each subject (grade 10-12) fulfilled in the three categories of inclusion of EE, EE content and implementation of EE.

Subject	***Inclusion of EE (%)***	***EE Content (%)***	***Implementation of EE/ procedure (%)***
Mathematics	25.0	13.9	16.7
Mathematics literacy	50.0	58.3	66.7
English	0.0	0.0	0.0
Life orientation (LO)	100.0	80.6	100.0
Life Science	100.0	67.1	100.0
Geography	100.0	91.7	75.0
Physical sciences	25.0	60.7	83.3
History	25.0	34.2	0.0
Economics	100.0	89.8	66.7
Business studies	100.0	77.3	66.7
Accounting	0.0	0.0	0.0

Subject	*Inclusion of EE (%)*	*EE Content (%)*	*Implementation of EE/ procedure (%)*
Computer applications technology (CAT)	50.0	59.8	58.3
Information technology (IT)	50.0	49.1	25.0
Engineering, graphics and design (EGD)	0.0	0.0	0.0
Visual arts	0.0	0.0	0.0
Consumer studies	50.0	46.3	41.7
Tourism	100.0	57.4	33.3

From the grade 10-12 subjects that included EE in some form, mathematics, history, IT and consumer studies met less than 50% of the content criteria. LO, geography, economics and business studies achieved more than 75% of the criteria for EE content. From the subjects that included EE in any form, mathematics, history, IT, consumer studies and tourism met less than 50% of the criteria for EE implementation. It was found that, although history included EE, the subject did not meet any of the criteria for implementation of EE, while LO and life science met all of the criteria for implementation of EE.

The total score for the EE included and implemented in each subject was calculated (Figure 3). The majority of subjects met over 50 % of the criteria. Of the subjects that included EE, mathematics, history, IT and consumers met the least number of criteria.

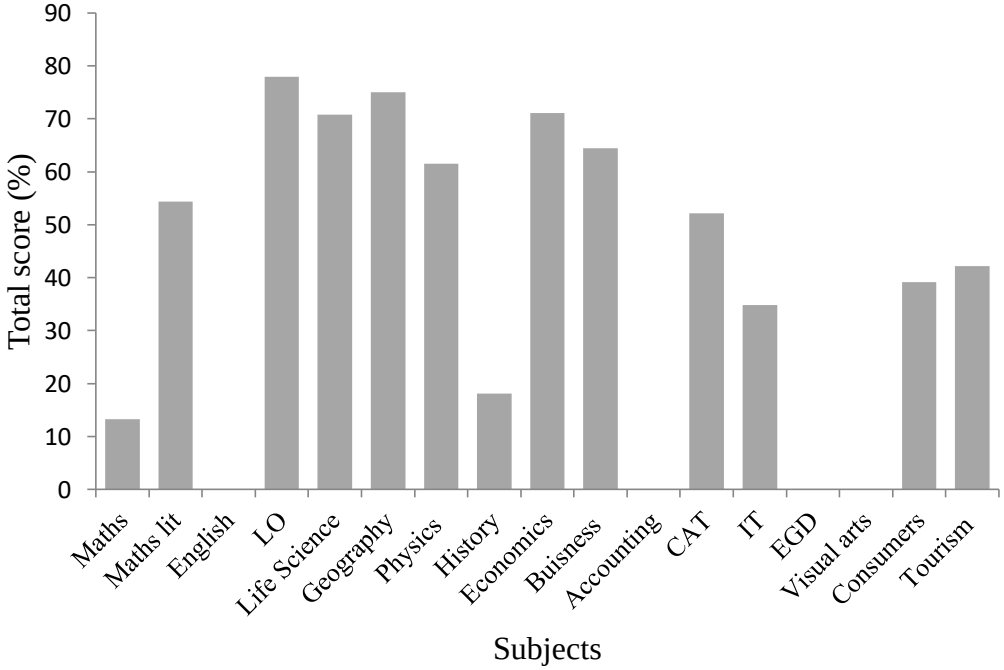


Figure 3: The average EE score (%) for each GDE grade 10-12 subject based on the three themes (inclusion of EE, EE content and implementation of EE)

Overall, the syllabus documentation does not make reference to allowing for learner feedback. Learner feedback would entail allowing the learner to have a platform to give their feedback regarding the teaching tools, relevance and content. This is necessary so that the educators may understand what is effective and what needs to be changed. This information is relevant to and needs to be considered when updating the syllabus. From the thirteen subjects that include EE, an analysis of the EE content included in the overall syllabus was assessed based on the content criteria (Figure 4). It was seen that the schooling curriculum met many of the content criteria but fell short in terms of including environmental legislation and encouraging educators to include current affairs or environmental developments. In terms of holistic coverage of environmental issues, the syllabus of many subjects addressed environmental issues in an economic, social and/or environmental context and 8 of the subjects specifically referenced sustainability but few made reference to the role that technology plays and the inclusion of the environment in development. The majority of the syllabuses mentioned specific environmental examples, most being in a South African context, but few mentioned examples that occur over different temporal scales. While the subjects met many of the criteria for environmental issue analysis, few of the subjects' syllabuses addressed the overall complexity of environmental issues.

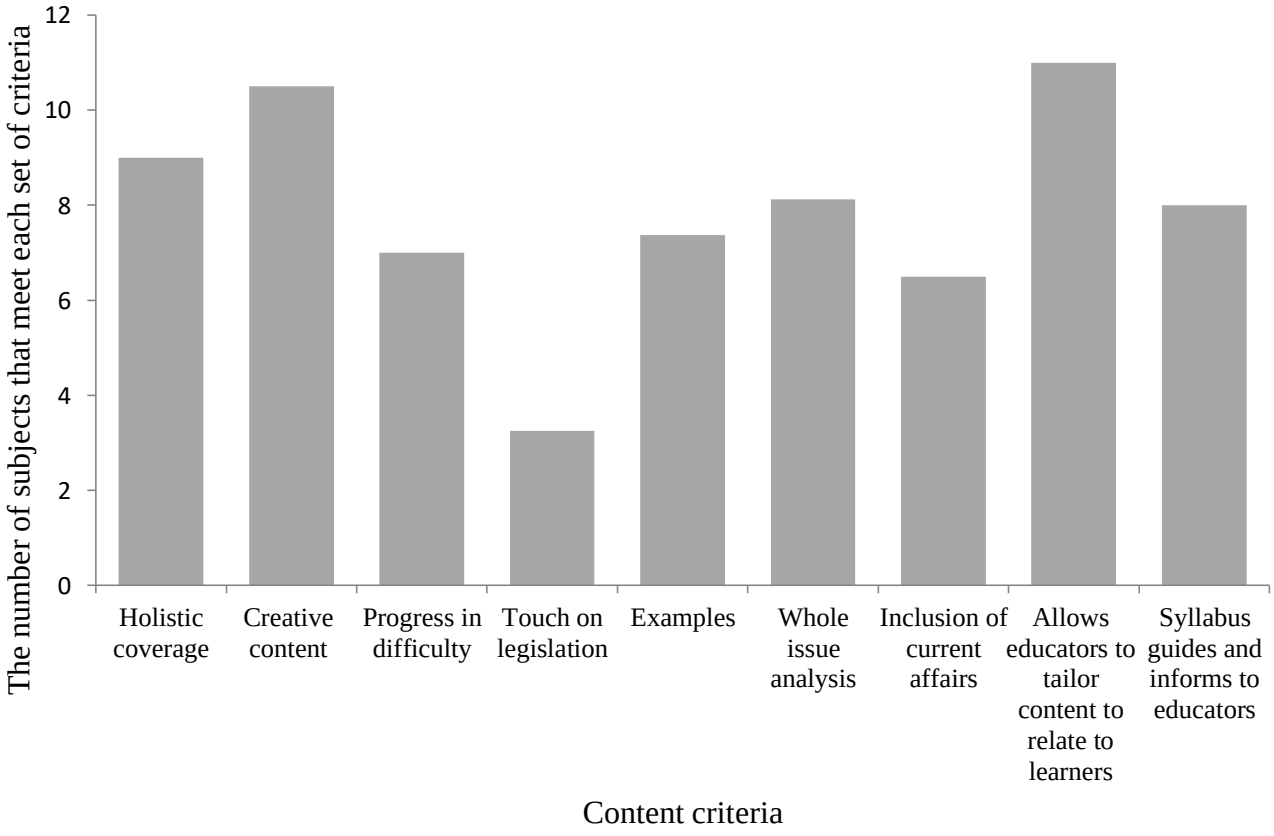


Figure 4: The number of GDE grade10-12 subject syllabuses that met each of the nine content criteria

The implementation of EE in the overall syllabus was also evaluated according to the implementation criteria (Figure 5). While most of the subjects include EE in each grade and EE in most subjects places emphasis on promoting problem solving skills in learner, less than half of the syllabuses make references to a variety of methods, encourage action, enhance practical skills and promote critical thinking.

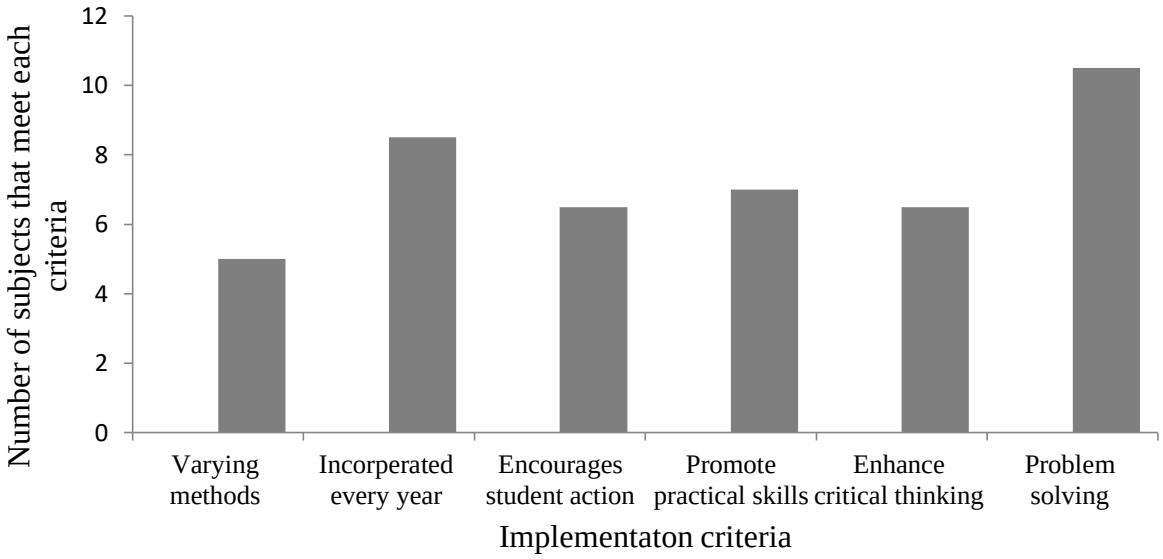


Figure 5: The number of grade 10-12 subject syllabuses that met each of the six implementation criteria.

5.3. Teacher interview analysis

This study took place in Gauteng, South Africa. The total sample selected to participate in the learner questionnaires and teacher interviews consisted of 11 schools: four IEB schools, four upper quintile GDE schools (referred to as the GDE-U school group) and three lower quintile GDE schools (referred to as the GDE-L school group). In order to maintain the anonymity of the participant schools the four IEB schools will be referred to as IEB1, IEB2, IEB3 and IEB4, the four GDE-U schools will be referred to as GDE-U1, GDE-U2, GDE-U3 and GDE-U4 and the three GDE-L schools will be referred to as GDE-L1, GDE-L2 and GDE-L3. At each school a teacher who was identified by the principal as a potential participant, and who volunteered to be interviewed is shown in Table 7. The selected teacher was chosen by the principal as the teacher who was most knowledgeable about the school's environmental education programme.

Table 7: The position held by the selected teacher(s) who were interviewed at each school.

School	***Position***
IEB1	Life orientation/ Religious education teacher
IEB2	Life orientation teacher and head of high school
IEB3	Head of the environmental programme/ English

School	*Position*
	teacher and Life Science teacher
IEB4	Life Science teacher
GDE-U1	Life Science teacher
GDE-U2	Life orientation teacher
GDE-U3	Life Science teacher
GDE-U4	Life Science teacher
GDE-L1	Life Science teacher
GDE-L2	Life Science teacher
GDE-L3	Physical sciences/ chemistry teacher

In-class EE

The in-class EE at each of the selected schools was assessed based on EE lesson planning, influencers of environmental topic selection (GDE/IEB, current affairs, personal drivers or learner push) and EE methods utilised by the educators. The EE lesson planning was assessed based on the six criteria (teacher acknowledgement of the importance of EE, teacher knowledge of environmental issues and current events, teacher creativity in lesson planning, teacher conducting extra research to prepare for lesson, teacher's effort to take a cross-disciplinary approach to EE and teacher's ability to relate EE to learner's home life). The total scores were calculated as percentages (Figure 6). From the interviews it was found that the educators from IEB2, GDE-U2 and GDE-1 fully achieved all six of the criteria. IEB1, IEB4, GDE-U1, GDE-U4 and GDE-L2 did not achieve half the criteria. GDE-U1 did not meet any of the criteria (only covering what the GDE required) and therefore scored the lowest, while GDE-U4 scored the second lowest. In the IEB school type, IEB4 scored the lowest, in the GDE-U school type GDE-U1 scored the lowest and in the GDE-L school type GDE-L2 scored the lowest. Over all the GDE-L school group had the highest score of 75% and the IEB school group had the second highest score of 62.5%, while the GDE-U school group had the lowest score of 47.9%.

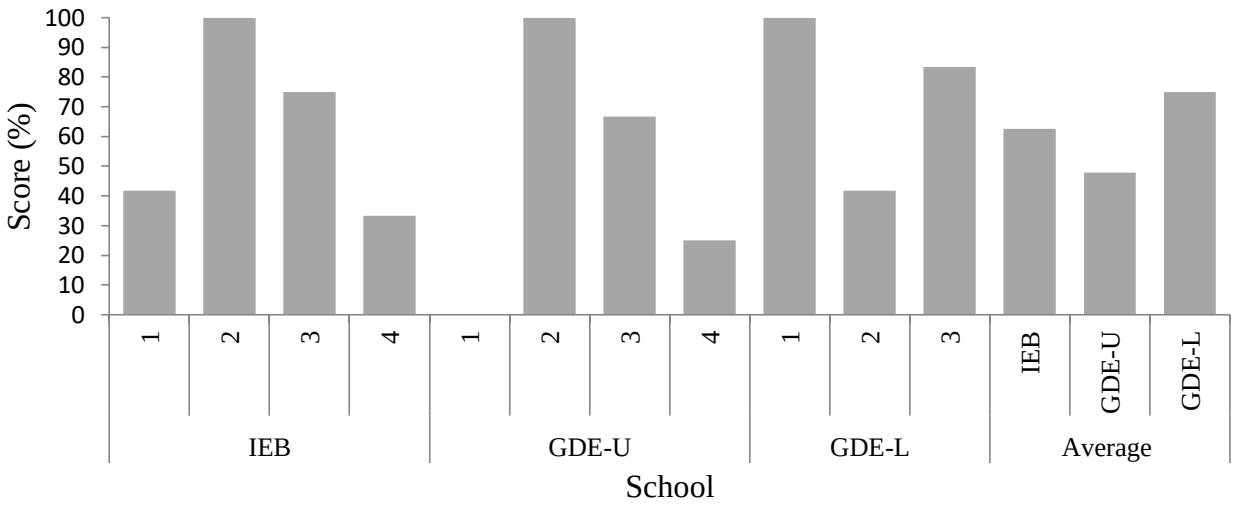


Figure 6: The average score assigned to each of the study schools and the average score for each school type based on the six criterial of EE lesson planning

The number of criteria that each school type achieved was assessed (Table 8). Almost all of the educators (excluding GDE-U1) who participated in this study stated that they related the lesson contents to the learners' home life. Teacher acknowledgement of the importance of EE, followed by teacher knowledge of environmental issues and current affairs, were the next two criteria achieved most frequently. Acknowledging the importance of EE entailed educators recognising that EE and the goals of EE to create environmentally literate and conscientious youths is of importance (not mentioning if anything is done to achieve this). Two educators (IEB4 and GDE-U1) did not acknowledge the importance of EE in the classroom, rather just viewing it as a section in the syllabus. The GDE-U1 educator further stated that,

"*as a teacher it would be my choice to participate in the Green Team (the school's environmental committee), but I don't, and this disinterest is shared by other teachers*".

Two educators acknowledged the importance of a small section of EE (IEB1 and GDE-U4). The educator from GDE-U4 rightfully stated that,

"*when covering population dynamics, it can be seen that the human population is increasing exponentially and with this comes an increase waste and the students need to understand this*".

but only acknowledged the importance of EE in terms of proper waste disposal and eliminating littering behaviour (focusing solely on anti-litter campaigns whenever asked about EE implementation). The educator from IEB1 spoke more about the importance of encouraging the learners' (already existing) environmental interests (which were created by "social media or their fellow learners") but both did not seem to acknowledge the importance of EE as a whole and were selective in which components of EE were important. All remaining; GDE-U and IEB educators, as well as all GDE-L educators acknowledged the importance of EE in the classroom. The GDE-L3 educators stated that,

"*even if the GDE were to remove environmental studies from the syllabus, we have to teach it and talk about it because learners need to be aware of environmental issues and the negative side of development*".

The educators' insights regarding current environmental affairs was assessed when asked about looking at the specific examples that educators selected to incorporate into their lessons with regards to the geographic and temporal scales of issues and the causes, complexity and solutions of environmental issues (looking at section 1, question 3 of the teacher interview; appendix 1). Here the educators often mentioned information that they had read about, watched videos on, seen on the news or have witnessed in their community. The educators from IEB4, GDE-U1 and GDE-U4 had very little knowledge regarding environmental affairs and therefore did not mention specific or current environmental issues but rather utilised more generalised examples. The educators from IEB1 and GDE-L2 had a basic level of knowledge regarding environmental affairs, the educator from IEB1 stated that the majority of their knowledge regarding environmental affairs comes from the learners and the videos that they recommend while the educator from GDE-L2 displayed little knowledge regarding environmental affairs outside of the community.

The two least achieved criteria were teacher creativity in lesson planning and teachers conducting extra research in preparation for lesson. To assess educator creativity in lesson planning, variation in EE methods and learning environments utilised by the educator were assessed (section A,

question 5 of the interview; appendix 1). The willingness of the educator to conduct extra research in order to prepare for lessons was also assessed. Over 50% of the participants stated that they attempt to take a cross-disciplinary approach to the environmental topics, issues and solutions they discuss in class.

Table 8: The percentage of schools from each school type and in the total sample group achieved the six criteria of in-class EE lesson planning.

	Educator acknowledgment of the importance of in-class EE	***Educator knowledge of current environmental issues based on their choice of environmental examples (section A question 3 of interview).***	***In-class EE relates to home life***	***Educator creativity in lesson planning (based on section A, question 5 of the teacher interview)***	***Educator tendency to conduct extra research prior to environmental lessons***	***Educator takes a cross disciplinary approach to EE (based on section A question 1 of the questionnaire)***
Total IEB	62.5%	62.5%	100.0%	50.0%	50.0%	50.0%
Total GDE-U	62.5%	50.0%	75.0%	25.0%	25.0%	50.0%
Total GDE-L	100.0%	83.3%	100.0%	50.0%	50.0%	66.7%
Total	75.0%	65.3%	91.7%	41.7%	41.7%	55.6%

The influencers of environmental topic selection were assessed for each school. Not all schools mentioned influencers apart from the GDE/ IEB; the educator from GDE-U1 stated that the CAPS syllabus is extensive enough and there is no need to select further topics. In the IEB school type, current affairs and learner relatability were the greatest influencers of topic selection. The IEB educators from IEB2 and IEB3 stated that learner relatability played a large role in their topic selection processes as the learner are disconnected from real word issues and find it difficult to relate to the effects of climate change that they have not personally felt or seen. In the GDE-U school type, current affairs and teacher's personal choice were the greatest influencers. In the GDE-L school type, all GDE-L educators stated that learner relatability was highly influential in their choice of topics as learners have limited access or knowledge regarding global events but they do experience climate change impacts and pollution in their communities.

Finally, the in-class EE methods were analysed and the number of EE methods utilised by each school was recorded (Figure 7). GDE-U4, GDE-U1 and IEB4 utilised the least number of in-class EE methods. IEB1, GDE-U2 and GDE-U3 utilised the highest number of in-class EE methods. While there is much variation in the number of in-class EE methods utilised the IEB and GDE-U school types, all three GDE-L schools utilised a similarly number of EE methods and therefore the

GDE-L school type utilised the highest average number of EE methods, followed by the IEB school type.

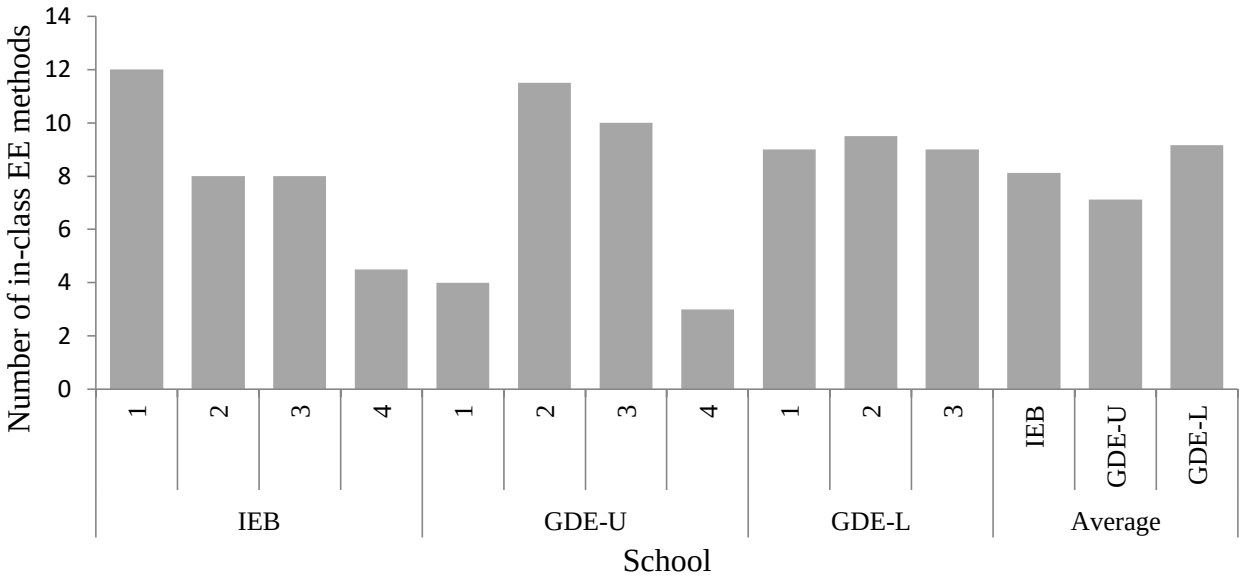


Figure 7: The number of in-class EE methods utilised by each school in this study and the average number of methods utilised by each school type

In terms of EE methods utilised by each school type, the educators at IEB schools mentioned a total of 14 methods that they utilise during their EE lessons. Three of the four IEB educators mentioned that they utilise videos, pictures/posters, group work activities, class discussions, learner presentations and learner driven education as methods of environmental education. IEB1 stated that they utilised social media as an environmental education method in which the learners had to create environmental campaigns. The educator from IEB4 stated that, although they have attempted to utilise outdoor education as an EE method, the older learners are often uninterested outside the classroom. Three of the four IEB educators stated that learner presentations, group work activities and learner driven education are vital parts of their lesson plan as learners interact better and in greater depth with the topics, and it also allows the learners to associate a memorable experience with the topic at hand. During the GDE-U educator interviews, the educators mentioned a total of 14 methods that they utilise in their EE lessons. Three of the four GDE-U schools mentioned that they utilise videos and pictures/posters, practical work. The educators from GDE-U1 and GDE-U4 did not utilise the methods of group work activities, class discussions, class debates or learner driven education as they stated that their learners are unable to stick to the topic and tend to be too disruptive when interacting with one another. This response is unsurprising when considering the class size at the GDE compared to the IEB schools. The GDE-L educators interviewed mentioned a total of 10 methods that they utilised in their EE lessons. Two out of three GDE-L educators mentioned utilising videos, pictures/ posters, excursions, outdoor education, group work activities, class debates, class discussions, learner presentations, learner self-research and learner driven

education. The educator from GDE-L3 stated that the school minimised on cost and time by taking learners on excursions to local areas such as the local paper plant.

Extracurricular EE

The extracurricular EE methods utilised at each school were analysed (Figure 8). IEB3 utilised the highest number of extracurricular EE methods, followed by GDE-U2. As with the in-class EE methods, the GDE-L schools listed a consistent number of extracurricular methods. The IEB school group listed the highest average number of extracurricular EE methods, while the GDE-L school group only listed a marginally high number of extracurricular methods than the GDE-U school type.

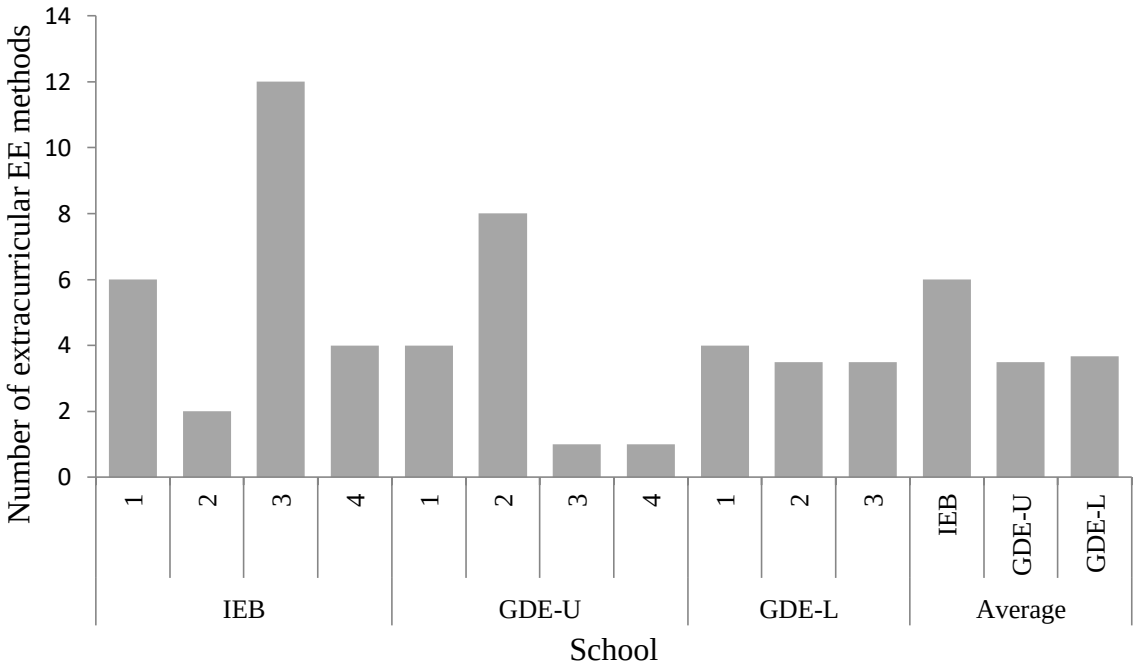


Figure 8: The number of extracurricular EE methods utilised by each school in this study and the average number of methods utilised by each school type

The most commonly used extracurricular EE methods (which were mentioned by more than five of the participant schools) included learner environmental committees, presence of recycling bins, recycling drives, anti-litter campaigns and the presence of a vegetable or flower garden. A learner environmental committee, recycling bins, recycling drives, the eco-bricks programme, anti-litter campaigns and the presence of a vegetable or flower garden were methods that were utilised across all three school types.

The IEB schools utilised 15 extracurricular EE methods. Three of the four IEB schools utilised a learner environmental committee, recycling bins and recycling drives. IEB3 worked closely with the Owl Rescue Centre and encouraged learners to collect used plastics to create owl houses which were located around the school and placed rat traps around the school to collect rats for the owls.

Once a month the learners would be allowed to accompany the organising educator to deliver the plastics to the Owl Rescue Centre and assist the centre. Both IEB3 and IEB4 held school wide recycling competition. The school tuck shop at IEB1 no longer gave plastic straws or packaging to the learners. IEB1and IEB4 also encouraged learners to take part in environmental marches and demonstrations. IEB conducted a school-wide litter removal on Mandela Day. IEB1 instructed the educators to upload textbooks and notes online and instruct the learners to take noted and submit work on their I-Pads and laptops to decrease paper usage (the school is trying to move back to hard-copies because the educators found that the I-Pads were too disruptive and distracting).

The GDE-U schools utilised 10 extracurricular EE methods. All four GDE-U schools utilised an anti-litter campaign. GDE-U2 utilised the most extracurricular methods compared to the other GDE-U schools and these included having a learner environmental committee, recycling bins, rain harvesting for the school's swimming pool, an anti-litter campaign, a vegetable garden that learners work in and a monthly school trip to a nearby animal shelter to volunteer learner. GDE-U1 also had a learner environmental committee, held recycling drives and anti-litter campaigns, and also encouraged learners to create eco-bricks. The educators at GDE-U 2 encouraged learners to submit their work digitally in order to cut down on paper usage. The learners at GDE-U3 were supplied with I-pads, which educators said decreased the school's paper usage, but these were taken back and reassigned to a lower quintile school.

The GDE-L schools utilised 8 extracurricular methods. All three GDE-L schools utilised anti-litter campaigns and two of the three GDE-L schools had a garden present at the school.

EE attraction

In the teacher interviews the motivation behind including EE practices in the classroom, extracurricular activities and general school activities were analysed. The motivations mentioned by the IEB (Figure 9a), GDE-U (Figure 9b) and GDE-L (Figure 9c) educators were separated into three themes: push for EE, desired outcome of EE and effective EE methods. Under the theme of "push": teacher push, school push and learners push for EE were examined. The teacher push sub-theme was further broken down into three minor-themes: teacher push due to personal reasons, school characteristics and curriculum opportunity. Under the theme of "desired outcome of EE" the potential learner outcome and community outcome of EE (according to the educator and school) were evaluated. The final attraction theme of "effective methods" looked at the EE methods that the teachers mentioned that they have utilised and found to be beneficial and useful to their lessons. Each of the schools and school types had varying opinions that were classified under one of the subthemes.

It was found that the, while the IEB and GDE-U educators felt that their school's management pushed educators to implement EE, none of the GDE-L educators mentioned that their schools pushed them to implement EE. The educator push to implement EE decreased across the three school groups, from the IEB (which reported the most reasons for implementing EE that related to educator push) to the GDE-L schools (who reported the least). This being said, the implementation of EE due to desired learner outcomes increased across the three school groups from IEB to GDE-L.

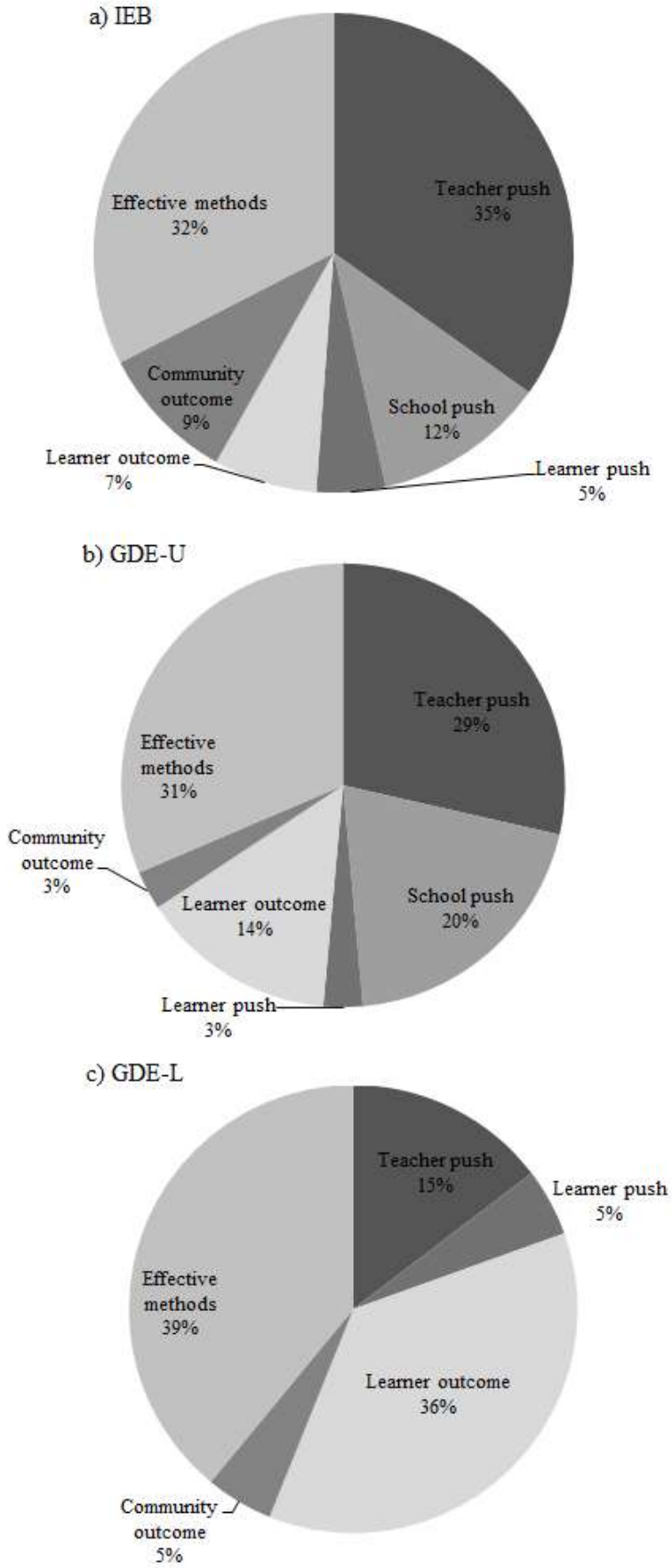


Figure 9a, b and c: The components that make up the motivation behind the IEB, GDE-U and GDE-L school types incorporating EE and EE practices

IEB school type

The specific factors that attracted IEB educators to implementing EE are displayed in Table 9. The motivation to include EE and EE practices in the IEB school type were analysed (Figure 9a) and it was found that push for EE was the biggest motivation (51.2%) in IEB schools, with teacher push responsible for 68.2% of this. The educator at IEB2 stated that

"*an important motivation is the drive to see the world change for the better and getting the learners involved in that particular change and us as educators adjust in order to give them (the learners) the platform to allow them to know what they need to do to make the world better for future generations*".

This sentiment was shared by the educators from IEB4 and IEB3. In terms of teacher push due to curriculum opportunity, the idea of a holistic and "hidden" curriculum was mentioned by both two of the schools. Regarding the "hidden" curriculum and the need for the curriculum to be updated, the IEB2 educators stated that

"*we (the educators) need to think how we can change our approach to make it (education) more relevant*".

School push and learner push accounted for 22.7% and 9.1% of the total push to include EE methods. Only IEB1 incorporated EE because of learners displaying a passion for the environment and due to learners enjoying and requesting lessons regarding the environment.

Desired outcome contributed 16.3% of IEB motivation, learner outcome accounted for 42.9% of this and community outcome accounted for 57.1%.With regards to desired community outcomes, the IEB schools did state that they incorporated EE because of the large scale effect that it could have of the greater community that the school and learners belong to and because EE is vital for future survival. The educator from IEB3 stated that EE is important so that learners understand that

"*it is not about me, myself and I and what makes me happy but about what the individual can do to make everything better and make a difference for the better*".

The educators from IEB2 stated that

"*every step you take on a daily basis has an impact on the future and will have a larger effect as the learners will take what they have learnt ad guide their ten family members, who will intern guide others, and this creates a bigger impact*".

The effectiveness of EE methods accounted for 32.6% of the motivation of the IEB school type. More than one of the four schools stated that constant reminding and competitions (both IEB3 and IEB4 held recycling competitions across the grades and sports houses) are effective.

Table 9: The factors (push, desired outcomes, and effective EE methods) that attract IEB educators to EE implementation.

Attraction			*IEB1*	*IEB2*	*IEB3*	*IEB4*
Push	Teacher push	Personal reasons		• Educator's moral duty • Educator's passion	• Religion • Humans are a part of a larger system, have to work together	• Educator's moral duty
		School opportunity	• Learners respond well to EE lessons	• Have support of the IEB • Have the support of the school • Small class size •	• Small class size	
		Curriculum opportunity		• Address the "hidden" curriculum • To update the curriculum	• Educators feel that their subjects provide an opportunity for EE implementation	• Educators feel that their subjects provide an opportunity for EE • Address the "hidden" curriculum
	School push		• Want to reduce waste	• School's passion • Have sufficient resources • Push from IEB		• Reduce waste
	Learner push		• Learners enjoy EE lessons Learners are passionate			

Attraction		*IEB1*	*IEB2*	*IEB3*	*IEB4*
Desired outcome	Desired outcome for learner		• Additional skills and awareness • Learner empowerment • Creating well rounded learners		
	Desired outcome for community		• Large scale effect of sustainable behaviours	• Large scale effect of sustainable behaviours • Important for community perseverance to the effects of climate change	• Important for community perseverance to the effects of climate change
Effective/ favoured methods		• Visual aids • New technologies	• Outdoor education • Group work • Presentations • Practicals • Learner driven lessons • Problem solving	• School competitions • Vegetable garden • Extra-curricular EE • Constant reminding	• School competitions

GDE-U school type

The motivations behind GDE-U schools utilising EE practices were analysed (Figure 9b). The specific attractions to the implementation of EE are displayed in Table 10. In the GDE-U school type push from the teachers, schools and learners accounted for 51.4% of the GDE-U motivation and teacher push made the largest contribution of 55.6% of the total push for EE. The educator interviewed from GDE-U2 stated that they understood the importance of EE in all subjects because of their background in science and economics and also stated that EE is prominent, as they "*want there to be a legacy and an environment to enjoy later*". School push and learner push made a contribution of 38.9% and 5.6% to the total push in GDE-U schools for EE. In terms of teacher push due to school characteristics, only the life orientation educator from GDE-U2 stated their subject was an effective platform for EE. Only learners from GDE-U3 pushed for EE practices at their school because the learners at this school personally felt the effects of climate change in their home lives because of many of the learners living in township areas.

Desired learner outcome accounted for 83.3% of educator motivations to implement EE that related to a desired outcome. In terms of community desired outcome, the educator from GDE-U2 stated that their school consists of "*1 300 learners and their impacts would be tremendous, EE would lead to a tremendous positive impact*". The effectiveness of EE methods accounted for 31.4% of the GDE-U schools motivation to utilise EE practices and all four GDE-U schools stated that learners respond well to visual aids.

Table 10: The factors (push, desired outcomes, and effective EE methods) that attract GDE-U educators to EE implementation.

Attraction			***GDE-U1***	***GDE-U2***	***GDE-U3***	***GDE-U4***
Push	Teacher push	Personal reasons		• Educator's moral duty • lessons • Educator's education	• Educator's moral duty • Educator's passion	• Educator's moral duty
		School opportunity		• Learners respond well to EE		• Learners respond well to EE lessons
		Curriculum opportunity		• Educators feel that their subjects provide an opportunity for EE implement-ation • Address the "hidden" curriculum • To update the curriculum		
	School push		• Reduces litter • GDE requirements	• School's passion	• GDE requirements • Avenue to make money	• Reduces litter • Avenue for to make money

Attraction		*GDE-U1*	*GDE-U2*	*GDE-U3*	*GDE-U4*
	Learner push			• Learners personally feel the effects of climate change	
Desired outcome	Desired outcome for learner		• Additional skills • Increase awareness • To eliminate miscon-ceptions and knowledge gaps	• Learner empower-ment	• Increase awareness
	Desired outcome for community			• Important for community perseveranc e to the effects of climate change	
Effective/ favoured methods		• Visual aids	• Debates • Fieldtrips • Learner driven lessons • Visual aids • Problem solving activities	• Debate • Visual aids •	• Outdoor education • Visual aids • Constant reminding

GDE-L school type

The motivations of GDE-L schools to incorporate EE practices were analysed (Figure 9c). The factors that attract GDE-L educators to implementing EE are tabulated below (Table 11). 41.5% of the GDE-L schools' motivation to make use of EE practices was due to wanting to create a specific outcome, more specifically to create a positive learner outcome. The educators from GDE-L1 and GDE-L3 made particular reference to wanting to expose the learners to more creative career opportunities (such as conservation/ environmental occupations) so that learners would have a greater chance of finding employment. The educator from GDE-L3 said that EE was important to create critical thinkers by showing learners that "*everything has its disadvantages no matter how many advantages it may have and how convenient it may be*". The educator from GDE-L2 felt that

EE to create "*knowledge, skills and a good attitude*" was important as "*knowing about something makes it possible to care for and sustain that somethings and make responsible decisions*".

Push for EE accounted for 19.5% of GDE-L schools' motivation and 75.0% of this is teacher push to include EE practices. GDE-L educators did not push to include EE practices because of a need to improve the curriculum. Learner push made up 25.0% of the GDE-L schools' push to utilise EE practices due to educators from GDE-L1 and GDE-L3 reporting that learners in their schools feel the effects of climate change more closely because of growing up in an underprivileged township area. The educators from these two schools mentioned specific examples in which learners experience and are impacted by pollution, diseases, lack of resources and climate change. The GDE-L3 educators stated that,

"*the problems that we face in this areas, and source of environmental destruction that we see, is the blockage of the sewerage system that cause leakages and the municipality takes a long time to come to fix them. We see small kids playing in this dirty water, which creates more health problems, and a bigger problem.*"

The educator from GDE-L2 also stated that,

"*a vegetable garden is needed not only to teach children how to grow and harvest their own food but most importantly, in this case, to provide them with food as many of our children do not have enough food at home which impacts their ability to*".

Effectiveness of EE methods accounted for 39.02% of the total motivation behind GDE-L schools incorporating EE methods and practices. At least two of the three GDE-L educators stated that the learners respond well to outdoor education, learner presentations, practical lessons, learner-driven lessons and lessons in which the teacher utilises the smart board (provided by the GDE). The educator from GDE-L3 stated that utilising outdoor education or practical methods of EE is effective as

"*most of the teaching is done in class were we (the educators) give the learners information but when you take them outside the can actually see what you were talking about and this leads to them remembering better, the same can be said for presentations*".

Table 11: The factors (push, desired outcomes, and effective EE methods) that attract GDE-L educators to EE implementation.

Attraction			***GDE-L1***	***GDE-L2***	***GDE-L3***
Push	Teacher push	Personal reasons	• Educator's moral duty	• Humans are a part of a larger system, have to work together	• Educator's moral duty • Humans are a part of a larger system, have to work together
		School opportunity		• Learners respond well to EE lessons	• Learners respond well to EE lessons

Attraction		***GDE-L1***	***GDE-L2***	***GDE-L3***
	Curriculum opportunity			
	School push			
	Learner push	• Feel the effects of climate change		• Feel the effects of climate change
Desired outcome	Desired outcome for learner	• Enhance awareness • eliminate misconceptions and knowledge gaps • promote pro-environmental attitudes • learner empowerment entrepreneurship	• additional skills • Enhance awareness • eliminate misconceptions and knowledge gaps • promote pro-environmental attitudes • knowledge for action • entrepreneurship • vegetable garden as a source of food	• Enhance awareness • additional skills • eliminate misconceptions and knowledge gaps
	Desired outcome for community	• Important for community perseverance to the effects of climate change	• Upliftment and resilience of community	
Effective/ favoured methods		• Learner presentations • Learner driven lessons • Visual aids • New technology	• Outdoor education • Group work activities • Debates • Practicals • Learner-driven lessons • Problem solving activities • New technology • Vegetable garden	• New technology • Practicals • Learner presentations • Outdoor education

Comparison between Schools

The spread of motivations listed by each school from each of the three school types were analysed (Figure 10). Within each school type IEB2, GDE-U2 and GDE-L2 educators listed the most motivations for including EE and EE practices while IEB1, GDE-U1 and GDE-L3 educators listed the least. IEB2 educator listed the highest overall motivations for implementing EE while the GDE-U1 educator listed the least. Even though GDE-L2 listed the second highest number of motivations, the GDE-L schools uniformly listed more motivations to implement EE practices than the two other school types and IEB2 and GDE-U2 were the only school to list more motivations than any school in the GDE-L school type.

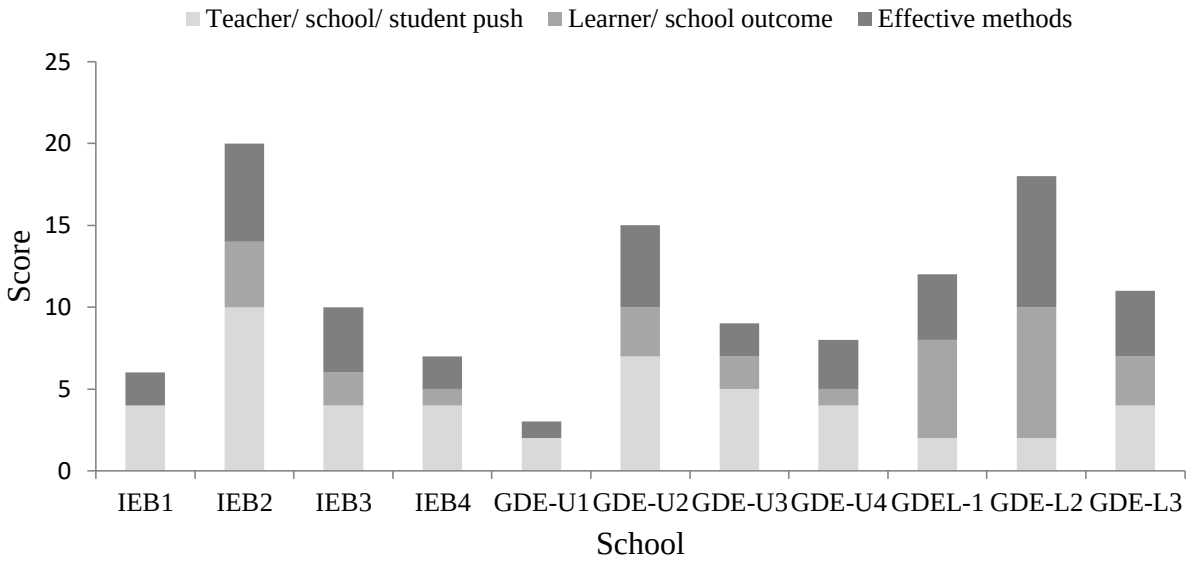


Figure 10: The number of drivers to implement EE practices and the division of the drivers between the three motivation themes mentioned by educators from each of the selected schools

EE detraction

The educators interviewed in this study also discussed various reasons that deterred them from EE practices and implementation. The overall responses from the IEB (Figure 11a), GDE-U (Figure 11b) and GDE-L (Figure 11c) educators fell into two categories: barriers to the implementation and administration of EE practices and barriers to achieving the objectives of EE. The sub-themes under the theme of barriers to the implementation of EE included issues with methods, issues with lesson planning and content, issues with resources, issues with support, time constraints and class size. The theme of barriers to achieving the objectives of EE was broken down into three objectives of EE being barriers to promoting environmental knowledge, barriers to promoting pro-environmental attitudes and barriers to promoting sustainable behaviour.

It was found that from upper class schools (IEB) to middle class schools (GDE-U) to lower class schools (GDE-L) the educators progressively report more barriers to implementation of EE and less barrier to positive outcomes of EE. 48.2%, 39.6%, and 19.4% of the barriers mentioned by the IEB, GDE-U and GDE-L educators (respectively) were barriers to positive learner outcomes while

51.8%, 60.4% and 80.7% of the barriers mentioned by the IEB, GDE-U and GDE-L educators (respectively) were barriers to implementation of EE. In terms of barriers to positive outcomes it was found that the IEB and GDE-U educator listed more barriers to creating pro-environmental attitudes while the GDE-L educators listed more barriers to enhancing learner environmental knowledge. In terms of barriers to implementation of EE, lack of resources was more frequently reported by the GDE-U and (more so) the GDE-L educators while lack of support was more frequently mentioned by IEB educators. All educators mentioned time constraints, lack of support and issues with EE methods but only the GDE educators mentioned having a large class size.

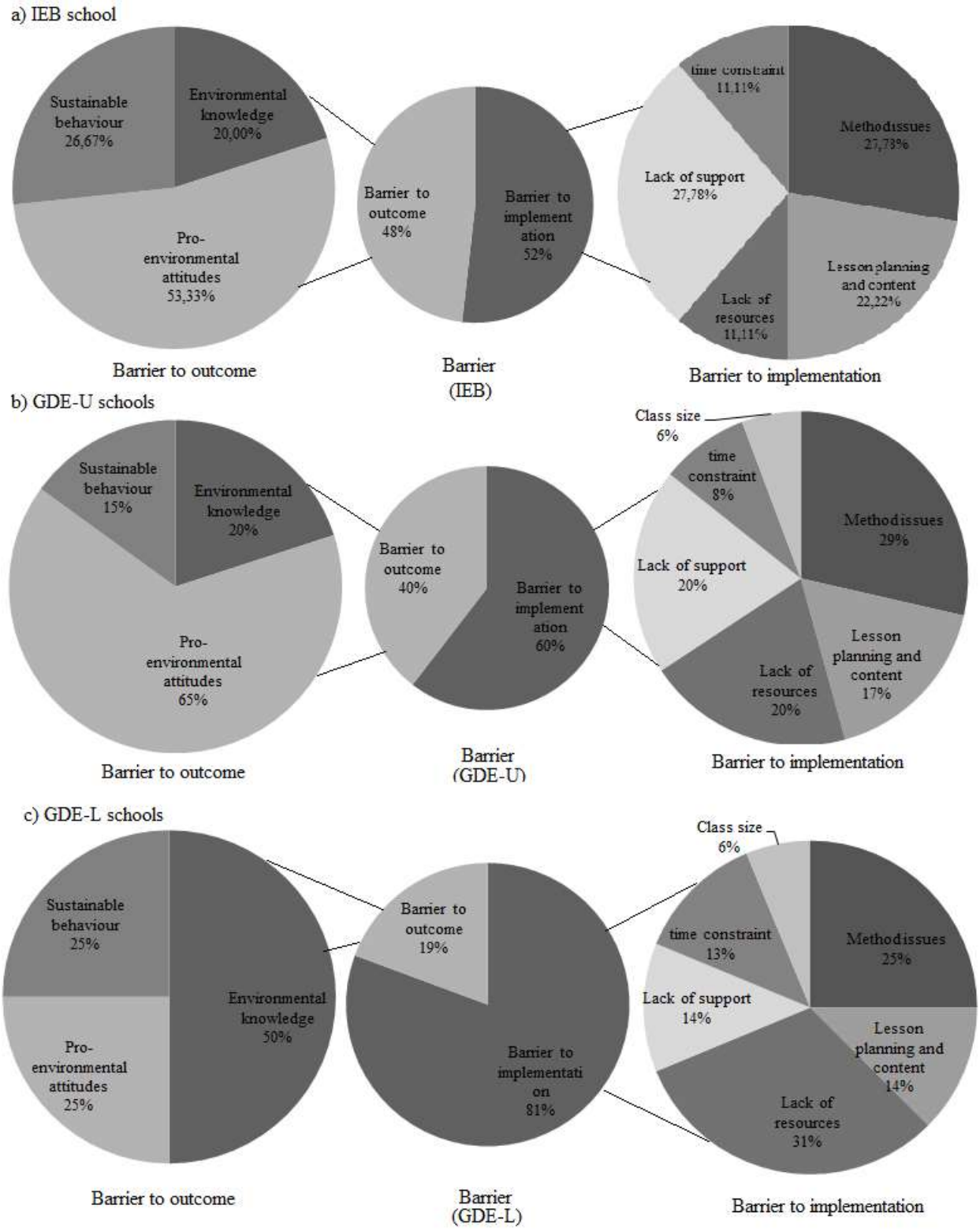


Figure 11a, b and c: The barriers mentioned by the IEB, GDE-U and GDE-L school types that related to either the implementation of EE or to creating a successful learner EE outcome

IEB school type

The barriers to implementation and positive learner outcome of EE in IEB schools were assessed (Table 12). With regards to barriers to implementation of EE 27.8% of these barriers fell under the subtheme of issues with methods. From the experience of the IEB educators; field trips are avoided due to legal issues and "red tape", the learners tend to be easily bored and distracted during outdoor education and learner-driven education is time consuming because the learners deviate from the topic. Some schools want to implement a recycling system but had problems creating a recycling programme. IEB1 stated that the school did not have a convenient system in place; their current system relied on the learners placing all recyclables in one bin and then the learners who were part of the environmental committee would separate the recyclables. This posed a health issue for the learners and also consumed time. IEB2 had recently recovered from a financial crisis and had not yet put a recycling system in place.

Issues with lesson plans and content accounted for 22.2% of the barriers to EE implementation. In terms of lesson content, the educators from IEB2 stated,

"*there's always a challenge in terms of making sure that it is relevant and getting on par with what the new trends are".*

The educators from IEB3 felt that collaboration and interdisciplinary EE is more "*sustainable if it were project driven rather than expected to be consistently incorporated across subjects*". 27.8% of the barriers to implementation pertained to a lack of support and this pertained to support from learners' homes and changes in school management which meant that their environmental programme was not given adequate support.IEB3 and IEB4 educators felt that the school year is too short to cover all the necessary topics, further incorporate EE across all subjects and topics and utilise creative methods such as outdoor education, field trips, group work activities and debates. None of the IEB educators mentioned their class size to be a barrier to EE as the IEB classes are relatively small (usually capped at 25 learners).

With regards to barriers to positive outcomes of EE, the sub-theme of barriers to promoting pro-environmental attitudes formed the largest portion (53.3%) of the barriers to achieving the objectives of EE. The educator from IEB4 stated that,

"*the learners who are passionate will participate but to others it seems like unnecessary effort in the end*".

The educators from IEB2 stated that a major challenge is the learners disconnect from environmental issues as

"*most of the things that concern environmental health and responsibility do not impact them (learners) at home, therefore they do not see it as much of an importance*".

The educators from IEB3 felt that EE would be more effective if the learners' parents encouraged and supported environmentally responsible behaviours at home because without this there is a disconnect between what the learners are taught in the school and what the learners implement it in their personal lives. Both the educators from IEB2 and IEB3 expressed that the incorporation of EE from a young age is important in order to create positive environmental attitudes in learners.

Table 12: Showing the barriers to EE implementation and barrier to positive learner outcome experienced by IEB educators.

Barriers	***IEB1***	***IEB2***	***IEB3***	***IEB4***
Educators experienced issues implementing EE in regards to:				
Issues with methods	• Learner driven lessons • Recycling	• Recycling	• Fieldtrip	• Outdoor education
Issues with lesson planning and content	• Lacking environmental knowledge and having to conduct extra research	• Lacking environmental knowledge and having to conduct extra research	• Planning cross-subject collaborations	• Planning cross-subject collaborations
Issues with resources	• Lack new technologies			• Lack of natural areas
Lack of support		• Lack support from learner homes • Changes to school management	• Changes to school management	• Home support • Co-ordination within school
Time constraints			• Time constraints	• Time constraints
Class size				
Educators reported barriers to positive learner outcomes of EE as learners:				
Knowledge		• lack general knowledge	• Lack general knowledge • lack independent skills	
Attitude		• are disconnected from environmental issues • lack interest in recycling	• Are disconnected from environmental issues • Are complacent • Are uninterested • Feel that EE is repetitive • Lack creativity in solutions	• Are uninterested

Barriers	***IEB1***	***IEB2***	***IEB3***	***IEB4***
Behaviour		• Display no permanent changes to behaviour	• Display no permanent changes to behaviour • Are not self-motivated	

GDE-U school type

The barriers to implementation and positive learner outcome of EE in GDE-U schools were assessed (Table 13). 28.6% of the barriers to implementation of EE mentioned by GDE-U educators related to issues with EE methods. Group work posed a problem because learners were disruptive and distracted during group work activities, The schools tend to discourage community service due to legal and safety issues and the school is cautious of allowing the learners to represent the school unsupervised. All GDE-U educators that participated in this study stated that they experienced issues with fieldtrips that pertained to learner misbehaviour, funding, legal obstacles, time constraints, scheduling conflicts and the extra effort of getting permission from all parties involved (including other teachers whose lessons the learners will miss and teachers who need to stand in for those supervising the fieldtrip). The GDE-U educators felt that while fieldtrips did offer many benefits, the challenges outweigh benefits. Learners were destructive and uninterested in the school vegetable garden and schools did not have the space or resources to build and sustain and garden. Educators also stated that their school had experienced issues getting recycling bins and having them picked up. The educators reported that large class sizes and time constraints further hindered the implementation of these methods and spread resources thin.

Challenges with lesson planning and content accounted for 17.1% of the barriers to EE implementation mentioned by the GDE-U educators. Educators from GDE-U2 also stated that they were deterred from EE because they do not have the answers to the questions that the learners inevitably ask regarding solutions to environmental challenges. Educators from GDE-U1 stated the environmental science section of the life science syllabus is scheduled at the end of the school year and this is problematic because the learners tend to lack the ability to concentrate and interact with the work as they would at the beginning of the school year. 20.0% of the barriers to implementing EE practices related to issue with resources. Funding was a common barrier and the educators stated that being a higher quintile school meant that the government allocated very little funding to them. Other issues with resources include lack of space to construct a vegetable garden, lack of recycling bins provided by the school and no access to new technologies to utilise in the classroom.

The barriers to promoting pro-environmental attitudes accounted for 65.0% barriers to positive outcomes. Subject choice proved to be a challenge as the GDE schools place subjects into categories and the learners select a subject from each category, therefore learners often take geography or life science without passion because they were not able to choose their preferred subject to fill a subject slot. Some educators also said that some learners chose to take life science and geography because they felt that it was easy. In terms of barriers to enhancing environmental knowledge educators from GDE-U3 stated that the learners lacked practical and independent skills to fully apply what they are taught as

"*the learners no longer are required memorise the textbook but rather are required to apply what they learnt into practical scenarios, but struggle to do so*".

The educator from GDE-U2 stated that because of the internet and cell phones their learners want "fast" knowledge and instant information which is not always understood, retained or applied.

Table 13: Showing the barriers to EE implementation and barrier to positive learner outcome experienced by GDE-U educators.

Barriers	***GDE-U1***	***GDE-U2***	***GDE-U3***	***GDE-U4***
Educators experienced issues implementing EE in regards to:				
Issues with methods	• Fieldtrips	• Fieldtrips • Recycling • Community service	• Fieldtrips • Group work • Vegetable garden	• Fieldtrips • Vegetable garden • Recycling
Issues with lesson planning and content	• Creatively planning lessons • EE is scheduled last in the syllabus	• Lacking environmental knowledge and having to conduct extra research • Having no actual solution to environmental issues • The syllabus being outdated	• Planning cross-subject collaborations	
Issues with resources	• lack of funding	• Lack of funding • No contact with nature	• No access to new technologies	• Lack of funding • Issues with recycling system • Lack space for a vegetable garden
Lack of support	• Teacher lacks passion for EE	• Teachers not supporting each other	• Lack of GDE support • Lack support from learner homes	• Lack support from learner homes • Lack of interest from school
Time constraints	• Lack time	• Lack of time	• Lack of time	
Class size		• Large class size		• Large class size

Barriers	***GDE-U1***	***GDE-U2***	***GDE-U3***	***GDE-U4***
Educators reported barriers to positive learner outcomes of EE as learners:				
Knowledge		• Have easy access to information, which they easily forget	• Lack general knowledge • Lack independent skills	• Lack general knowledge
Attitude	• Uninterested • Subject choice • Focus on merely passing	• Are disconnected from nature • Are uninterested	• Are disconnected from nature • Subject choice • Lack creativity in solutions • Are economically motivated • Are merely focused on passing the subject	• Subject choice • Lack creativity in solutions • Are merely focused on passing the subject
Behaviour				• Won't take action • Display no permanent changes to behaviour • Are not self-motivated

<u>GDE-L school type</u>

The specific barriers to GDE-L EE implementation and positive learner outcomes were assessed (Table 14). In terms of barriers to EE implementation, issues with methods accounted for 25.0% of the barrier to implementation of EE. The GDE-L educators mentioned that they experienced problems with regards to funding and organising fieldtrips and lacked space and staff to supervise to create a vegetable garden. 31.2% of the barriers to implementing EE related to a lack of resources. In terms of lesson planning and content the GDE-L1 educator stated that,

"*when you do teaching, you teach the students so that they can pass and based on what you are given. If you are passionate you go further but at the end of the day you have to teach the syllabus*".

The educator at GDE-L1 also stated that the lack of new technologies in their school posed a barrier to EE; this was in reference to the school's smart boards malfunctioning and the GDE delaying the repairs. Educators reported lack of support accounted for 12.5% of the issues GDE-L educators experienced with EE implementation. Like the IEB and GDE-U schools, the GDE-L educators stated that they felt that the school year is too short to cover all the necessary topics, further incorporate EE across all subjects and topics and utilise creative EE methods. Similar to the GDE-L

educators, the educators stated that the large class size deterred them from EE practices as it put strain on the school's already limited resources and did not allow for the learners to have the individual attention they needed.

Barriers to promoting environmental knowledge accounted for the largest proportion (50.0%) of the barriers GDE-L educators perceived to achieving objectives. The educators from GDE-L1 and GDE-L2 stated that a barrier to promoting environmental knowledge in learners is the learners' lack of knowledge regarding global environmental issues outside of their community. The educator from GDE-L2 stated that,

"*our learners take environmental issues very lightly as they do not understand the impact that something as small as a plastic wrapper could have on the environment*".

The teachers stated that this was due to the learners' lack of exposure to or lack of interest in global issues coming from closed communities and having immediate issues in their communities.

Table 14: Showing the barriers to EE implementation and barrier to positive learner outcome experienced by GDE-L educators.

Barriers	***GDE-L1***	***GDE-L2***	***GDE-L3***
Educators experienced issues implementing EE in regards to:			
Issues with methods	• Fieldtrips	• Vegetable garden	• Fieldtrips
Issues with lesson planning and content	• Lacking environmental knowledge and having to conduct extra research • Having to plan creative lessons		
Issues with resources	• Lack of funding • No access to new technologies • Lack resources to plan creative lessons		• Lack of funding • Lack resources to be creative
Lack of support	• Teachers/ learners not being supported by the school • Lack support from GDE		
Time constraints		• Time constraints	• Time constraints
Class size	• Large class size		
Educators reported barriers to positive learner outcomes of EE as learners:			
Knowledge	• Lack knowledge regarding global environmental happenings	• Lack knowledge regarding global environmental happenings	

Barriers	***GDE-L1***	***GDE-L2***	***GDE-L3***
Attitude		• Existing attitudes are difficult to alter	
Behaviour		• Existing behaviours/ habits are difficult to alter	

Schools

The numbers of total barriers mentioned by the educators from each school involved in this study, as well as the number of barriers that fall under the two themes, were analysed (Figure 12). In the IEB school type, the IEB4 educator listed the highest number of barriers to implementation of EE and educator from IEB3 listed the highest number of barriers to achieving the objectives of EE. Over all, the educator from IEB3 listed the highest number of barriers. In the GDE-U school type, GDE-U2 listed the highest number of barriers to implementing EE and GDE-U4 listed the highest number of barriers to achieving the objectives of EE. Overall the educator from GDE-U4 listed the highest number of barriers. In the GDE-L school type, GDE-L1 listed the highest number of barriers to the implementation of EE and the educator from GDE-L2 listed the highest number of barriers to achieving the objectives of EE. The educator at GDE-L1 listed the highest number of barriers. The educator at GDE-U2 listed the highest number of barriers to the implementation of EE practices and IEB3 listed the highest number of barriers to achieving the objectives of EE.

The GDE-U school group listed the highest number of overall barriers and highest number of barrier to achieving the objectives of EE. The GDE-L school group listed the highest number of barriers to implementation of EE practices. Across school types the GDE-L school type listed the least number of total barriers. This could be because of a low number of barriers to achieving the objectives of EE that GDE-L educators listed. The GDE-L educators listed much less barriers to achieving the objectives of EE than the other school types.

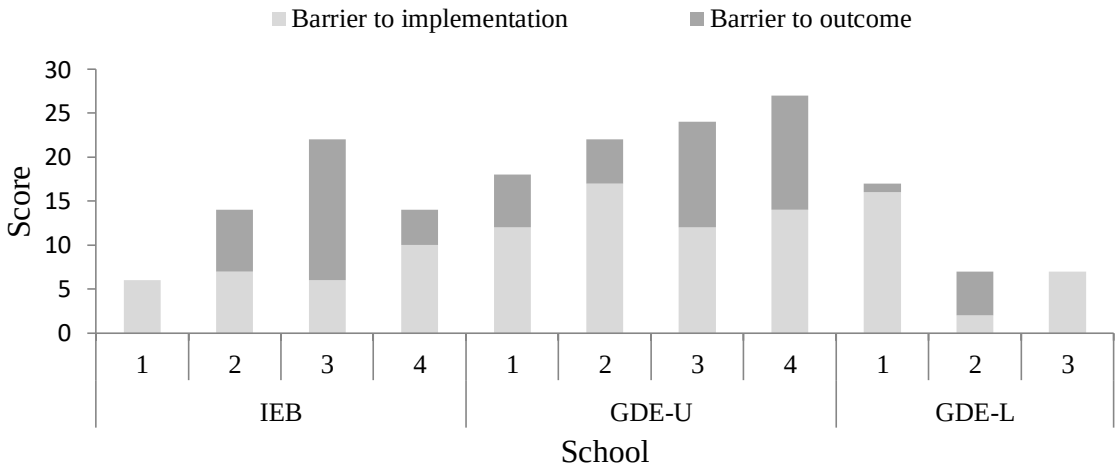


Figure 12: The number of barriers experienced, and the division of the barriers experienced by educators from each school (in terms of implementing EE practices) between the two themes of barriers to the implementation and administration of EE practices and barriers to achieving the objectives of EE.

5.4. Learner questionnaire analysis

The IEB sample consisted of 128 learners and contributed to 34% of the sample group and the GDE-L sample consisted of 220 learners and contributed to 58% of the sample size, while the GDE-U sample consisted of 32 learners and contributed the least to the overall sample size- 8% (Figure 13). The three GDE-L schools in this study contributed evenly to the GDE-L sample while the IEB and GDE-U schools contributed unevenly to their respective sample size.

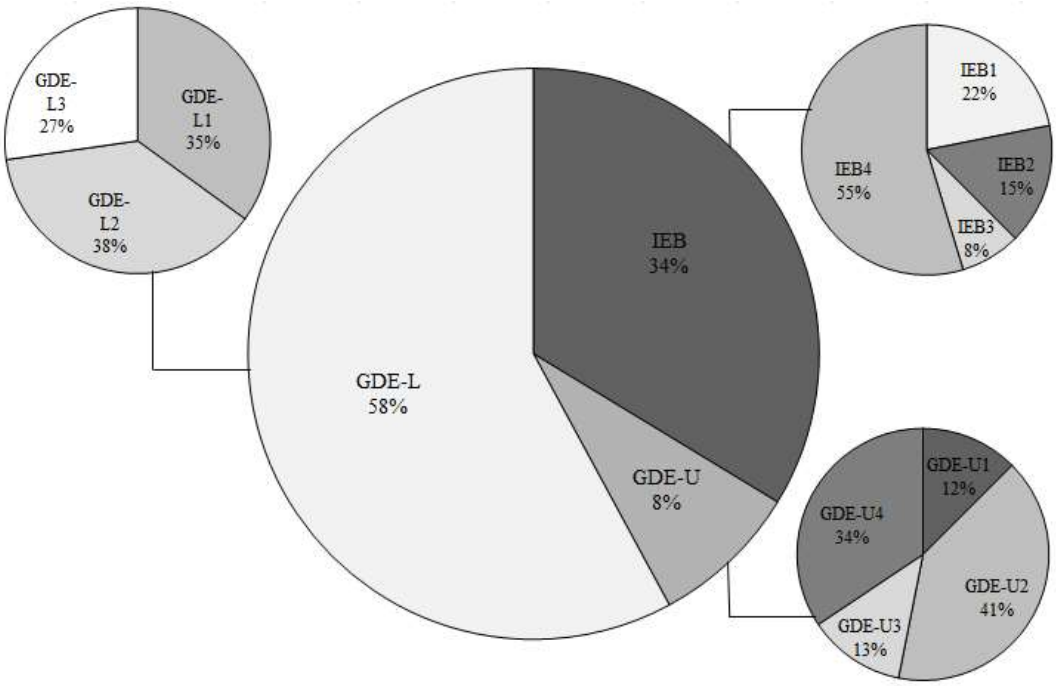


Figure 13: Break down of the total sample of learners participating in this study by school type and school .

Each of the selected schools made varying contributions to the total sample group (Figure 14). The contribution of each school depended on the number of grade 11 learners who were willing to participate in the study filling in the questionnaire. The GDE-U group made the lowest contribution to the sample group while the schools in the GDE-L group made the largest contribution.

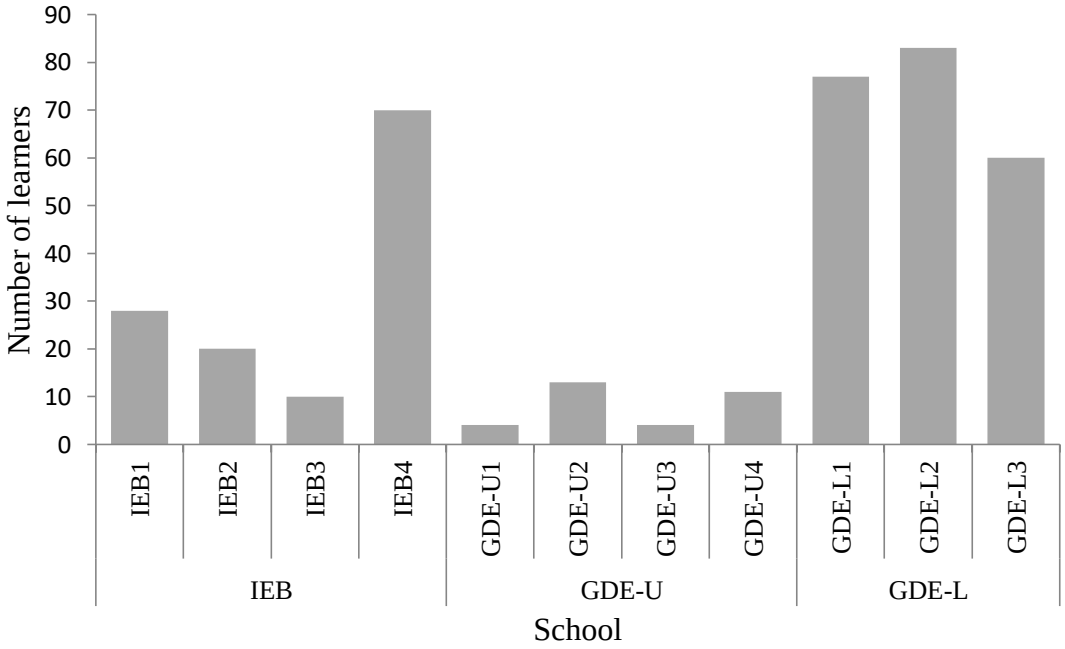


Figure 14: The number of learners from each of the 11 selected schools that participated in this study.

Over-all environmental literacy

Correlation

The correlation of the knowledge, attitude and behaviour scores for the total learner sample was evaluated. There was a positive correlation ($r>0$) between the knowledge, attitude and behaviour sections (Figure 15a, b and c). The correlation between knowledge and behaviour ($r=0.094$, $p= 0.067$) was weaker than that of behaviour to attitude ($r=0.206$, $p<0.001$) and knowledge to attitude ($r=0.183$, $p< 0.001$).

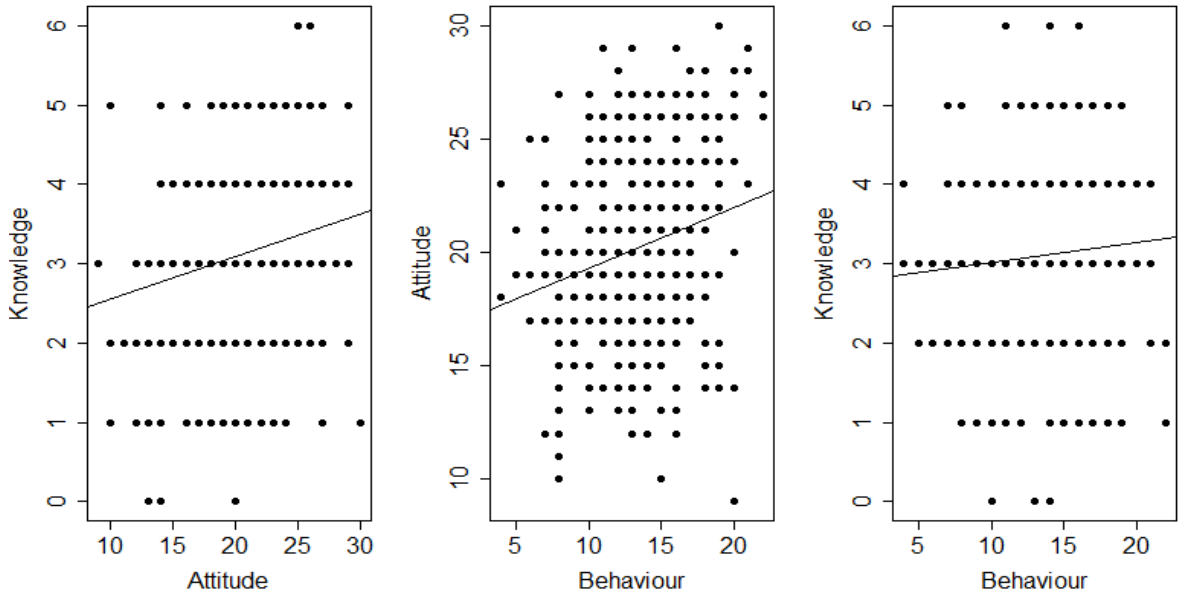


Figure 15a, b, and c: The correlation of learner answers for three questionnaire sections (knowledge, attitude and behaviour) for the total sample group.

The correlation between the knowledge, attitude and behaviour scores for each school type was analysed. The scores of the three sections were first analysed for the IEB school type (Figures 16a, b and c) and there was a positive correlation between the knowledge and attitude scores (r=0.127, p=0.154), a strong positive correlation between the attitude and behavour scores (r=0.384, p<0.001) but a negative correlation between the knowledge and behaviour scores (r< -0.001, p=0.995).

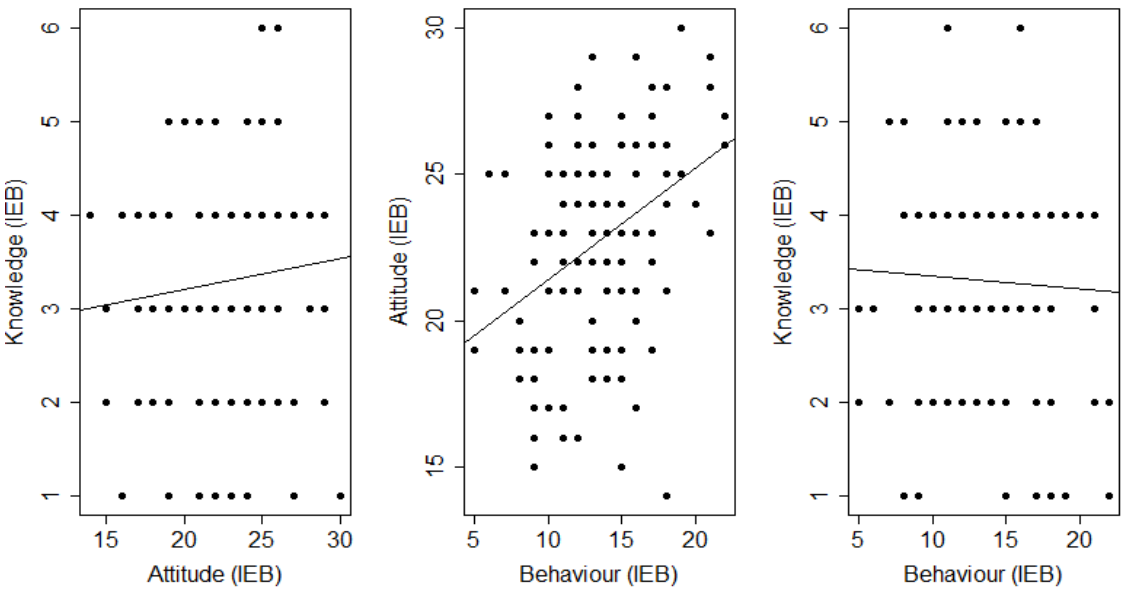


Figure 16a, b, and c: The correlation of learners' answers for the three questionnaire sections (knowledge, attitude and behaviour) for the IEB school type.

In the GDE-U schools there was a strong correlation between the scores of the three sections (Figure 17a, b and c). The knowledge and attitude scores (r= 0.569, p<0.001), the behaviour and attitude scores (r= 0.335, p= 0.061) and the behaviour and knowledge scores (r=0.396, p= 0.025) all were in agreement.

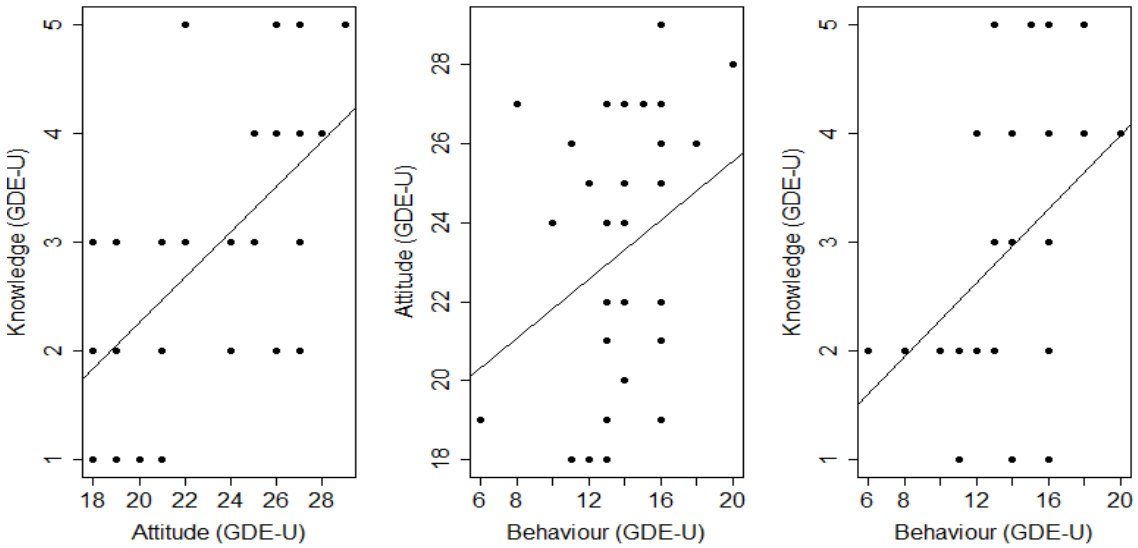


Figure 17a, b, and c: The correlation of learner's answers for the three questionnaire sections (knowledge, attitude and behaviour) for the GDE-U school type

The correlation between the GDE-U scores (Figure 18a, b and c) showed a positive relationship between the knowledge and attitude sections (r=0.119, p=0.078), behaviour and attitude sections (r=0.121, p=0.073) and behaviour and knowledge sections (r=0.111, p=0.100).

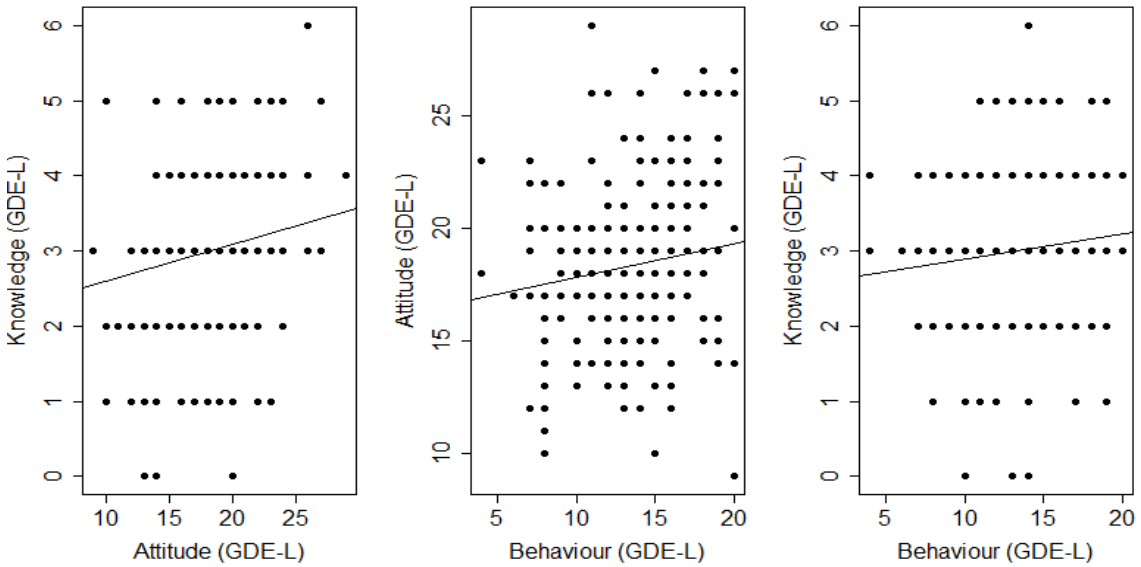


Figure 18a, b, and c: The correlation of learner's answers for the three questionnaire sections (knowledge, attitude and behaviour) for the GDE-L school type.

Question 2 (“human society has the right to alter the natural environment to fulfil their needs”) and 6 (“humans are the dominant species and are meant to rule over nature”) of the attitude section were related and showed a positive correlation (r=0.308, p<0.001) (Figure 19), while question 5 of the attitude section (“animals and plants have the same right as humans to exist and therefore should be able to co-exist”) and question 3 of the behaviour section (“if find a spider in my house, I kill it, leave it or take it outside.”) were related but display a weaker correlation (r=0.075, p=0.102) (Figure 20) for the total sample.

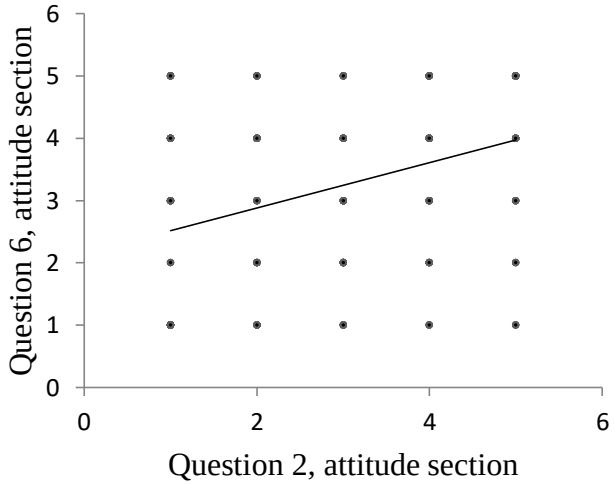


Figure 19: Correlation between scores from question 2 (“human society has the right to alter the natural environment to fulfil their needs”) and question 6 (“humans are the dominant species and are meant to rule over nature”) from the attitude section of the learner questionnaire.

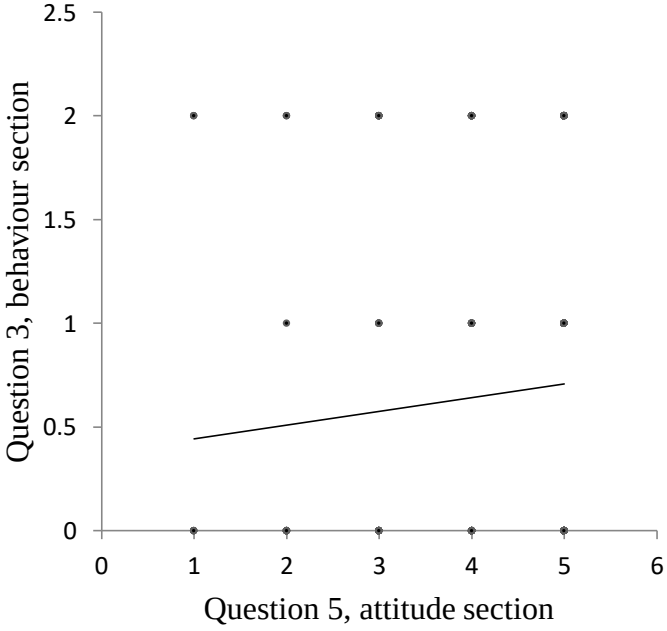


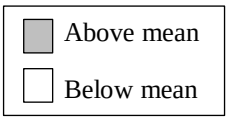
Figure 20: Correlation between scores from question 5 (“animals and plants have the same right as humans to exist and therefore should be able to co-exist”) of the attitude section and question 3 (“if find a spider in my house, I kill it, leave it or take it outside.”) of the behaviour section of the learner questionnaire.

Knowledge, attitude, and behaviour variation between schools

The mean score for each section (knowledge, attitude and behaviour) was calculated for each school (Table 15). Average knowledge, attitude and behaviour scores for IEB3 and GDE-U2 were all above the average score for each section across all schools, while the average scores for GDE-U4 and GDE-L3 were all below the mean score for each section.

Table 15: The mean knowledge, attitude, and behaviour scores for the learner questionnaire for each school.

School	***Knowledge***	***Attitude***	***Behaviour***
IEB1	3.357	23.071	13.321
IEB2	3.500	21.600	12.600
IEB3	3.400	25.400	16.000
IEB4	3.214	22.557	13.514
GDE-U1	2.750	23.000	12.250
GDE-U2	3.615	24.692	15.462
GDE-U3	3.250	24.500	12.500
GDE-U4	2.091	21.182	13.000
GDE-L1	3.221	18.571	12.675
GDE-L2	3.193	19.048	14.675
GDE-L3	2.467	16.950	12.283
mean	3.096	21.870	13.480



In terms of knowledge, majority of the learners correctly answered 41%-61% of the knowledge questions except for the learners from GDE-U4, who scored below this range (Figure 21). There was a significant difference in mean knowledge scores within and across school types ($p<0.001$) (Figure 21). Across school types, GDE-L3 scored significantly lower than IEB2 and IEB4, and IEB2 scored higher than GDE-U4. Within school types, GDE-L1 and GDE-L2 scored significantly higher than GDE-L3.

The IEB and GDE-U groups had an average attitude score of 70% and above, ranging to 85%, while the GDE-L group all had average attitude scores of below 65% (Figure 21). The greatest variation between the schools' scores occurred within the attitude section as there was a significant difference in attitude scores of schools across school types ($p <0.001$) but no significant difference in attitude scores of schools within the same school type. IEB1, IEB3 and IEB4 scored significantly higher than GDE-L1 and GDE-L2, while all IEB schools scored higher than GDE-L3. GDE-U2 scored higher than all of the GDE-L schools and GDE-U3 scored higher than GDE-L3.

The average score for the behaviour section of the learner questionnaire ranged between 55%-72% (Figure 21). The behavioural scores were more consistent and there was only a significant difference within the GDE-L group ($p<0.001$). GDE-L2 scored significantly higher than GDE-L1 and GDE-L3.

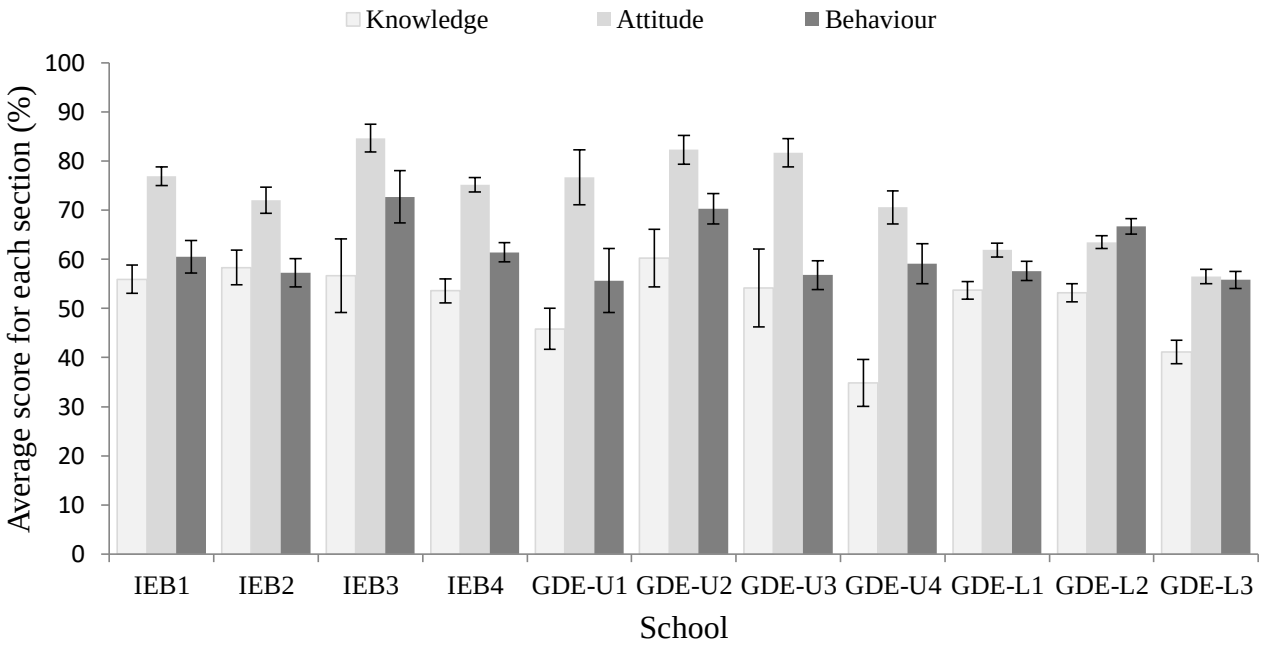


Figure 21: The average (± SE) knowledge, attitude, and behaviour scores (%) for the learner questionnaire for each school.

Variation amongst the three school types (IEB, GDE-U, and GDE-L) in knowledge, attitude and behaviour scores for the learner questionnaire was also analysed (Figure 22). The IEB group had a higher average knowledge and behaviour score, the GDE-U group had a slightly higher average attitude score and the GDE-L group scored lowest for all three sections. The only significant difference between the three school types occurred between the attitude scores ($p < 0.001$). The GDE-L group scored significantly lower than the IEB and GDE-U groups. There was also an over-all significant difference ($p=0.003$) in scores between the IEB and GDE-L groups.

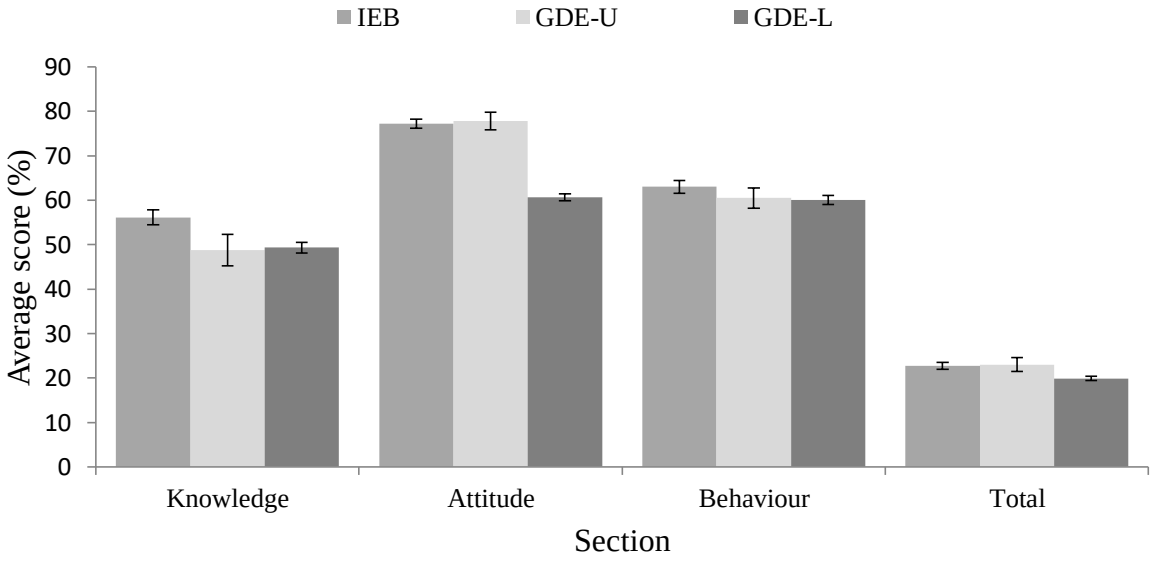


Figure 22: The mean (± SE) knowledge, attitude, behaviour, and total questionnaire scores (%) for each of the three school types (IEB, GDE-U and GDE-L) involved in this study.

Perceived environmental education (EE)

The learners at each school were given examples of EE and asked if their school provided any form of EE, the number of learners who perceive that their school provided EE was recorded. 91 %, 59% and 36% of IEB, GDE-U and GDE-L learners, respectively, stated that their school provided EE. In total 57% of participants stated that their school provided EE.

The learners who stated that their school provides environmental education were asked to elaborate on the methods that their school utilised (Figure 23). The methods included in-class EE, outdoor education, field trips, recycling, working on the school's vegetable/ flower garden, having a guest speaker educate the learners, school clean-ups and education from the school's environmental committee.

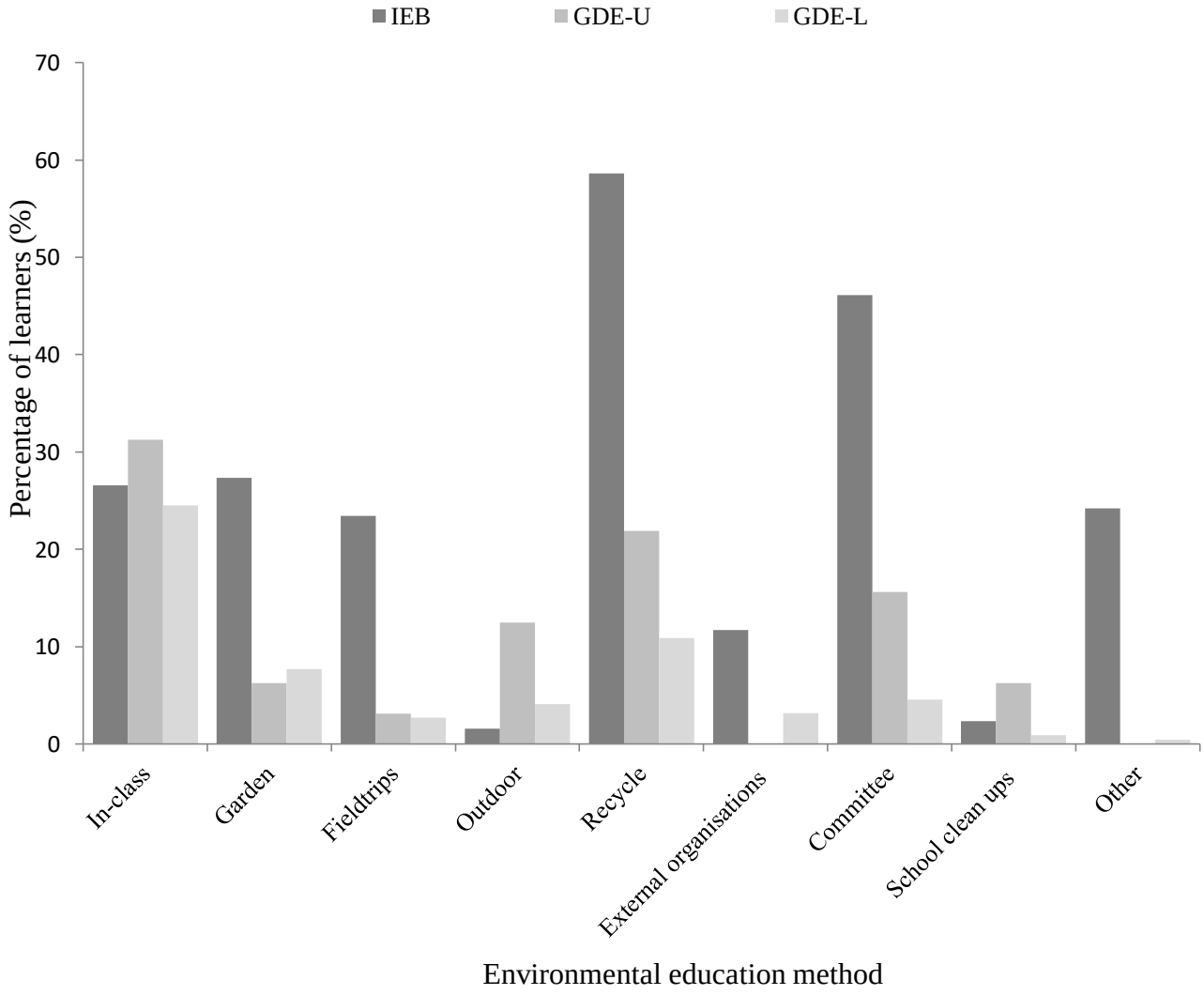


Figure 23: The percentage of learners in each school type that stated that their school utilises particular environmental education methods.

The average knowledge, attitude and behaviour scores for the total learner group that perceived that their school provided EE and those who did not were compared (figure 24). The behaviour ($p=0.947$) scores did not vary significantly but there was a variation in the mean knowledge ($p= 0.007$) and attitude scores ($p<0.001$) with learners who stated that their school provided EE scoring higher than those who did not. Learners from the EE group obtained a marginally lower behaviour score than the group that stated that their school did not provide EE.

The average knowledge, attitude and behaviour scores of learners from each school type who stated that their school provided EE and those that did not were compared (Figure 24). There was little variation in knowledge scores ($p=0.091$) of learners from each school type but there was a significant difference in attitude ($p<0.001$) and behaviour ($p<0.001$) scores. There was no mean difference in attitude scores within school types but the IEB EE group and both GDE-U groups had a higher attitude score that both the GDE-L groups. In terms of behaviour scores within and across school types, the greatest variation was due to low behaviour score of the GDE-U group that

perceived EE. Within the GDE-U school type, the EE group scored significantly lower than the group that did not perceive EE and across school types the GDE-U EE group scored significantly lower than the both IEB and GDE-L school types.

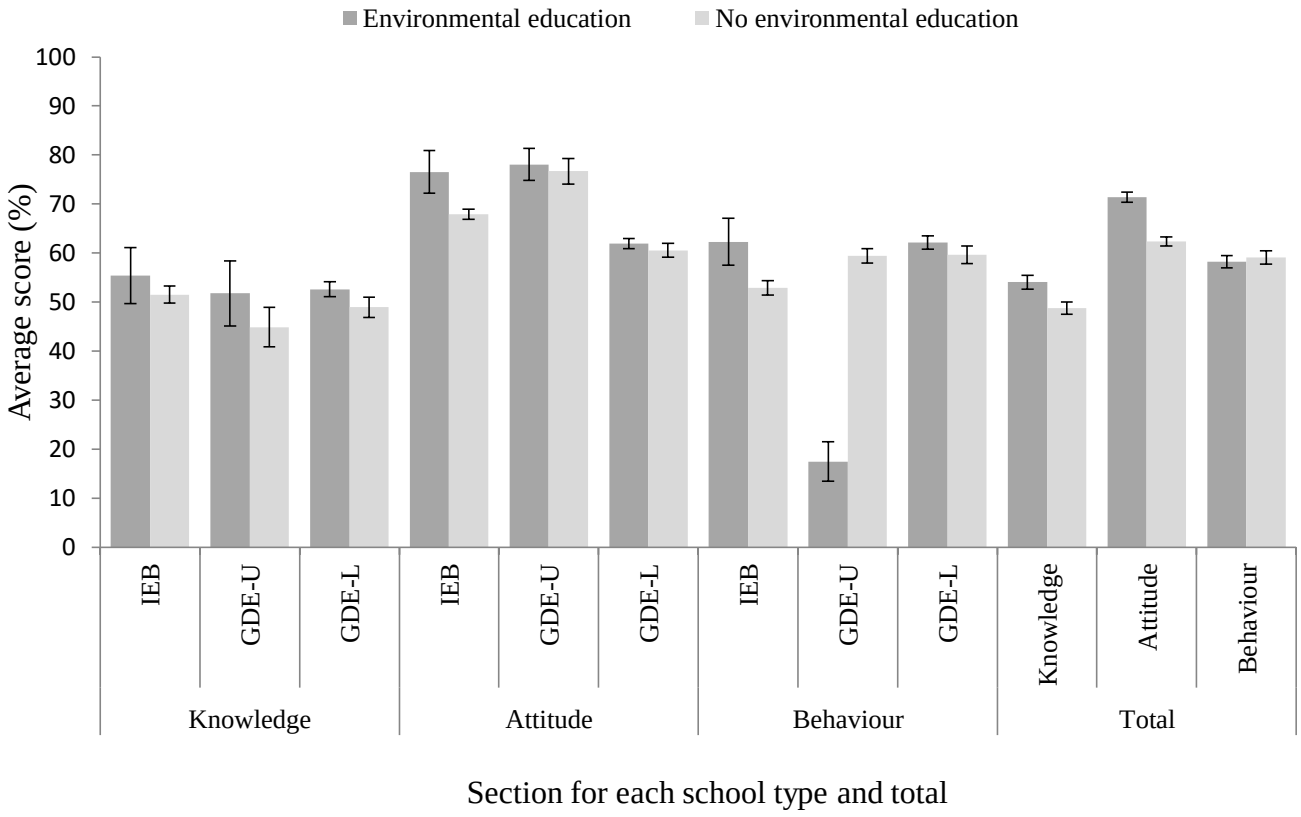


Figure 24: The average (± SE) knowledge, attitude, and behaviour scores (%) of learners from each school type and the total learner sample who stated that that their school provided environmental education and learners who stated that their school did not provide.

In-class EE

The learners were asked if their school provides in-class environmental education as part of their environmental education programme and 27%, 31% and 25% of the learners from the IEB, GDE-U and GDE-L group, respectively, stated that their school provided in-class EE. 26% of the total sample group stated that their school provided in-class EE.

The knowledge, attitude and behaviour scores for the two groups (the learners who stated that their school provided in-class EE and the learners who did not) were compared across the total sample group (Figure 25). The learner group that stated that their school provided in-class EE obtained a significantly higher knowledge score ($p=0.01$) and a marginally higher attitude ($p=0.28$) and behaviour ($p=0.72$) score than the group that stated that their school did not provide in-class EE.

In terms of school type knowledge, attitude and behaviour scores of the two groups were compared within and across school types and there was a significant difference in knowledge ($p=0.01$) and attitude ($p<0.01$) scores but not behaviour ($p=0.25$). There was no variation in behaviour within

school types but the IEB learner group perceived that their school provided EE had significantly higher knowledge score than the GDE-L learner group that did not perceive in-class EE. There was also no significant difference in attitude scores within school type but both the IEB group and the GDE-U group scored significantly higher than the GDE-L group that did not perceive in-class EE. Both the IEB group and the GDE group that did not perceive in-class EE scored higher than the GDE-L group that perceived in-class EE. There was no observable pattern in the three sections between the two groups across the school types.

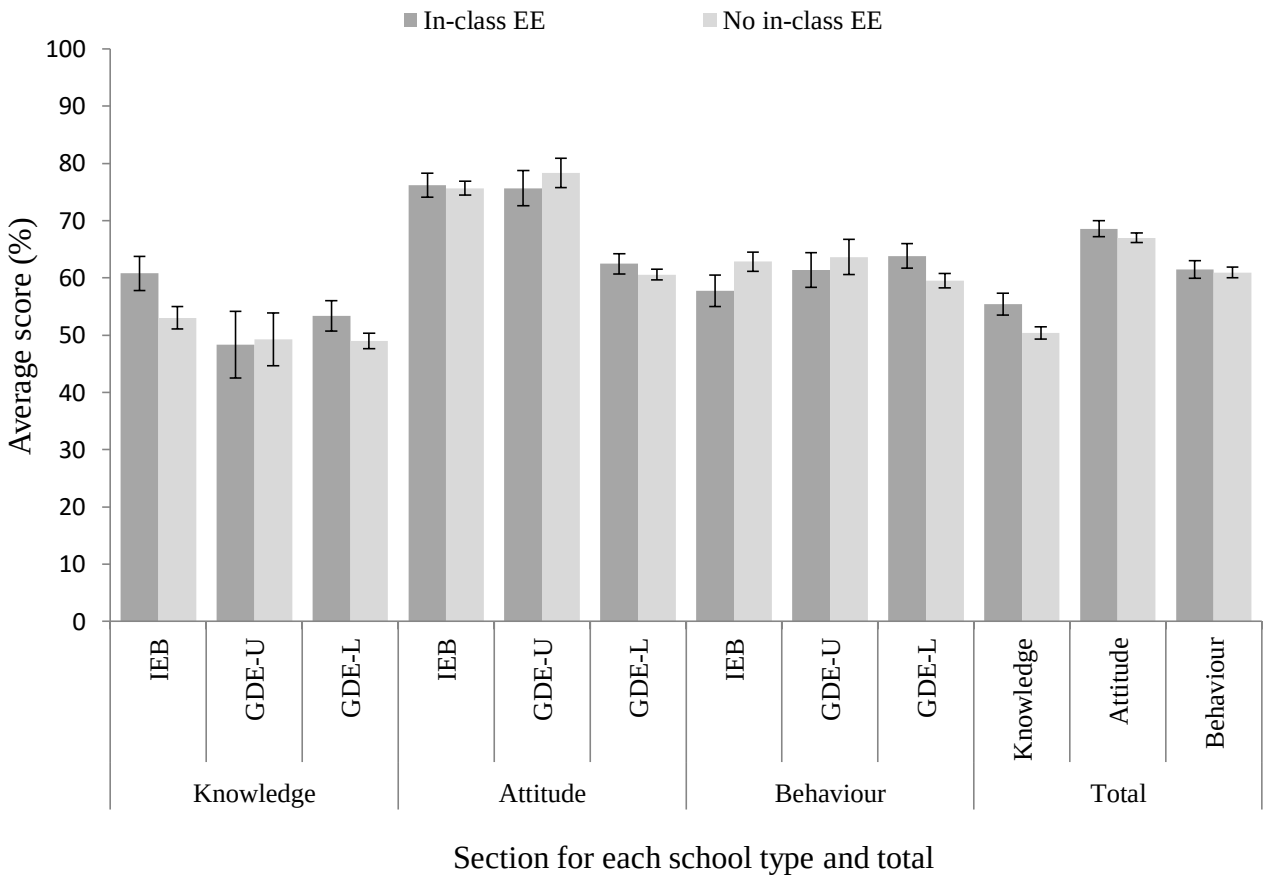


Figure 25: Average (± SE) knowledge, attitude and behaviour scores of learners from each school type and the total learner sample who stated that that their school provides in-class EE and who stated that their school does not provide in-class EE.

Practical focus on EE as part of the schools' initiatives

From the learner questionnaire the learners mentioned practical EE methods in three categories: working in the schools garden, going on fieldtrips and outdoor education. These practical methods were sometimes utilised to aid in-class EE. In the IEB, GDE-U and GDE-L learner group, respectively, 27%, 6% and 7% stated that their school encourages learners to help in the school's garden, 30%, 1% and 6% stated that their school provided field trips that aid in EE and 2%, 4% and 9% of learners stated that their school utilises outdoor education (Figure 23 above). For each practical EE method the frequency of use in certain school types was low, this made it difficult to

compare the variation in knowledge, attitude and behaviour across and within school types when utilising each practical method, therefore all three methods were analysed together as practical EE methods. 46.9%, 12.5% and 13.2% of IEB, GDE-U and GDE-L learners, respectively, stated that their school utilises at least one of the three practical EE methods. 24.5% of the total sample group stated that their school utilises at least one of the three practical EE methods.

The knowledge, attitude and behaviour scores of the learners who received practical EE (gardening, fieldtrips or outdoor education) and those who did not were compared (Figure 26). The learner group that stated that their school utilised practical methods of EE had a significantly higher average attitude ($p<0.001$) and behaviour ($p= 0.002$) score than the learner group that did not state that their school utilises practical EE methods. It can be seen that the learners who received practical EE also have a marginally higher knowledge score.

The knowledge, attitude and behaviour scores were also compared across school types for the two groups (practical EE and no practical EE) (Figure 26). Only four learners from the GDE-U group stated that their school utilises any three of the practical EE methods, thus the knowledge and attitude scores of GDE-U group that received practical EE varied. There was a significant difference between the two groups in attitude as, while there was no significant variation within school types, but both groups in the GDE-L school type had a significantly lower attitude score than both IEB groups and the GDE-U group that did not receive practical EE ($p<0.001$). The average knowledge and behaviour scores for the practical EE group are all marginally higher than the scores for the group that did not receive practical EE. Except for the average knowledge score for the IEB group, the practical EE group has a marginally lower score than the group that did not receive practical EE.

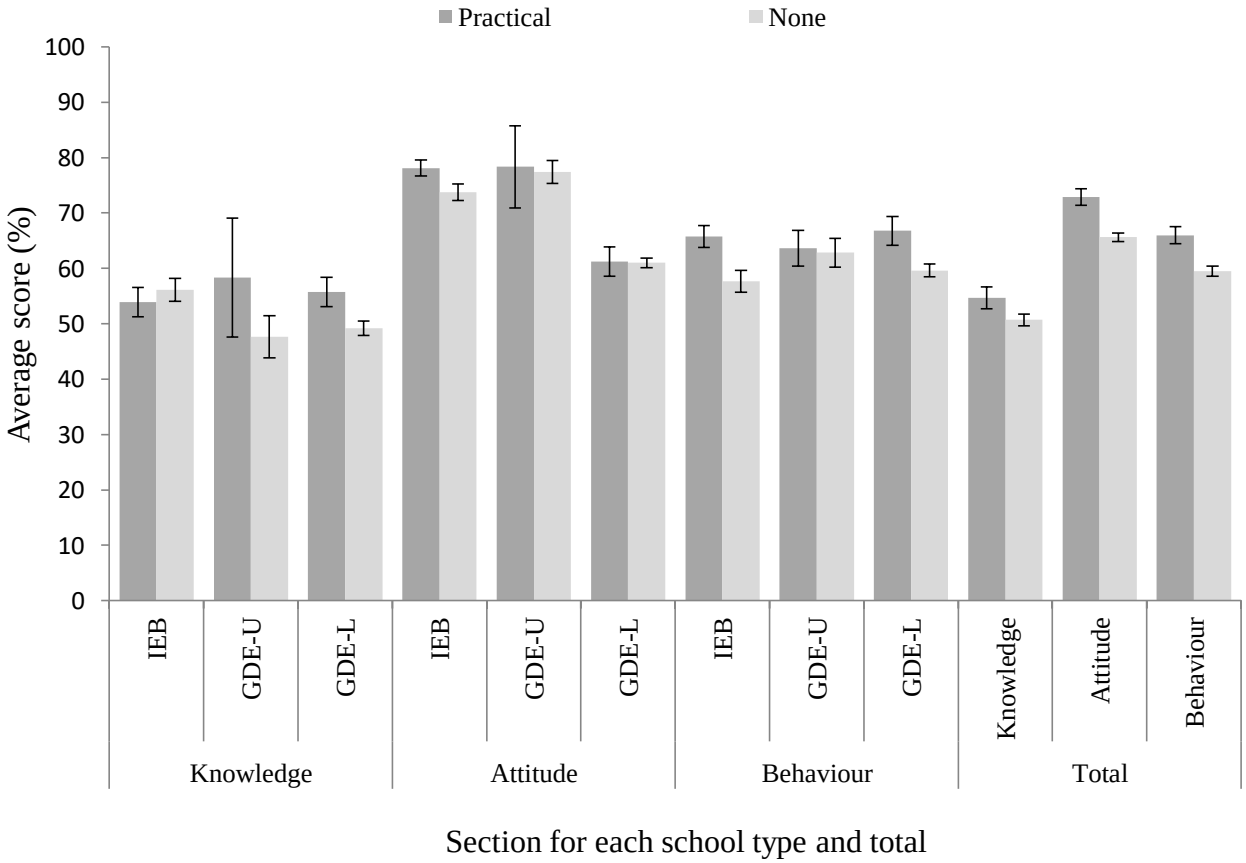


Figure 26: The average (± SE) knowledge, attitude and behaviour scores of learners from each school type and the total learner sample who stated that that their school utilises practical EE methods and who stated otherwise.

The average knowledge, attitude and behaviour of the total learner sample group was compared for each practical method to further understand which practical method could be most effective (Figure 27). The learners who stated that their school utilised gardening as a method of EE had a significantly higher knowledge ($p=0.005$), attitude ($p<0.001$) and behaviour ($p=0.039$) score than the rest of the sample group. The learners who stated that their school utilises field trips as a method of EE had a significantly higher average attitude score ($p=0.002$) and a marginally higher behaviour score than the rest of the sample group, but there was little variation in knowledge. The learners who stated that their school utilised outdoor education as a method of EE had a significantly higher average behaviour score ($p=0.043$) and a marginally higher average knowledge and attitude score than learners who did not mention any form of outdoor education.

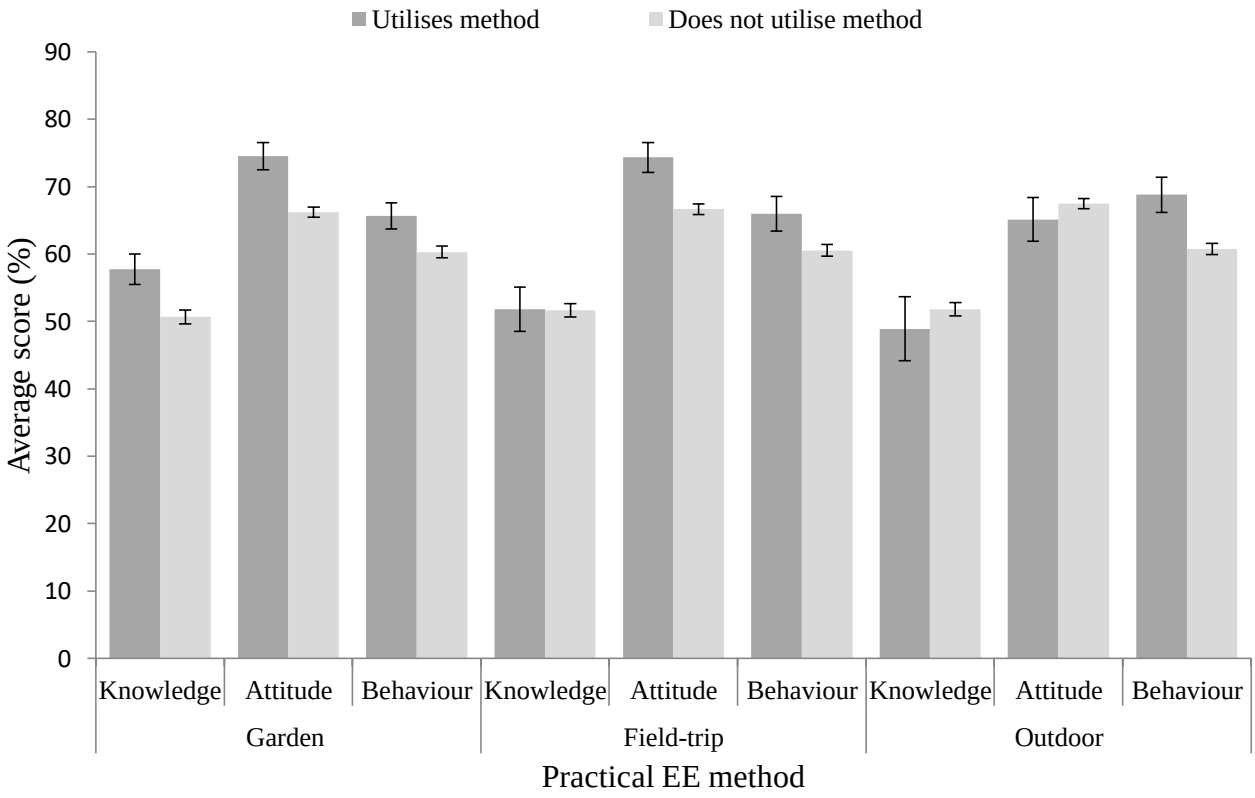


Figure 27: Comparison of the average (± SE) knowledge, attitude and behaviour scores of learners who stated that that their school utilised any of the three practical EE methods (Gardening field-trips and outdoor education) and the average (± SE) knowledge, attitude, and behaviour scores of the remaining sample group.

Extracurricular EE

Recycling, the use of guest speakers from external organisations, the use of an environmental committee and school clean-up initiatives were seen as extracurricular EE methods. The effects of recycling programmes on learner behaviour and the effects of external organisations, environmental committees and school clean-ups on learner environmental knowledge, attitudes and behaviours were assessed (Figure 28).

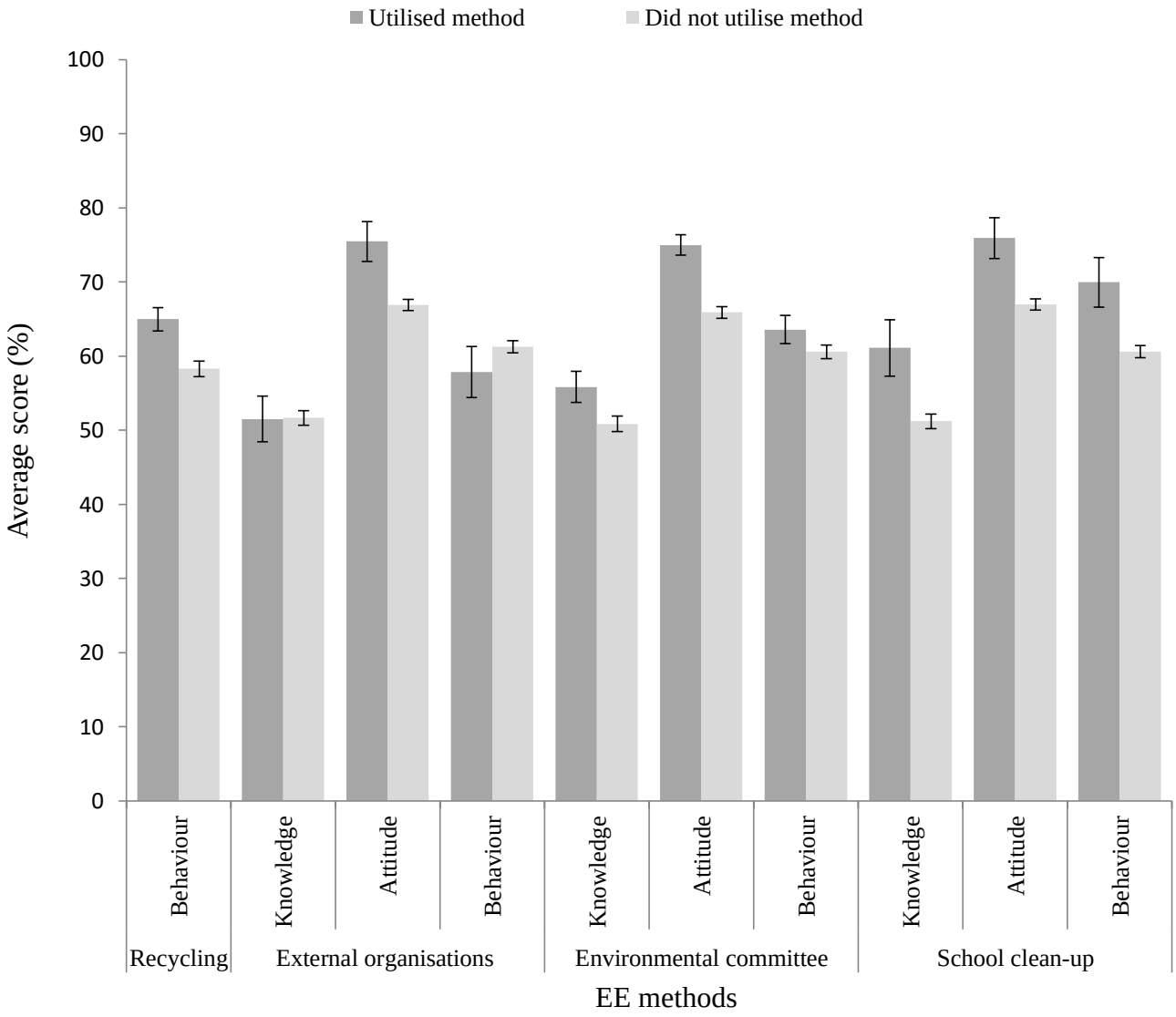


Figure 28: Comparison of the average (± SE) knowledge, attitude and behaviour scores of learners who stated their school implemented certain EE methods (recycling, inviting external organisations, utilising an environmental committee, and conducting school clean-ups) and the average (±SE) knowledge, attitude, and behaviour scores of the remaining learners.

The learners were asked if their school has an active recycling project and 57%, 22% and 11% of learners in the IEB, GDE-U and GDE-L group, respectively, stated that their school recycles material (Figure 28). 27% of the total sample group stated that their school recycles material. The average behaviour scores of the two groups for the entire sample were assessed (Figure 28). The learners who stated that their school recycles had a significantly higher average behaviour score ($p=0.002$) than the learner who did not state that their school recycles. With further analysis, it was found that within the three school types the learner group that stated that their school recycles had a higher behaviour score than the learner group that did not state that their school recycles and the difference between the behaviour scores in the IEB group was found to be significant ($p=0.013$).

Learners from the IEB and GDE-L school types mentioned that guest speakers from external organisations visited the school to educate them about the environment and environmental issues. None of the GDE-U learners mentioned guest speakers. Twenty-two learners in total stated that a guest speaker had visited their school. The learners who mentioned guest speakers had a significantly higher attitude score ($p=0.005$) than the rest of the sample group (Figure 28). There was little to no difference in the average knowledge ($p=0.995$) and behaviour ($p=0.303$) scores between the two groups.

From the total sample group, 63 learners mentioned that the environmental committee played a large role in their school's EE programme, the majority of this sample consisted of IEB learners (Figure 23). The group that stated that their school utilises environmental committees to educate learners had a significantly higher average attitude score ($p<0.001$) and a marginally higher average knowledge ($p=0.056$) and behaviour score ($p=0.184$) than the rest of the sample group (Figure 28).

Eighteen learners from the total sample group mentioned that their school utilises school clean-ups as an EE method (Figure 23). The learners who stated that their school utilised school clean-ups as a form of EE had a significantly higher average knowledge ($p=0.020$), attitude ($p=0.008$) and behaviour ($p=0.014$) score than the rest of the sample group (Figure 28).

Learner subject choice

The learners were asked to indicate their choice of school subjects (Table 16). Not all schools offered the same range of subjects. Life Science, physical sciences, geography, business studies/ economics, accounting, history and CAT were subjects that learners in all three school types were offered and subjects that the participants selected. In many of the GDE-U schools the subjects were offered in sets, this greatly affected which subjects the learners chose.

Table 16: The school subjects that participant learners from each school included in their subject choice.

Subject	***School type***		
	IEB	**GDE-U**	**GDE-L**
Life Science	✓	✓	✓
Physical sciences	✓	✓	✓
Geography	✓	✓	✓
Business studies/ economics	✓	✓	✓
Accounting	✓	✓	✓
Consumer studies		✓	✓
Tourism	✓	✓	
History	✓	✓	✓
Computer application technology (CAT)	✓	✓	✓
Information technology (IT)	✓	✓	
Engineering graphics and design(EGD)	✓	✓	
Visual arts	✓	✓	
Drama	✓		

Subject	*School type*		
	IEB	**GDE-U**	**GDE-L**
Music	✓		
Dance	✓		

The popularity of each of these subjects (excluding drama, music and dance, which none of the GDE schools offered) was analysed (Figure 29). In the IEB school type life science, physical sciences and business studies were the most common subject choices. In the GDE-U school type life science, physical sciences, geography and accounting were the most commonly selected subjects and in the GDE-L group the most commonly selected subjects were life sciences, physical sciences and geography. In the GD-L group, 100% of the learners selected life science as one of their subjects and the very few learners selected any other subject combinations other than life science, physics and geography. All learners in the GDE-L group who selected geography took life science and physical sciences or history and the majority of learners who selected business studies also selected life science and consumer studies.

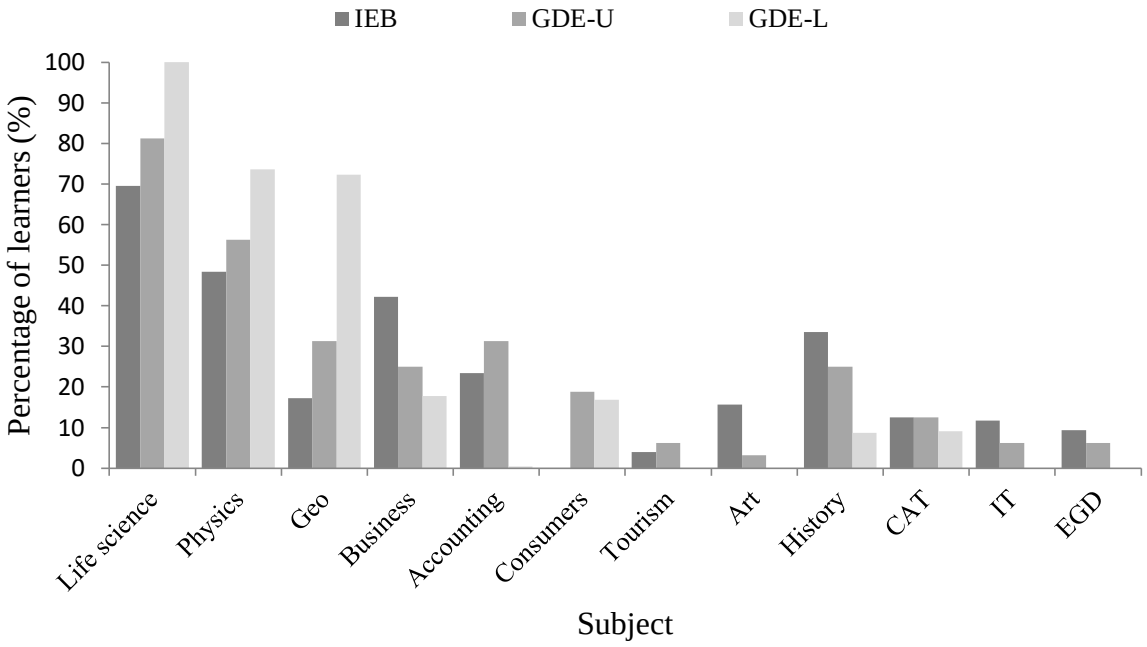


Figure 29: The percentage of learners from each school that selected Life Science, physical sciences, geography, business studies/ economics, accounting, consumer studies, tourism, art, history, CAT, IT and EGD.

Life Sciences

88.2% of the total learner group took Life Science as one of their subjects. The average knowledge, attitude and behaviour scores for the learners who selected Life Science and those that did not were calculated for the entire sample and each school type (Figure 30). In terms of the entire sample, there was no significant difference in the knowledge (p=0.453) or behaviour scores (p=0.0.863) of

learners that selected Life Science and learners that did not but the learners who did not select Life Science had a significantly higher average attitude score ($p<0.001$).

In terms of the three school types there was no significant difference in the average knowledge ($p=0.159$) and behaviour scores ($p=0.603$) of the two groups within and between school types. While there was no significant difference in average attitude scores between the two groups within school types, the GDE-U groups did have a significantly lower average attitude score than both groups from the other two school types ($p<0.001$). It was observed that the average knowledge, attitude and behaviour scores of IEB learners in the two groups had little variation, but the learners who did not select Life Science did have a slightly higher score for all three categories. The GDE-U learners who selected Life Science had a marginally higher knowledge and attitude score but a lower behaviour score than the learners who did not selected Life Sciences.

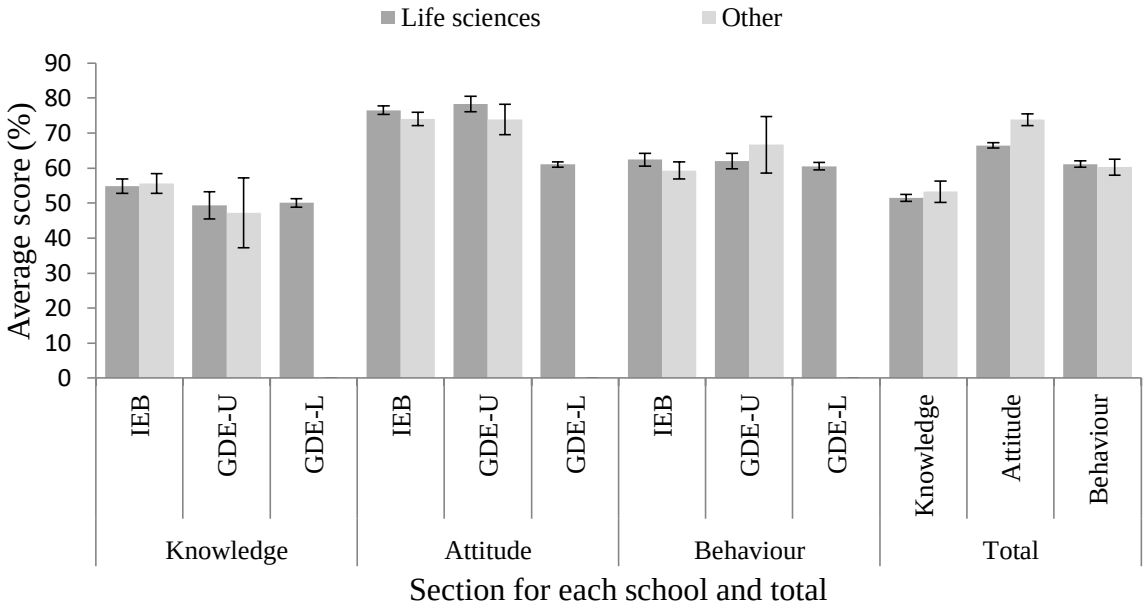


Figure 30: The average knowledge, attitude, and behaviour questionnaire scores (± SE) of the learner group that selected Life Science and the learner group that did not select Life Science for the total sample and for each school type.

Geography

50.3% of the total learners sample took geography as one of their chosen subjects. The average knowledge, attitude and behaviour scores for the learners who selected geography and those that did not were calculated for the entire sample and each school type (Figure 31). In terms of the total sample group there was no significant difference in the average knowledge ($p=0.069$) and behaviour scores ($p=0.198$) but the group that did not select geography did have a significantly higher average attitude score ($p<0.001$). It was observed that the group that did not select geography did have a marginally higher knowledge score but a marginally lower behaviour score.

In terms of the three school types, there was no significant difference in the average knowledge (p=0.145) and behaviour scores (p=0.129) of the two groups within and across school types. There was no significant difference in the average attitude scores of the two groups within school types but both GDE-L groups received a significantly lower average attitude score than the IEB and GDE-U groups. The average knowledge, attitude and behaviour scores of the IEB group that selected geography and the group that did not select geography displayed little variation. The GDE-U that selected geography received a marginally higher knowledge score but a slightly lower behaviour score while the GDE-U group that selected geography had a slightly higher knowledge and behaviour score.

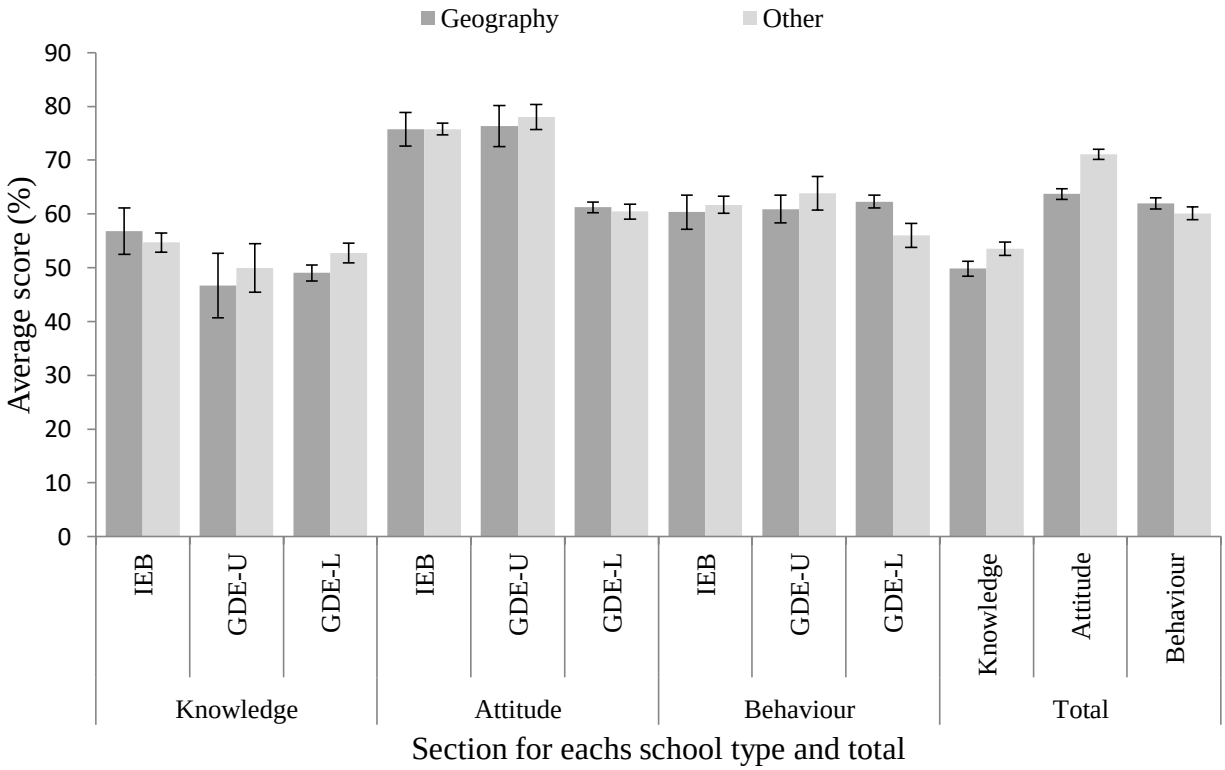


Figure 31: The average knowledge, attitude, and behaviour questionnaire scores (± SE) of the learner group that selected geography and the learner group that did not select geography for the total sample and for each school type.

Life Science and geography

47.1% of the total sample selected both geography and Life Science while 9.0% selected neither subject. More learners selected Life Science without geography (40.8%) than learner geography without Life Science (Figure 32).

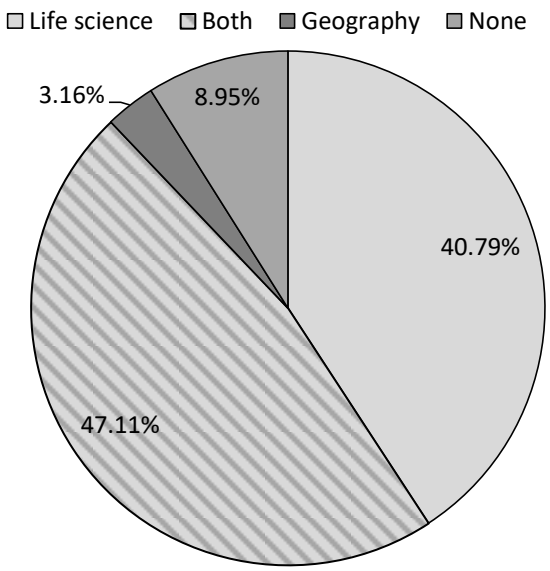


Figure 32: The proportion of learners (in the total sample) that selected both Life Science and geography, Life Science only, geography only and neither Life Science or geography.

The knowledge, attitude, and behaviour scores of the four groups were assessed (Figure 33). There was no difference in knowledge ($p=0.321$) or behaviour ($p=0.482$) between the four groups but the group that chosen both Life Science and geography scored significantly lower ($p<0.001$) than the groups that took neither subject as well as the group that only took Life Science. The behaviour scores for all four groups were consistent but the group that did not select either subject and the group that only selected Life Science had a marginally higher average knowledge score.

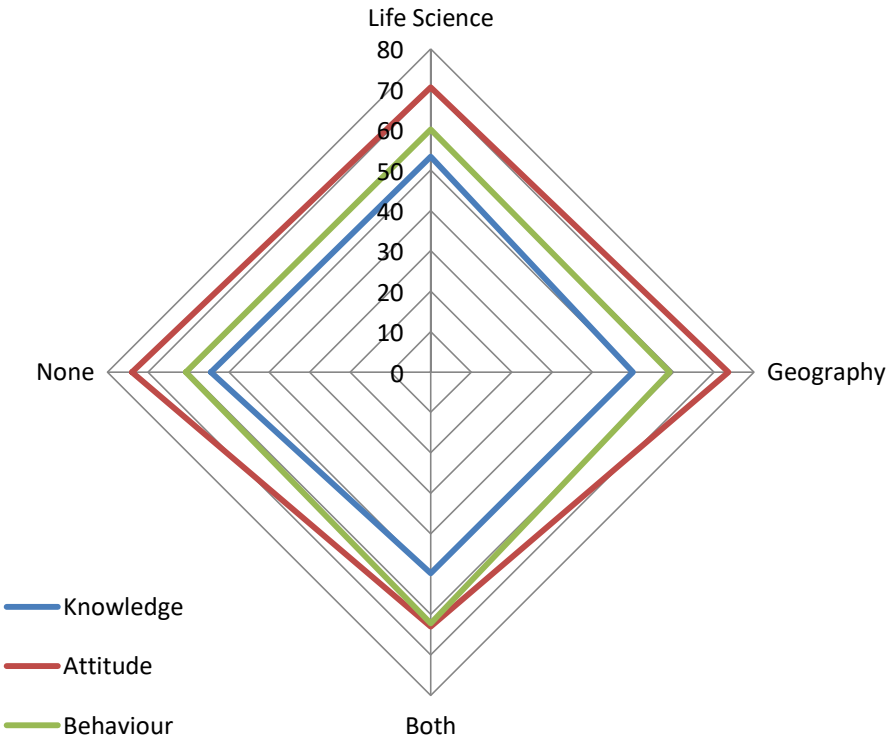


Figure 33: The average knowledge, attitude, and behaviour scores (± SE) of the learner groups that selected both Life Science and geography, Life Science only, geography only and neither Life Sciences or geography for the total sample.

Business studies/ economics

26.6% of the total sample group took business studies/ economics as one of their chosen subjects. The average knowledge, attitude and behaviour scores for the learners who selected business studies/ economics and those that did not were calculated for the entire sample and each school type (Figure 34). In terms of the entire sample there was no significant in the average knowledge ($p=0.233$) and attitude scores ($p=0.322$) but the group that did not select business studies/ economics did have a significantly higher behaviour score ($p<0.001$).

In terms of variation between the two groups within and across school types, there was no significant difference in the average knowledge scores ($p=0.065$) but the group that did not select business studies/ economics in the GDE-U school type did have a marginally higher knowledge score while the group that selected business studies/ economics in the GDE-L school type did have a slightly higher average knowledge score. There was no significant difference in the average attitude scores of the two groups within school types but both GDE-L groups had a significantly lower average attitude score ($p<0.001$) than the two groups in the IEB and GDE-U school types. The average attitude scores of the group that did not select business studies/ economics were marginally higher in both the IEB and GDE-U school types. The average behaviour score of the GDE-L group that selected business studies/ economics was significantly lower ($p=0.002$) than the IEB, GDE-U and GDE-L group that did not select business studies/ economics. Within the IEB and GDE-U school types the group that selected business studies/ economics had a marginally lower behaviour score than the group that did not select business studies/ economics.

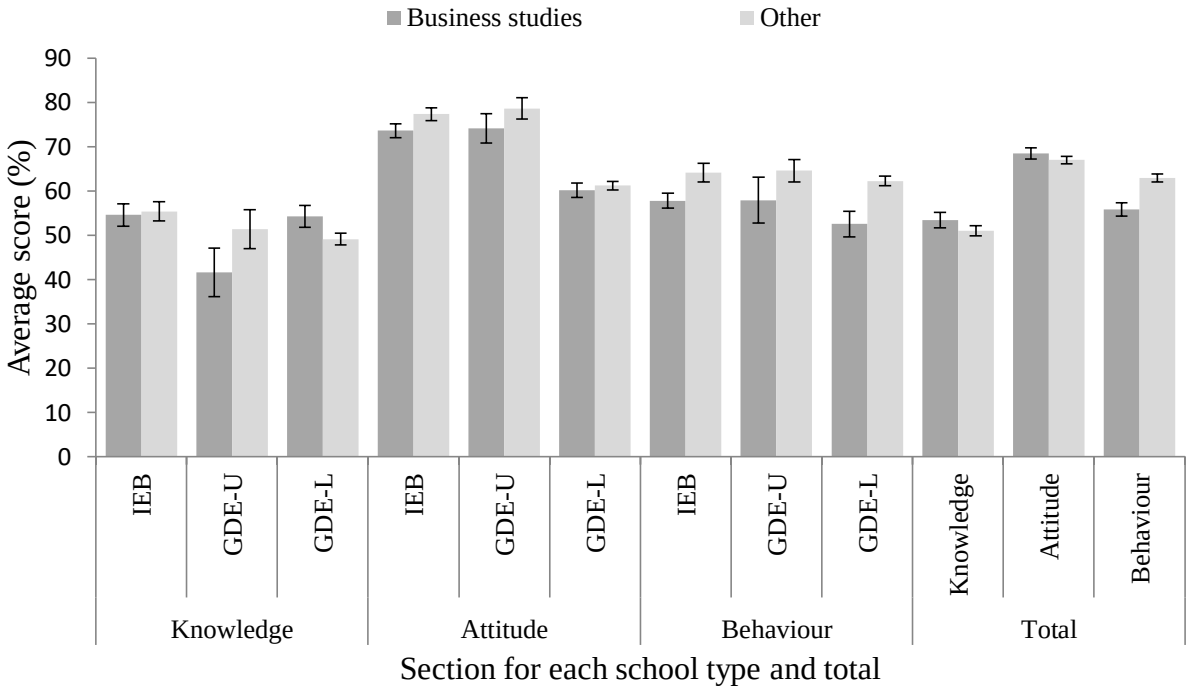


Figure 34: The average knowledge, attitude, and behaviour questionnaire scores (± SE) of the learner group that selected business studies/ economics and the learner group that did not select business studies/ economics for the total sample and for each school type.

Physical sciences

63.7% of the total learner sample took physical science as one of their chosen subjects. The average knowledge, attitude and behaviour scores for the learners who selected physical science and those that did not were calculated for the entire sample and each school type (Figure 35). In terms of the total sample, there was no significant difference in the average knowledge ($p=0.105$) and attitude ($p=0.618$) scores between the two groups but the group that selected physical education did have a significantly higher average behaviour score ($p<0.001$). It was observed that the group that selected physical science had a marginally higher average knowledge score.

In terms of variation within and across school types, the GDE-L group that did not select physical sciences attained a significantly lower ($p<0.001$) average knowledge score than the GDE-U and IEB group that selected physical science. The IEB group that selected physical science had a marginally higher average knowledge score than the IEB group that did not select physical science. There was no significant difference in the average attitude scores of the two groups within school types but there was a significant difference across school types ($p<0.001$). The GDE-L group that did not select physical science had a significantly lower average attitude scores than both groups in the IEB and GDE-U school types, and the GDE-L group that did select physical science had a significantly lower average attitude score than both IEB groups and the GDE-U groups that selected physical science. The GDE-U and GDE-L groups that did select physical science had a marginally higher average attitude score than the GDE-U and GDE-L groups that did not select physical science. There was a significant difference in the average behaviour scores ($p<0.001$) as the GDE-L

group that did not selected physical science had a significantly lower behaviour score than the IEB, GDE-U and GDE-L groups that did select physical science. The IEB and GDE-U group that selected physics attained a marginally higher average behaviour score than the IEB and GDE-U groups that did not select physics.

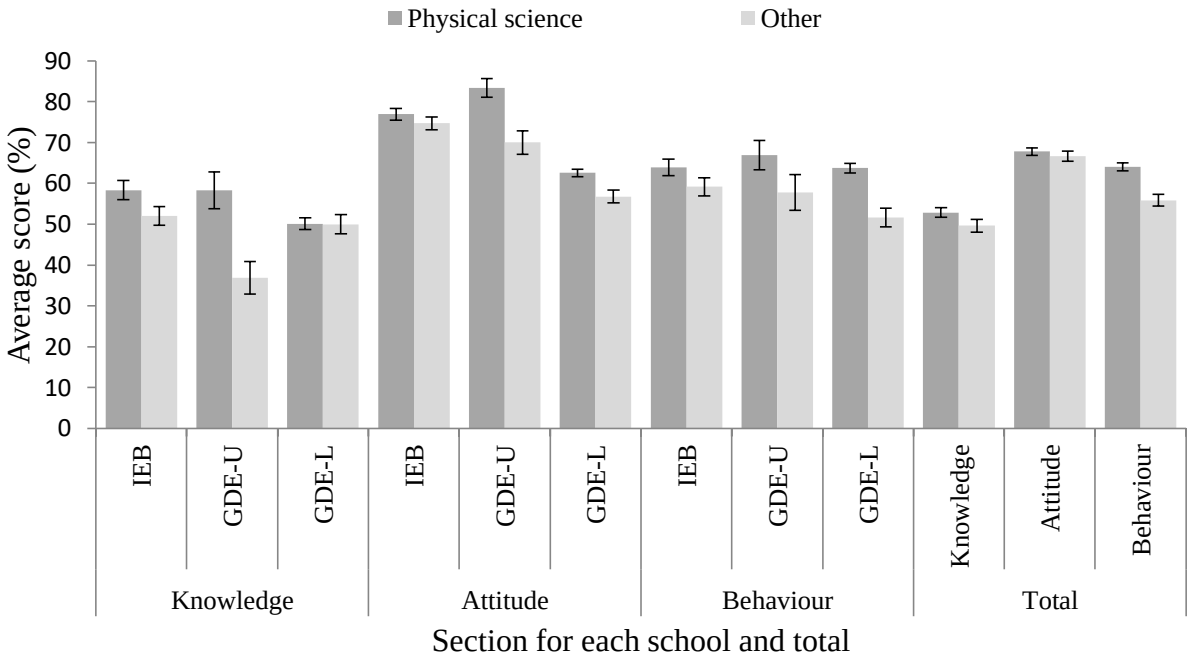


Figure 35: The average knowledge, attitude, and behaviour questionnaire scores (± SE) of the learner group that selected physical science and the learner group that did not select physical science for the total sample and for each school type.

Sources of environmental knowledge

The learners were asked to state their primarily sources of environmental knowledge/ environmental information and were provided with the options of school, social media, news, word of mouth and an option of "other". Many of the learners stated that they obtained their information from a combination of the provided sources. Therefore the number of learners who selected each source of knowledge for each school type was calculated to determine in what proportion each source of knowledge contributed to the learners' environmental knowledge base for each school type (Figure 36). For the IEB and GDE-U schools, social media was the most common source of knowledge. In the GDE-L school type most common source of knowledge was the news and second most common was social media. At least 20% of learners from all three school types stated that school contributed to their environmental knowledge base and (out of the three school types) more GDE-L learners stated that school contributed to their knowledge base. For the IEB school type, school was the second biggest contributor to the learner's environmental knowledge base.

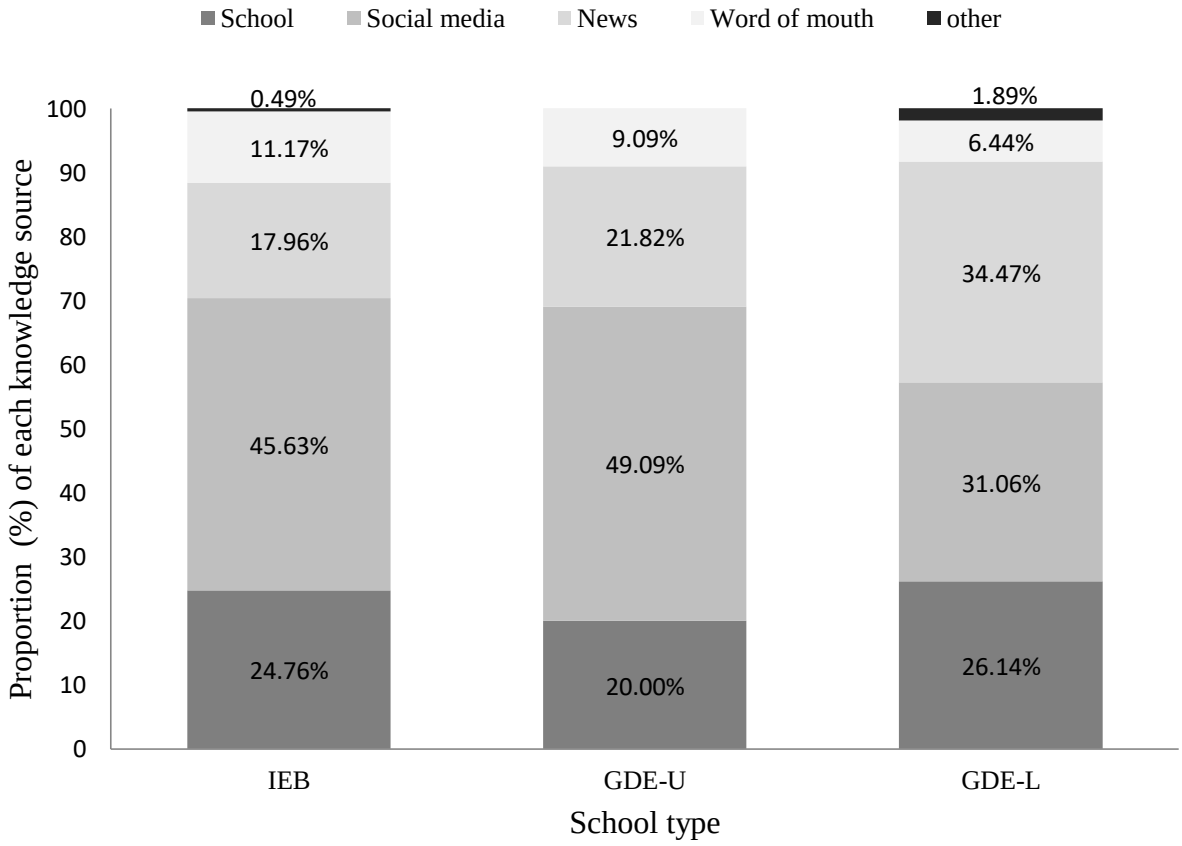


Figure 36: The proportion (%) of participant learners who selected each source of knowledge (school, social media, the news, word of mouth and other) for each school type.

Comparison on knowledge sources

The percentage of learners in the total sample group that mentioned any of the four environmental knowledge scores was calculated (Figure 37). In the total sample group social media was the most commonly mentioned source of environmental knowledge with 38.5% of all participants stating that social media was one of their primary sources of environmental knowledge. The news and school were both equally mentioned by the participants, 25.0% of the total learner participants stated that school was one of their primary knowledge sources and 26.7% of the total learners stated that school was one of their primary sources of environmental knowledge. 8.7% of the participants stated that word-of-mouth was one of their primary sources of environmental information.

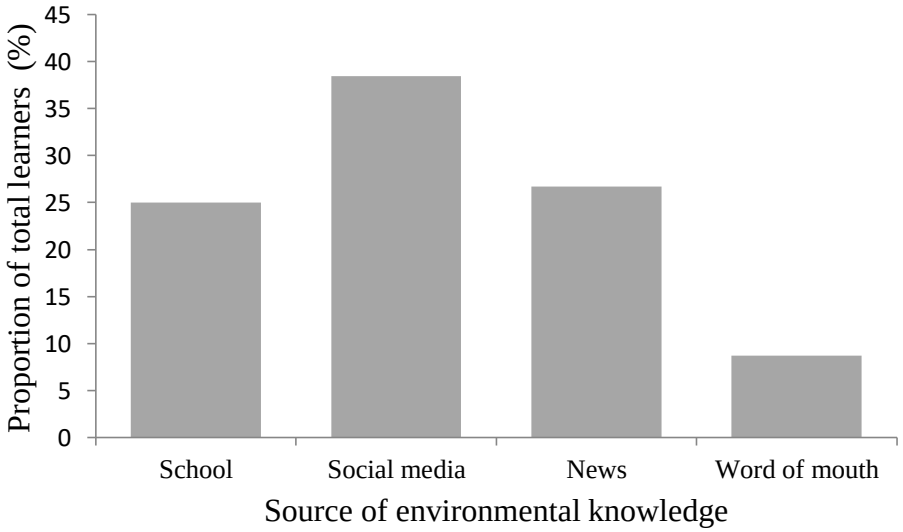


Figure 37: The proportion (%) of learners in the total sample that selected each source of knowledge (school, social media, the news, word of mouth and other) as a primary knowledge source.

The average knowledge, attitude and behaviour scores for the learners who stated that they utilised each source of environmental knowlegde was calculated (Figure 38). There was little variation in knowledge (p=0.488), attitude (p=0.083) or behaviour (p=0.658) between the learner groups that selected each knowledge source.

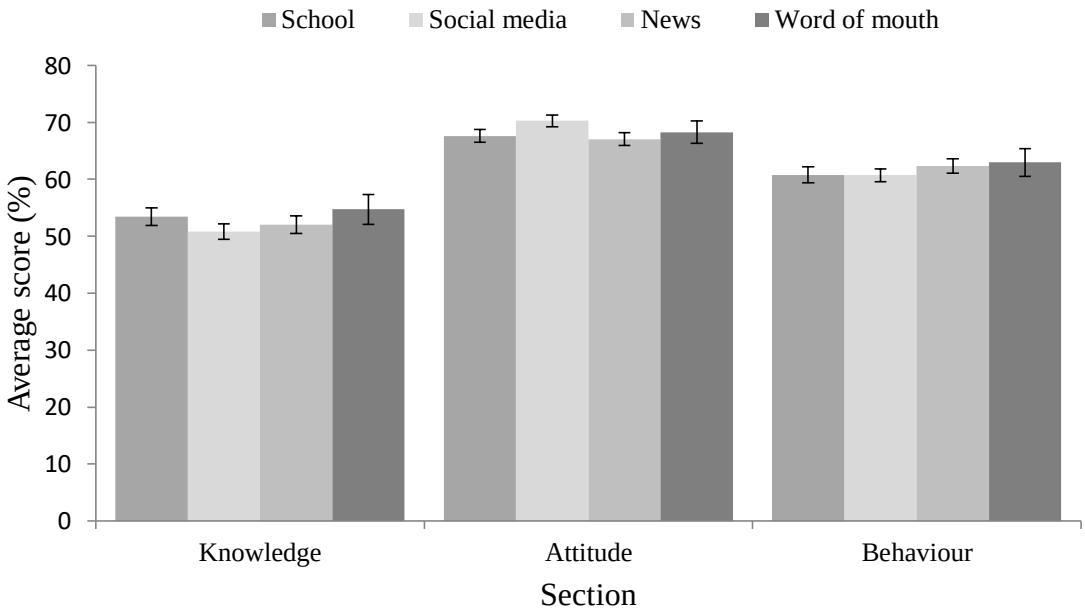


Figure 38: The average knowledge, attitude, and behaviour questionnaire scores (± SE) for the learners who stated that they utilised each source of environmental knowledge (school, social media, the news, and word of mouth).

School vs other knowledge sources

The number of learners who stated that their school was one of their primary sources of environmental knowledge was compared to the number of learners that stated otherwise (Figure 39). The proportion of learners in each school type that stated that school was one of their primary sources was similar across the three school types: 40.6% of IEB learners, 34.4% of GDE-U learners and 31.4% of GDE-L learners. 34.7% of the total learner sample stated that school was one of their primary sources of environmental information.

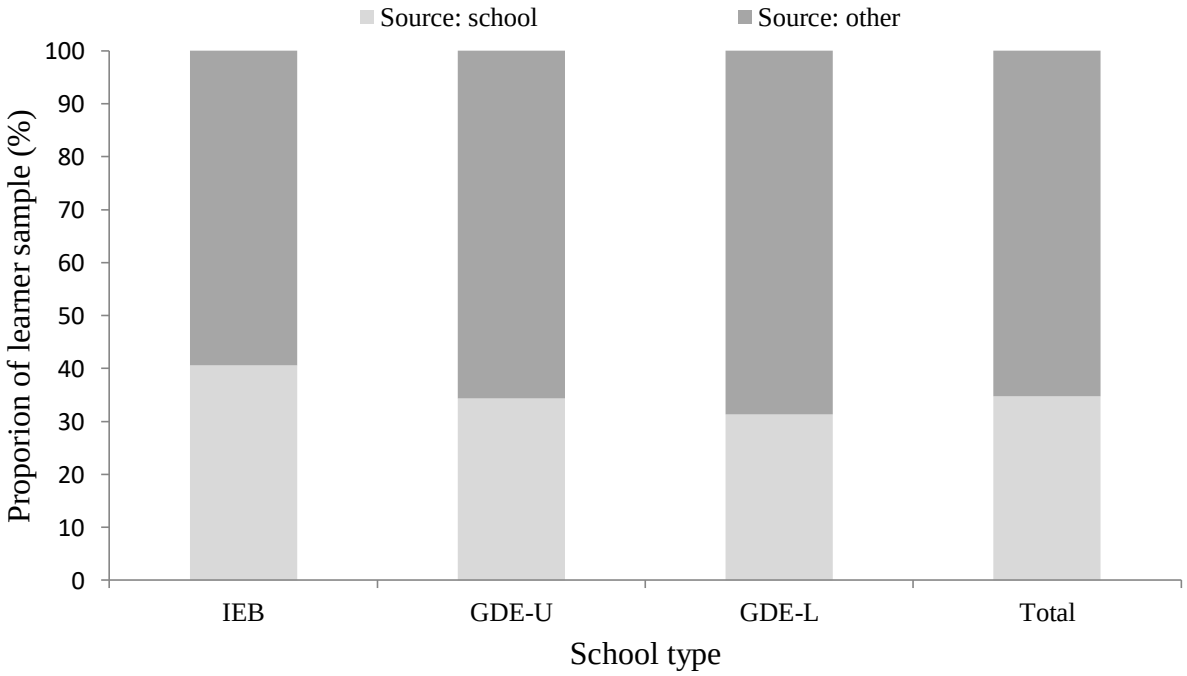


Figure 39: The proportion (%) of learners who stated that school was one of their primary sources of environmental knowledge and the learners who stated that school was not one of their primary sources of environmental knowledge.

The average knowledge, attitude and behaviour scores of all learners who stated that school was one of their primary sources of environmental information were compared to the average knowledge, attitude, and behaviour scores of the rest of the sample (Figure 40). There was no significant difference and little variation between the average knowledge ($p=0.093$), attitude ($p=0.824$) and behaviour scores ($p=0.787$) of the two groups.

The average knowledge, attitude and behaviour scores of the two groups were also compared within and across school types (Figure 40). There was no significant difference or pattern in the knowledge ($p=0.031$) or behaviour ($p=0.632$) scores of the two groups but there was a significant difference in the attitude ($p<0.001$) scores of the two groups. There was no variation in attitude scores within school types but both GDE-L groups had a significantly lower average attitude score than the IEB and GDE-U groups. It can be seen that there was little/ no variation in the average knowledge, attitude and behaviour scores of the group that stated that school was one of their

primary sources of environmental knowledge and the group that stated otherwise, both in the total group and within school types.

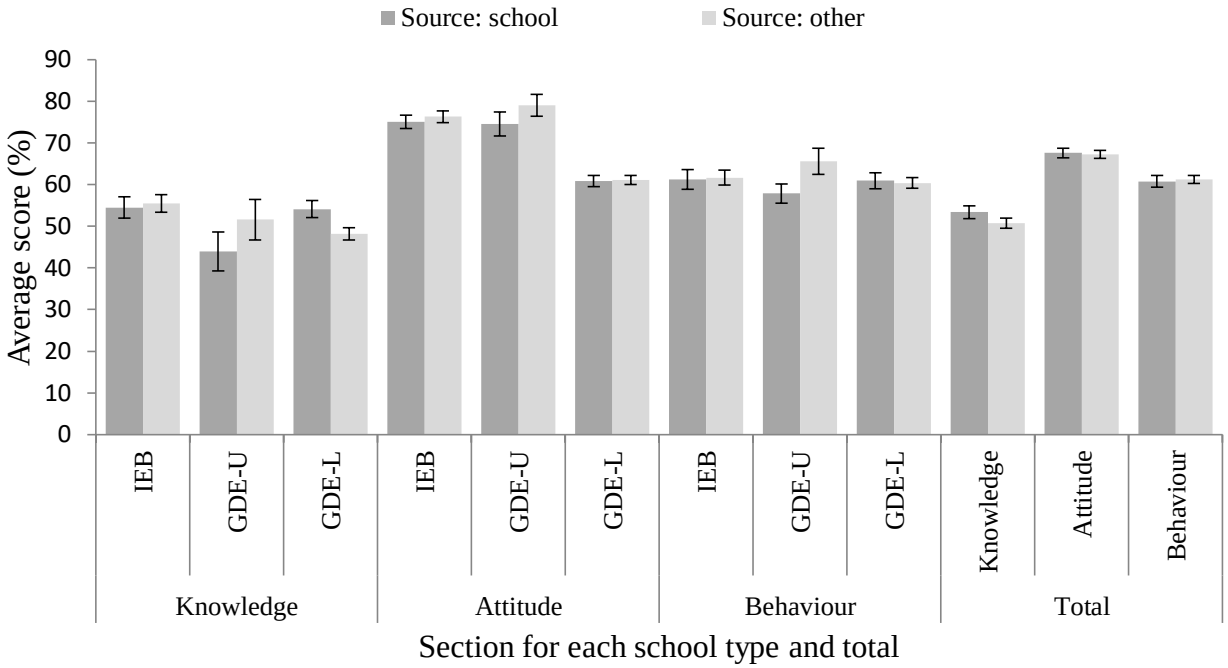


Figure 40: The variation in average knowledge, attitude, and behaviour questionnaire scores (± SE) of learners who stated that school was one of their primary sources of environmental knowledge and the learners who stated that school was not one of their primary sources of environmental knowledge.

Knowledge source that best supplements school

Of the 35.3% of the total learner sample who stated that school was one of their primary sources of environmental knowledge, 56.6% learners stated that school was their sole source of environmental education and the rest of the sample stated that they obtained their environmental knowledge from a combination of school and one or more of the provided sources of knowledge. In order to determine which knowledge sources best supplements school, the knowledge, attitude and behaviour scores of the two learner groups (Figure 41). There was no significant difference or variation in the average knowledge ($p=0.929$) or behaviour scores ($p=0.900$). Learners who stated that school was not their sole source of environmental knowledge did have a marginally higher attitude score than the learner group that stated that school was their sole source of environmental knowledge and the learners who stated that school and social media were their primary sources of environmental knowledge had a significantly higher average attitude score ($p=0.008$) than the learners who stated that school was their sole knowledge source.

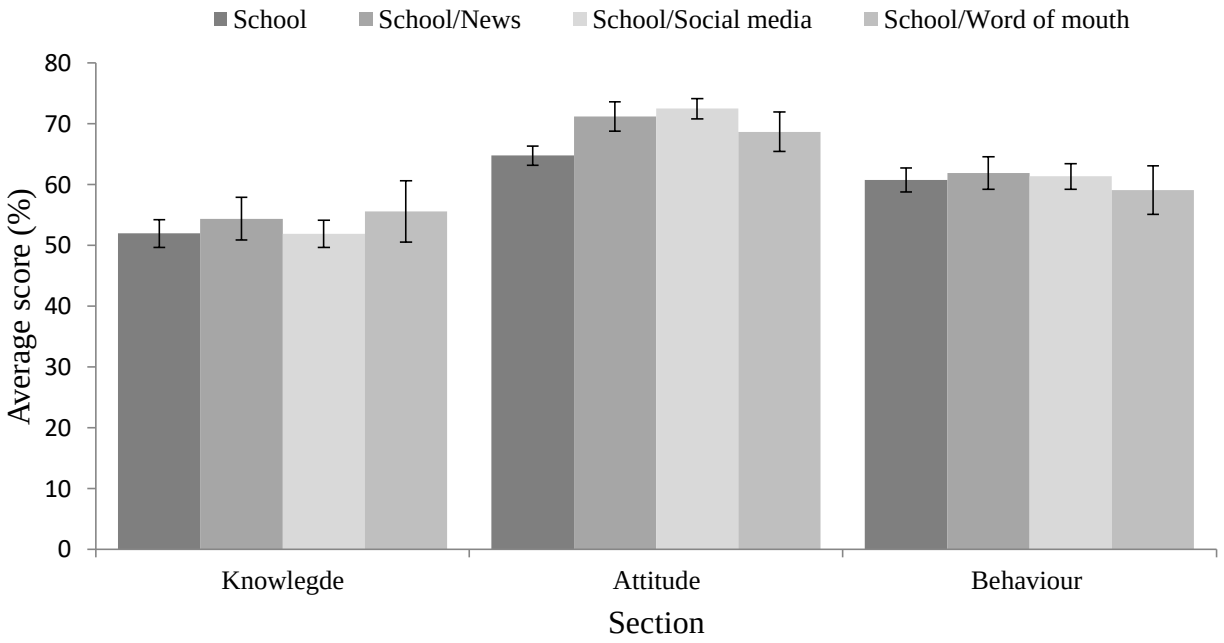


Figure 41: The average, knowledge, attitude, and behaviour questionnaire scores (± SE) of learners who selected school as well as the news, social media, or word of mouth as their primary sources of environmental knowledge.

School encouragement and learner reward

School encouragement

The learners were asked to describe what sustainable behaviours their school encourages. According to the learners from all school types, recycling and anti-litter behaviour was most encouraged by their schools. The learners also responded that their schools' encouraged reusing and reducing strategies for waste, aiding in the school's vegetable garden (if present), reduction of electricity, water and paper usage and participation in the school's environmental committee (if present). The learners from the GDE-U and GDE-L schools mainly stated that their schools encourage recycling, anti-litter behaviour and reduction of water, electricity and paper usage. While the IEB learners also stated this, some included that their school encouraged learners to stop using straws, to participate in environmental marches, to work in the vegetable gardens and to reduce the amount of meat that they consumed. Both the learners from the IEB and GDE-L school groups stated that their school encouraged the learners to make eco-bricks.[1]

It was found that 80%, 48% and 21% of the learners from the IEB, GDE-U and GDE-L groups, respectively, stated that their school encouraged sustainable behaviour (Figure 42). 66% of the total learner sample stated that their school encouraged sustainable behaviour.

[1] **Eco-brick: a plastic bottle filled with compact scraps of plastic and polystyrene to create a brick that can be used to build structures (Taaffe *et al.*, 2014).**

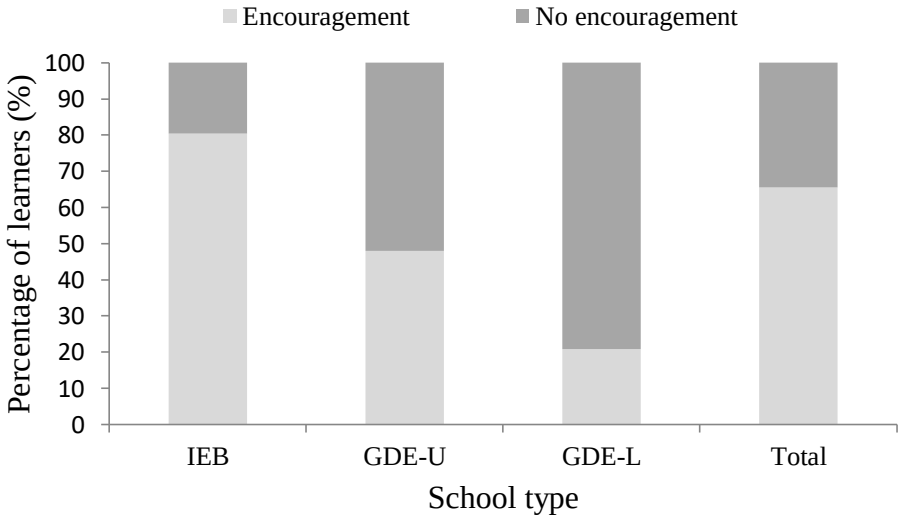


Figure 42: The percentage of learners who perceived that their school encouraged sustainable behaviour in the IEB, GDE-U, GDE-L, and total learner group.

The variation in attitude and behaviour was evaluated between the two groups (the group that received encouragement from their school and the group that did not receive encouragement) (Figure 43). From the total learners sample it was seen that learners who stated that their school encourages sustainable behaviour had a significantly higher attitude ($p<0.001$) and behaviour ($p=0.031$) score than the learners who stated that their school did not encourage sustainable behaviour.

There was a significant difference in attitude scores ($p<0.001$) between the three school types. Both GDE-L groups had a lower attitude score than the IEB and GDE-U groups that stated that their school encouraged sustainable education. There was no significant difference found within school types between the two groups but the group that received encouragement did have a marginally higher attitude score than the group that did not receive encouragement (Figure 43). There was no significant difference in the behaviour scores ($p=0.363$) but it was observed that the behaviour scores for the group that received encouragement was slightly higher than the group that did not receive encouragement.

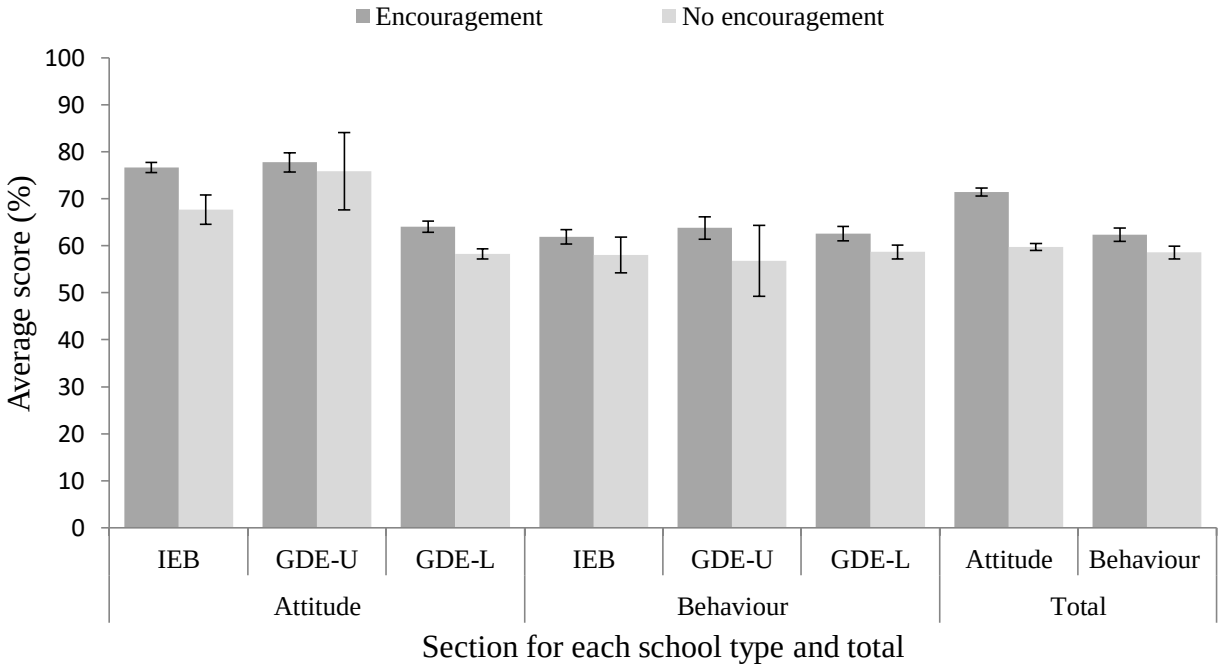


Figure 43: The average (± SE) attitude and behaviour questionnaire scores (%) of learners from each school type and the total learner sample who stated that that their school does encourage sustainable behaviour and learners who stated that their school does not encourage sustainable behaviour.

Learner reward

The learners were asked if their school rewarded sustainable behaviour (Figure 44). These "rewards" that learners mentioned on their responses included a prize to the class/ the sports house that recycles the most, money added to the learners' tuck shop accounts and recognition from the school and peers. It was found that 52%, 9% and 21% of learners from the IEB, GDE-U and GDE-L group (respectively) stated that their school rewarded sustainable behaviour. 70% of the learners that participated in this study stated that their school did not rewarded sustainable behaviour.

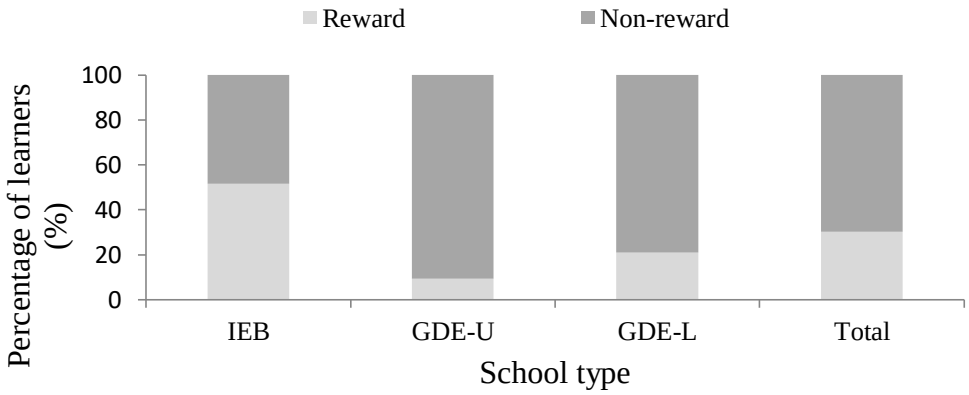


Figure 44: The percentage of learners who stated that their school rewarded sustainable behaviour in the IEB, GDE-U, GDE-L, and total learner group.

From the total learner sample the attitude and behaviour scores for the two groups (learners who stated that they were rewarded and learners who stated that they were not) were compared (Figure 45). The attitude scores for the reward group was significantly higher than the non-reward group ($p<0.001$). There was no significant difference in behaviour ($p=0.068$) but the mean behaviour score for the reward group was marginally higher than the non-reward group.

The average attitude and behaviour scores for the reward and non-reward learner groups were compared across the three school types (Figure 45). There was no significant difference in behaviour scores between the two groups for any of the school types ($p=0.381$) but the reward group in each school type did have a slightly higher mean behaviour score. There was a significant difference between the average attitude scores ($p<0.001$). There was no significant attitude difference between the reward and non-reward group within the three school groups but the reward group did have a slightly higher mean attitude. Both the GDE-L groups had a significantly lower average attitude score than the two IEB groups and the GDE-U non-reward group.

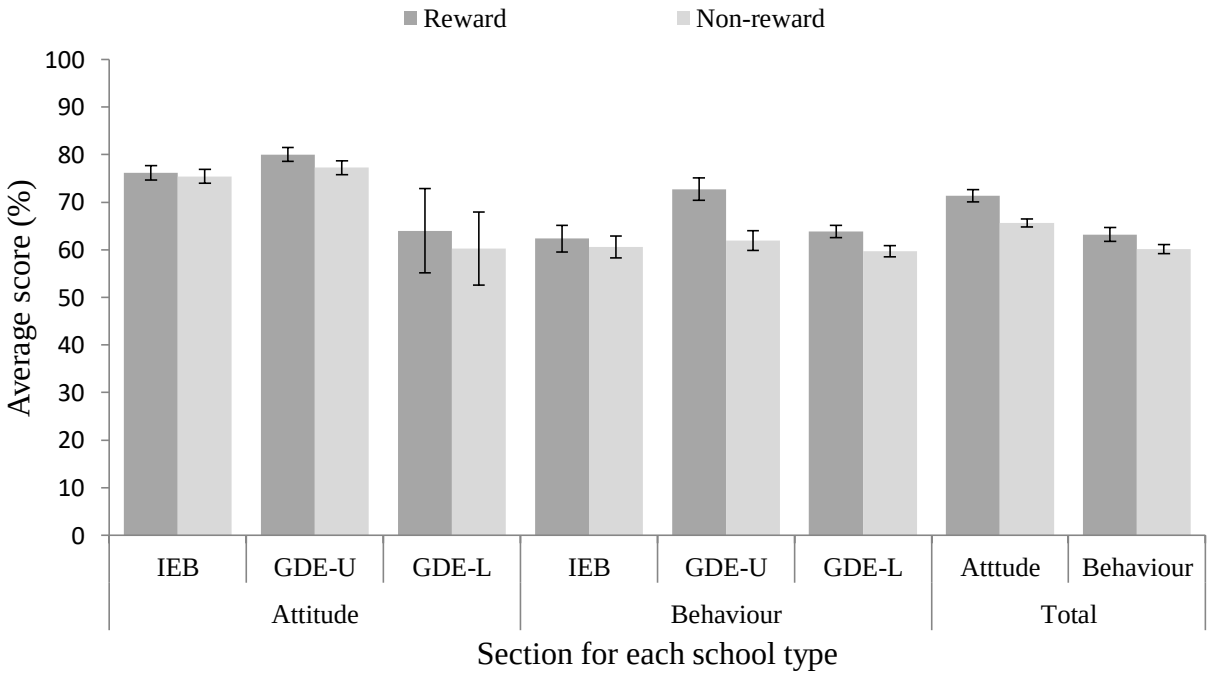


Figure 45: The average (± SE) attitude and behaviour questionnaire scores (%) of learners from each school type and the total learner sample who stated that that their school rewards sustainable behaviour and learners who stated that their school does not reward sustainable behaviour.

Encouragement and reward

The data were further compared to determine which learners stated that their school encouraged and rewarded sustainable behaviour, which learners stated their school either encouraged or rewarded sustainable behaviour and which learners stated that their school did neither (Figure 46). The majority of learners in the GDE-U and GDE-L groups stated that the school encouraged sustainable behaviour rather than rewarding sustainable behaviour. Across all three school types it was

observed that very few schools reward sustainable behaviour without encouragement. In the IEB and GDE-U group it was found that majority of the learners felt that their school encouraged and/or rewarded sustainable behaviour with very few stating that the school did neither, but in the GDE-L group 43% of the learners stated that their school did neither.

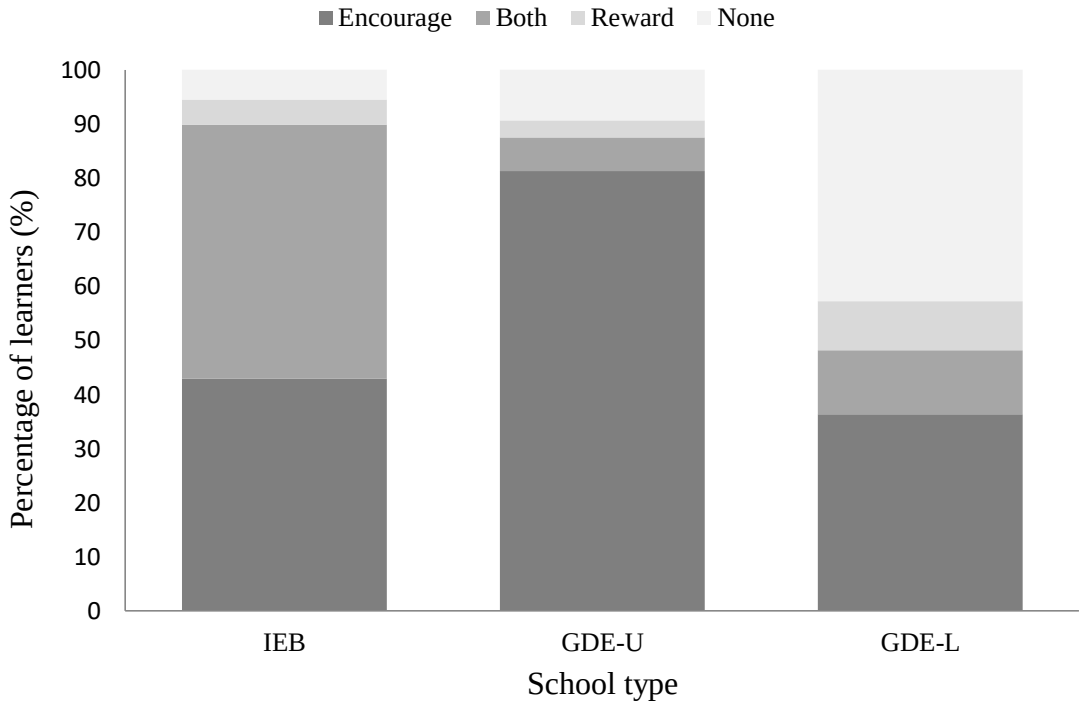


Figure 46: The proportion (%) of learners who stated that their school encourages and rewards sustainable behaviour, encourages or rewards sustainable behaviour or neither across the three school types (IEB. GDE-U and GDE-L).

The attitude and behaviour scores of the learner group that attended schools that encouraged and rewarded sustainable were compared to the rest of the sample (Figure 47). From the total learner sample group it was deduced that the attitude scores for the learner group that stated that their school encouraged and rewarded sustainable behaviour is significantly higher than the remaining learner group ($p<0.001$). There was no significant difference between the behaviour scores ($p=0.098$) but it was observed that the learner who stated that their school encourages and rewards sustainable behaviour had a slightly higher behaviour score.

The attitude and behaviour for the two groups were also compared within and across school types (Figure 47). In the GDE-U group only two learners stated that their school both encouraged and rewarded sustainable behaviour, this makes the data for the GDE-U in this comparison unreliable and accounts for the high standard error. Within school types, the learner group that stated that their school encourages and rewards sustainable behaviour had a marginally higher attitude and behaviour score. There was a significant difference in attitude scores between the two groups ($p<0.001$). The difference occurred across school types, rather than within school types. The GDE-L group that did not state that their school encouraged and rewarded sustainable behaviour scored

lower than the GDE-U group that did not stated that their school encouraged and rewarded sustainable behaviour and both IEB groups. There was no significant difference in behaviour within or between school types (p=0.482).

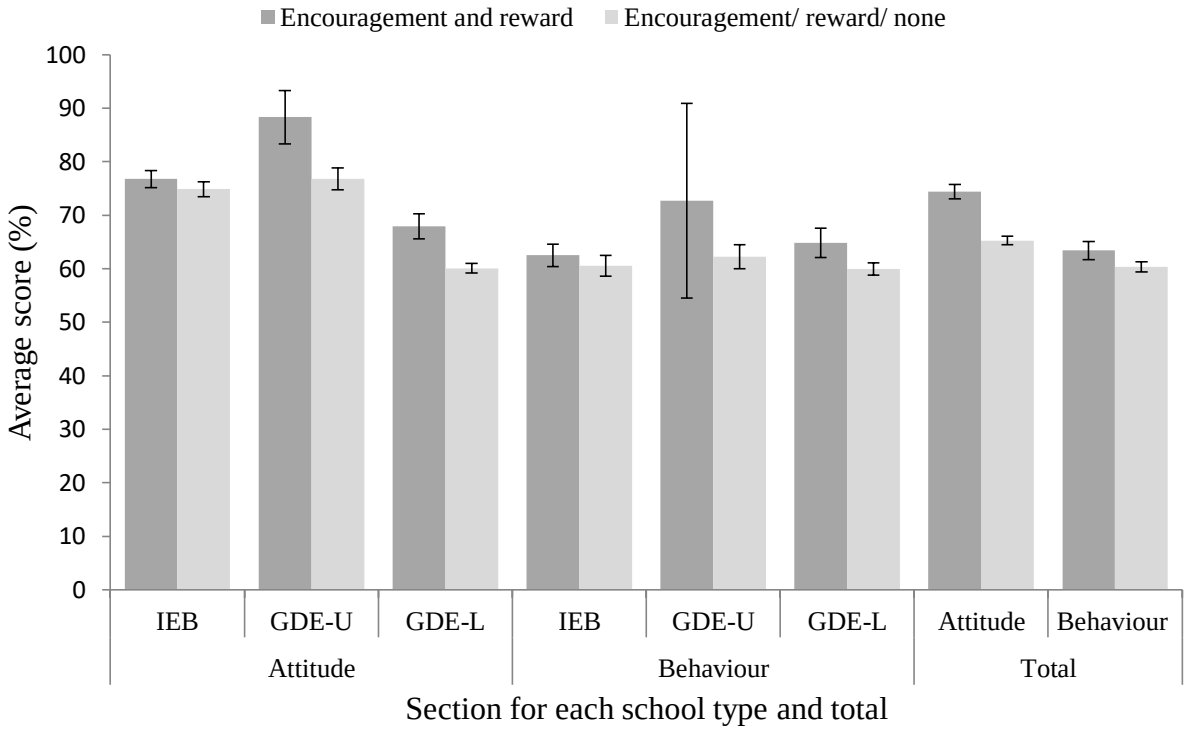


Figure 47: The average (± SE) attitude and behaviour questionnaire scores (%) of learners from each school type and the total learner sample who stated that that their school encouraged and rewarded sustainable behaviour and learners who stated that their school rewarded or encouraged sustainable behaviour or neither.

Other factors that affect environmental literacy

Gender

All schools selected for this study were co-ed schools. 64%, 75% and 67% of the IEB, GDE-U and GDE-L group, respectively, were female participants. Within the total sample group it was found that female learners scored marginally higher than male learners in the attitude and behaviour sections (Figure 48) and had a significantly higher (p=0.024) knowledge score than the male participants. Within the school types there was no significant difference between the male and female groups but there was a significant difference in knowledge (p=0.002) and attitude (p<0.001) across the three school types. The GDE-L male learners had a significantly lower score than the GDE-L female learners and both genders in the IEB group. In terms of attitude, the GDE-L group had a significantly lower attitude than the GDE-U female participants and the IEB male and female groups. With regards to knowledge and attitude, the female learners scored higher than the male participants but in terms of behaviour the male learners had a slightly higher score in the GDE-U and GDE-L school types (Figure 48).

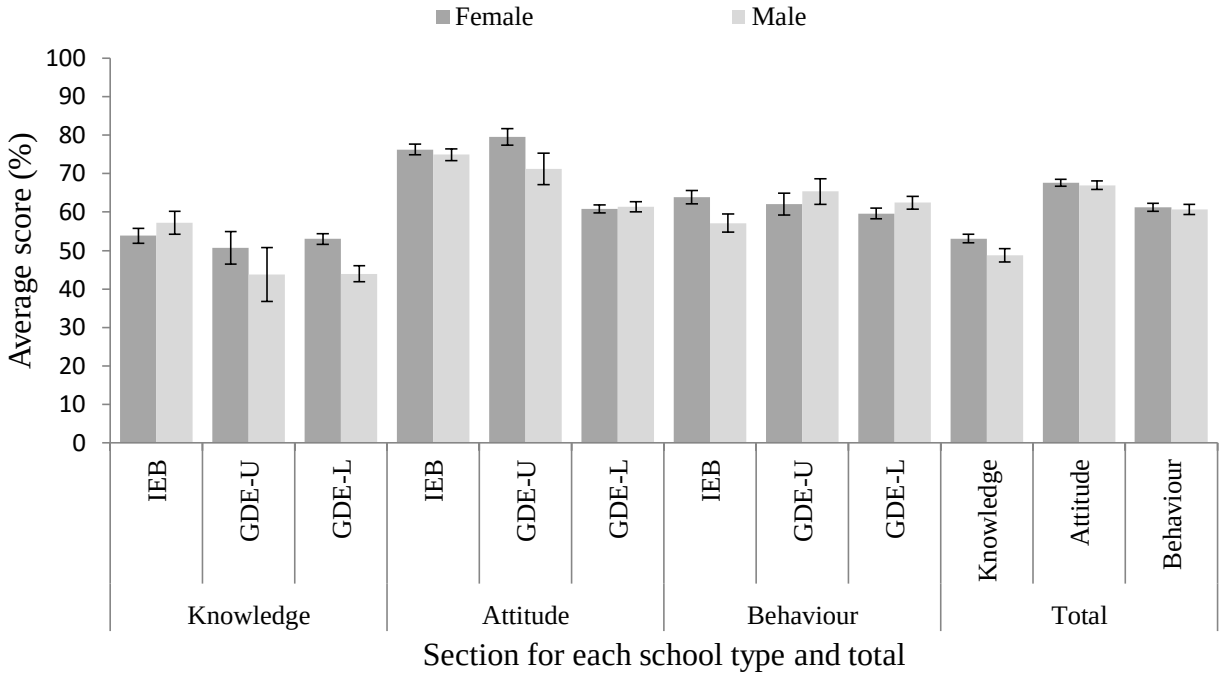


Figure 48: The average (± SE) knowledge, attitude, and behaviour questionnaire scores of male and female learners from each school type and the total learner sample.

Career choice

3%, 3% and 8% of the IEB, GDE-U and GDE-L groups, respectively, stated that they intend on pursuing a career that relates to the environmental/ sustainability field. These careers included marine and environmental conservation and science, zoology, geology, climatology, agricultural sciences and Life Science. 6% of the total learner sample stated that they intend on pursuing a career in the environmental/ sustainability field.

There was no significant difference in the average knowledge ($p=0.940$), attitude ($p=0,241$) or behaviour ($p=0.449$) scores between the learners who intended to pursue a career in sustainability-related fields and those who did not. Learners who did not intend on pursuing a career in sustainability-related fields did have a slightly higher average attitude and behaviour score (Figure 49).

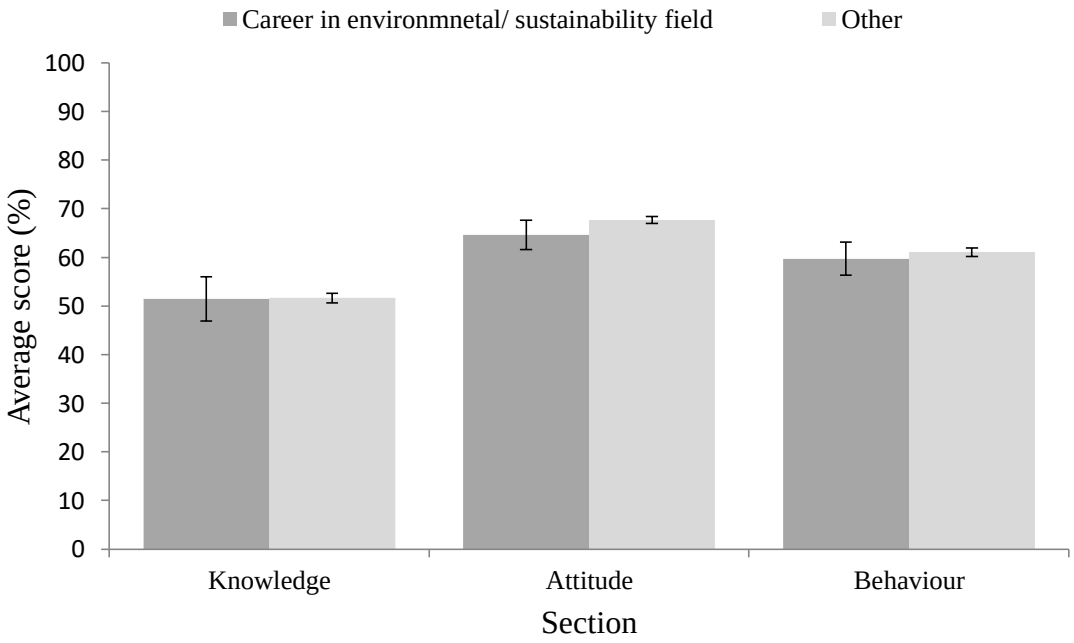


Figure 49: The average (± SE) knowledge, attitude and behaviour questionnaire scores of learners who stated that they intend on pursuing a career in the environmental/ sustainability field and learners who stated that they intend on pursuing careers in other fields.

External EE programmes

12%, 31% and 7% of the IEB, GDE-U and GDE-L group, respectively, were part of external environmental programmes. These programmes included church initiatives, scouts, community clean-up projects, participation in marches and estate programmes. 11% of the total sample group were part of external environmental programmes. It was observed that there was very little difference between the knowledge scores of learners who took part in external environmental programmes and learners who did not but there was a significant difference between the two groups' attitude and behaviour scores (Figure 50), with the group that partook in external programmes having significantly higher attitude ($p=0.005$) and behaviour ($p=0.001$) scores.

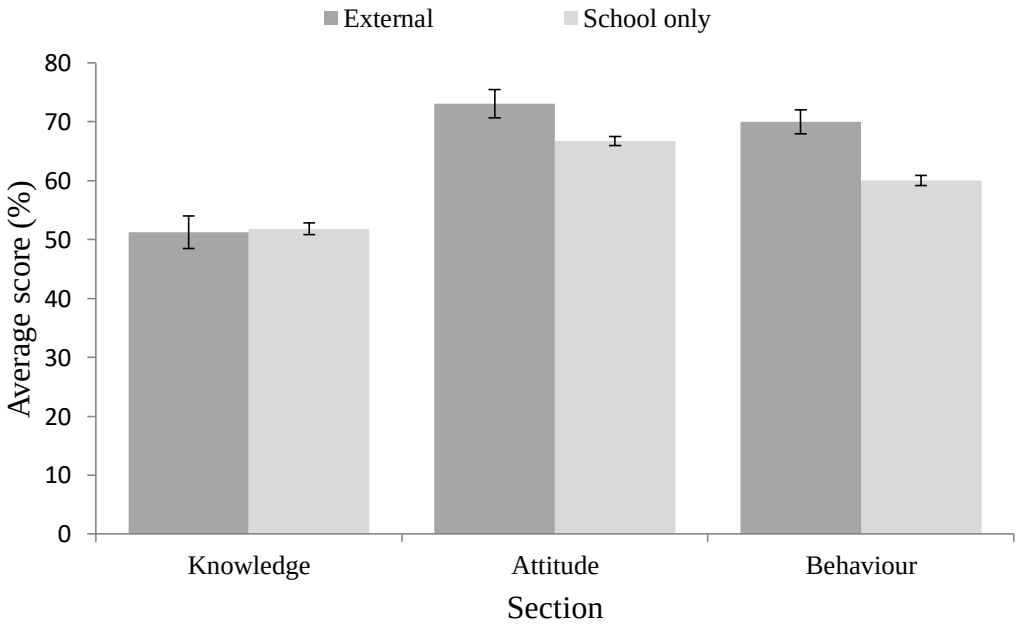


Figure 50: The average (± SE) knowledge, attitude and behaviour questionnaire scores of learners who stated that they were part of an external environmental programme and learners who stated that they were only part of the school's environmental programme.

5.5. School EE programme vs learner environmental literacy

The EE programmes at each school were analysed based on the 10 principles created (based on the Tbilisi principles; appendix 4). It was found from the teacher interviews that the principles least covered by the school quintiles were

- taking a multi-disciplinary approach to EE;
- taking learner input into account and
- incorporating EE into future developmental and growth planning.

The most frequently implemented principles across the entire school sample group (having achieved over 80% of the criteria) were

- the holistic approach to EE;
- making EE a life-long pursuit and
- analysis of the root causes of environmental issues.

Above 70% of the criteria were met for the remaining four principles:

- discussing environmental issues that cover all three of geographic and temporal scales;
- analysing the complexity of environmental issues and
- utilising a range of methods.

The IEB school type scored lower than the other three school types for the principle of discussing the causation of environmental issues. This was due to the educator at IEB 1 stating that the causes

of environmental issues were not covered, but the remaining three IEB educators stated that they fully covered the causes of environmental issues in their lessons. The GDE-U school group scored the lowest for the principles of analysis of environmental issues at a range of geographical scales (educators tended to focus on larger scale issues), analysis of the complexity of environmental issues, use of varying educational methods, utilisation of learner feedback and inclusion of the environment in future growth and development planning. The GDE-U school group scored poorly for the principle of fully covering the complexity of environmental issues because the educators did not encourage creative or critical thinking or group discussions regarding environmental issues. The GDE-L school group scored the lowest of the three school types under the principles of analysis of environmental issues at varying temporal scales, taking a multi-disciplinary approach to EE and taking a holistic approach to environmental issues.

The total scores (from the 10 principles) for each school's EE programme were determined and compared to the average learner environmental literacy score for each school (Figure 51). In terms of the school's EE programme, there was little variation in the total between school types. Overall the IEB school group scored the highest and the GDE-U school type scored the lowest. Contrary to this, GDE-U2 scored the highest of all schools included in this study (meeting 96.9% of the criteria). The second highest scoring school was IEB2 (meeting 90.6% of the criteria) and IEB3, GDEL1 and GDEL3 shared the third highest score (all meeting 73.4% of the criteria). GDE-U1 had the lowest overall programme score of below 40% of the criteria met and IEB4, GDE-U4 and GDE-L2 all met just above 50% of the criteria.

In terms of the learners' environmental literacy (the average total questionnaire scores), the IEB school type had the highest average learner environmental literacy score and met most of the EE programme criteria. The GDE-L school group had lowest average learner environmental literacy score and had the second highest EE programme score.

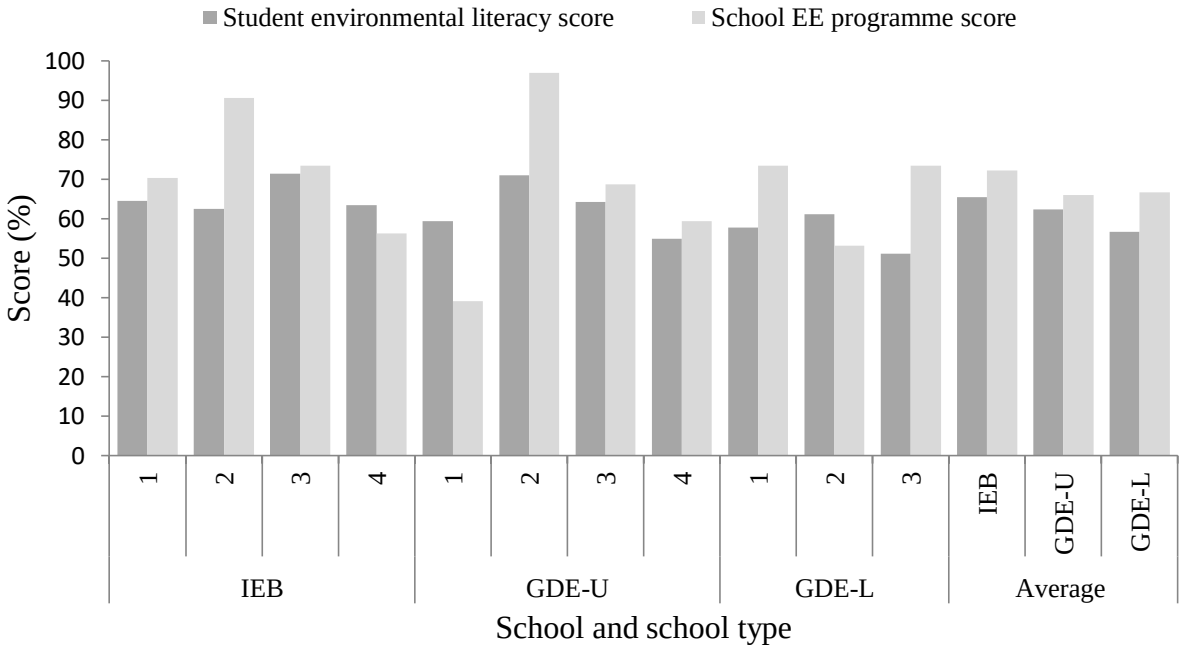


Figure 51: The comparison between the EE programme scores and the average learner environmental literacy score from each school and the total school type.

A further analysis of correlation was done to determine if the EE programme at each school was related to the average learner environmental literacy levels (Figures 52a, b, c, and d). The data were found to have a normal distribution and a Pearson Rank correlation test showed a significant positive correlation between the EE programme scores and the average learner environmental literacy scores for each school ($p=0.16$, $r=0.46$). The average knowledge, attitude and behaviour scores from each school were also tested to see that all three correlated to the EE programme score for each school. There was a positive correlation between the EE programmes scores and the average knowledge scores ($p=0.14$, $r=0.047$), the average attitude scores ($p=0.56$, $r=0.120$) and the average behaviour scores ($p=0.13$, $r=0.49$) for each school. It was observed that there was a weaker correlation between the EE programme score and the average attitude scores while there was a stronger correlation between the EE programme scores and the average knowledge and behaviour scores from each school.

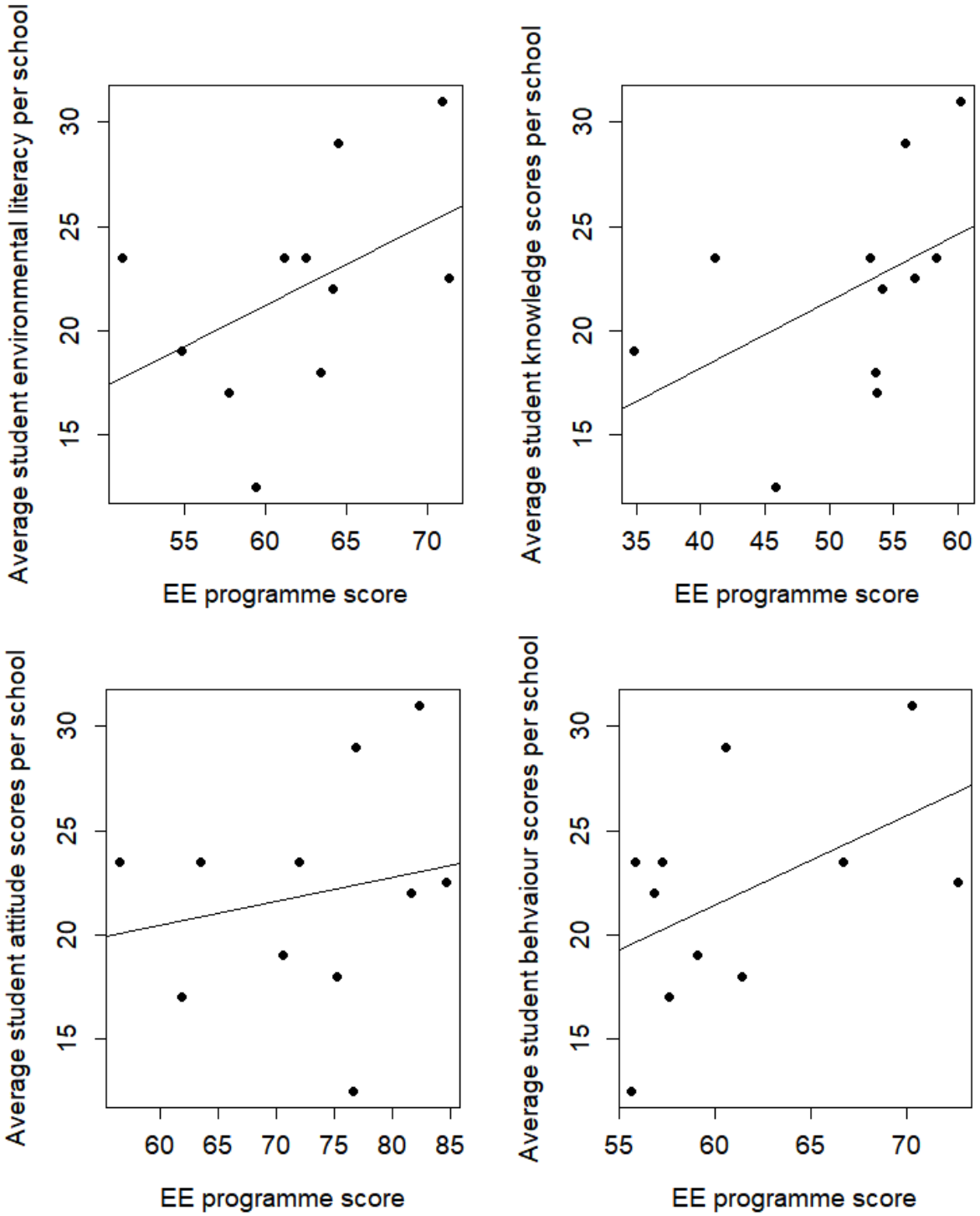


Figure 52a, b, c, and d: The correlation between the school's EE programme scores and the average learner environmental literacy, knowledge, attitude and behaviour questionnaire score at each school.

The relationship between the EE programme scores and average learner environmental literacy scores was also assessed for each school type (Figures 53a, b and c). It was found that there was a strong positive correlation between the two variables within the GDE-U school type (p=0.19, r=0.81) while there was a weak negative correlation between these two variables in the IEB

(p=0.99, r=0) school type and a strong negative correlation in the GDE-L (p=0.88, r= -0.18) school type.

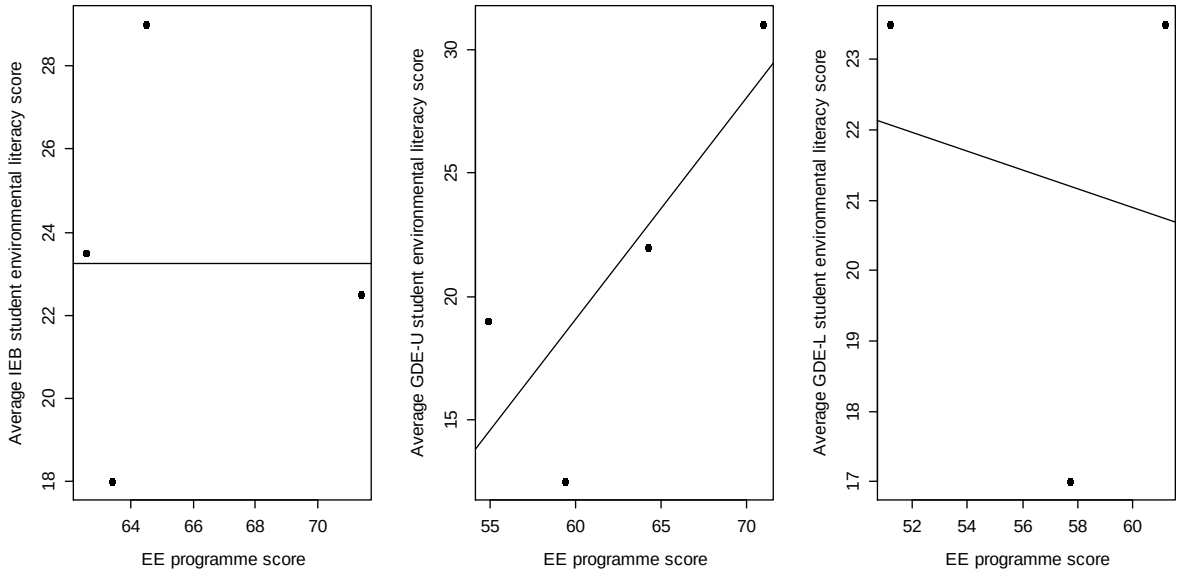


Figure 53a, b, and c: The correlation between the school's EE programme and the average learner's environmental literacy score at each of the three school types.

The information received from the teacher interview was compared to the learner average knowledge, attitude, and behaviour scores for each school (Table 16). The teacher interview was assessed based on in-class criteria, the number of in-class and extracurricular EE methods utilised and the number of Tbilisi principles met by each school. Within the GDE-U school group there was a positive relationship between what was found in the teacher interview and the learner questionnaire responses as both GDE-U1 and GDE-U4 received scores below the average for all for sections of the teacher interview analysis and had overall low scores in the learner questionnaire analysis; the opposite was found for GDE-U2. IEB3 and IEB4 follow this same trend.

From Table 17 it can be seen that, of the eleven schools, in nine of the schools the number of in-class methods utilised and in eight of the schools number of Tbilisi principles met by the schools had a positive relationships with learner knowledge scores. In eight of the eleven schools, the number of extracurricular EE methods utilised by the schools had a positive relationship with the attitude and behaviour learner score.

Table 17: Shows the scores allocated to each section of the teacher interview and the learner questionnaire analysis with the sections in which a school scored below the mean appearing in grey and above the mean appearing in white.

Teacher interview											
	IEB				***GDE-U***				***GDE-L***		
	1	2	3	4	1	2	3	4	1	2	3
In-class criteria score											
In-class methods											
Extracurricular methods											
Tbilisi score											
Learner questionnaire											
Knowledge											
Attitude											
Behaviour											
Total											

Chapter 6: Discussion

The human race has exploited and altered the natural environment in order to promote and support social and economic growth (Gifford and Nilsson, 2014). Many studies have advised that the pathway to creating a sustainable future and society lies in altering unsustainable behaviours in society (Mascia *et al.* 2003; Koger and Winter, 2004; Ehrlich and Kennedy, 2005; Bertoldi, 2019). The creation of sustainable behaviours can possibly be created through Environmental Education (EE) (Hines *et al*. 1987; Brereton, 2018). Difficulties in achieving effective EE are that the behavioural pathway is complex, the effectiveness of various EE methods and how EE programmes can be tailored to various socio-economic backgrounds are unclear (Hallfreðsdóttir, 2011; Sharp *et al.*, 2017; Briggs *et al.*, 2019). This study explored the current stated of EE policy, inclusion in the schooling curriculum, implementation at school and learner reception in Gauteng. This study was conducted in 11 Gauteng schools which all implemented EE initiatives with various levels of commitments. The study consisted of three school types: IEB (private), upper quintile GDE (government) and lower quintile GDE (government) schools. It explored the reasons for Gauteng schools' choices of methods and the effectiveness of these methods in promoting environmental literacy in their learner and considered whether global and South African legislation and policies translate into effective practical EE in Gauteng schools. It was found that South African policy and curriculum lacks mention of specific steps for EE implementation and the curriculum lacks mention of specific EE teaching methods. The Gauteng educators still utilise a variety of EE methods in and outside of the classroom but the implementation and learner reception of EE is still subject to socio-economic factors. It was found that there was a relation between the school's EE implementation and learner environmental literacy. These findings will be further explored in this chapter.

6.1. International and South African documents

From the document analysis (chapter 4, section 1) it was found that, while South African documentation corresponds with international documentation in terms of EE aims and steps that government and organisations need to take to implement EE, South African documents do little to outline how EE should be implemented in both formal and informal education (in terms of what EE should cover and include). This agrees with Ramsarup (2013), who stated that South Africa has successfully integrated SD themes into the country's policy and agenda and thus had created a good foundation on which to re-orientate the system but there had been little support within the Department of Higher Education and the Departments of Basic Education to supply teachers with the training, skills and knowledge that is needed for a green economy and to implement policy.

South African documentation aligns well with aspects of EE covered in international documents. From the content analysis it was seen that NEMA refers to Agenda 21 to set EE objectives and to measure performance, and both the NFSD and NSSD1 applied the global and South African Sustainable Development goals in their frameworks. This means that even though South African documents have not specifically mentioned certain topics covered by international documents, they

may still follow selected principles and guidelines. If this is the case, it is unclear as to whether South Africa applies selected international principles and how these principles may be modified in South African documentation so that they might to be better suited to a South African context (as in the case of NEMA and Agenda 21).

Due to climate change being a global issue, there is a big focus on global solutions even though these solutions need to be implemented at local level, which is complicated for local government (especially in developing countries) to work into already existing frameworks (Fourie, 2018). South Africa is very socio-economically and culturally diverse and is very reliant on the extraction and processing of natural resources in order to create employment and strengthen the economy (National Planning Commission, 2011). The diverse backgrounds of learners and communities in South Africa make it difficult to create standardised EE policy as sustainability has different meanings in different communities, thus EE needs to be tailored to the community and learner (Reid, 2013). These challenges may explain the reason for the gap in South African EE documentation.

6.2. Curriculum documents

In order to assess EE in the curriculum (CAPS) documents, the inclusion of EE, the content ("the what") and the procedure ("the how to") were assessed (chapter 4, section 2). An overall analysis of the syllabuses of the 17 subjects revealed that the South African formal education sector has made amendments to the curriculum to include EE (as stipulated by global and local documents). EE has been integrated across a range of subjects; therefore the overall South African curriculum takes an interdisciplinary approach to EE and, according to Potterton (2021) stated that EE should be incorporated across a range of subjects rather than being presented as a subject on its own, as it is not a reflection of reality to isolate EE. While the curriculum documents for some subjects did not stipulate the inclusion EE, it should be noted that the educators may choose to include EE in their lessons (as demonstrated by an IEB English educator who incorporated EE into comprehensions).

The curriculum documents met more of the EE guidelines set by global documents than those met by the selected local documents. In terms of the EE content, many subjects fell short in terms of the inclusion of environmental legislation, analysis of environmental issues at varying temporal scales, the environment in developmental planning, the complexity of environmental issues and encouraging educators to stay up to date on environmental developments. Overall the EE content was relevant and well integrated into the specific subject, thus well integrated.

The implementation of EE in the curriculum documents fell short in terms of not specifically referencing teaching methods, a variation in teaching methods, practical learning and the creation of practical and critical thinking skills. The curriculum documents met more of the EE guidelines set by global documents than those met by the selected local documents. While the curriculum did leave room for the educators to relate the set work to the context of the learner, the most significant shortfalls of curriculum documents included the lack of specific instruction, as in some subjects EE is not specifically referenced while other subject documents lack detail for EE content and (mostly) implementation, as confirmed by Potterton (2021). Lack of detail or leeway in the curriculum is

both a benefit and downfall of the curriculum (supported by Fien, 2001 and Motshegoa, 2006), as some subjects do not provide a comprehensive framework for content and implementation, thus leaving EE inclusion and implementation up to the discretion of the educator. This is both empowering to educators and potentially dangerous because of educators' lack of environmental knowledge and/or educators' lack of interest in EE (Mokhele, 2011). As stated by a lower quantile government school educator in this study, this could lead to educators implementing EE with varying degrees of effort as one may choose to plan creative and active lessons while others may apply minimal effort and this was also supported by Mokhele (2011). This finding agrees with Maharajh *et al. (*2016), who also stated that the curriculum is in need of teacher input regarding their teaching experiences in implementing EE in relation to the curriculum documents and Cotton (2006) further stated that taking into account educators' opinions would see that the curriculum is implemented as intended. The curriculum documents also made no reference to learner input. Bron *et al.* (2016) stated that this could be due to the process of collecting and incorporating learners' feedback being difficult and that there also may not be a clear process for collecting feedback. Learner feedback is necessary avoid limiting and restricting content and teaching methods and to implement the content stipulated in the curriculum documents within varying contexts (John, 2006).

6.3. In-school implementation of EE

It was found (in chapter 4, section 3) that all schools/educators implemented EE to varying extents. This was in contrast to Potterton's (2021) findings which suggested that many South African schools have ignored EE in the curriculum and policies.

In terms of content, EE incorporated into a range of subjects, as stipulated by the curriculum, but it was found that some educators incorporated EE simply because of curriculum instruction. The schools' implementation of EE met many of the Tbilisi principles but failed to take learner input into account and incorporate EE into future developmental and growth planning, similar to the curriculum documents. In terms of an interdisciplinary approach to EE; many of the educators felt that they did not meet this criteria as it was difficult to take an interdisciplinary approach to EE in a single subject due to them not being knowledgeable enough about other subjects to discuss integrated issues, cross-subject collaborations being time consuming and difficult to co-ordinate and some educators not feeling that EE relates to their subject. However, some schools did conduct cross-subject collaborations through EE projects and the curriculum did include EE across a range of subjects which could imply that the curriculum and, therefore, the educators take an interdisciplinary approach to EE.

Not all educators acknowledged the importance of EE in the schooling curriculum. Studies have found that many educators have an attitudinal barrier to EE as many see EE as a burden, therefore only implement EE when specified (see Ketlhoilwe, 2003; Lane, 2006; Ralph and Stubbs, 2013; Maharajh *et al*., 2016). Many of the educators were not knowledgeable about current environmental affairs and new developments; this was also found in a study by Schudel *et al.* (2008) who found that most teachers in South Africa possessed only a basic understanding of EE. Furthermore, many of the educators did not conduct additional research prior to environmental lessons because of feeling that extra research is not necessary, being overwhelmed by the amount of available

information that is constantly being updated and changed, not having the time or not feeling the push to do research regarding EE beyond the curriculum. This is problematic as the curriculum does not make reference to additional research and does not contain enough information on current environmental issues and current developments, thus the examples used in class (especially in private and upper quintile government schools) tend to be generic.

Most of the educators emphasised that they found it essential to relate their teaching to the learners' home lives and encouraged the learners to participate in extracurricular EE activities in order to make it relatable to the learners and to encourage the learners to implement sustainable practices and behaviours at home, thus meeting a vital requirement of EE (as stated in global and South African documents). This agreed with a study conducted by McIntyre *et al.* (2001), who stated that sociocultural factors need to be taken into consideration when planning and conducting lessons and educators from culturally diverse schools felt that it was very important to utilise home-based knowledge as a building block for school learning.

Although the curriculum documents and South African documents do not call for or specify the use of a variety of EE methods and fall short in clearly describing how EE should be implemented, most of the educators participating in this study used a variety of in-class and extracurricular EE methods (both learner driven and teacher driven) that involve problem solving activities, practical work, group work activities, class discussions, outdoor activities and fieldtrips. However, the less enthusiastic educators did not utilise as many EE methods as the remaining educators. In a study conducted by Mokhele (2011) it was stated that, while some educators took the initiative within their classrooms to vary the EE methods, others did not. Therefore, the lack of specific guidelines or details regarding EE methods and procedures creates inequality and unevenness in EE implementation as the teacher decided how they choose to (or choose not to) implement EE (Potterton, 2021). Other important factors could be time constraints, educators stated that the school year was too short to cover the work set by the curriculum and go beyond the curriculum to include more information and utilise creative methods, this could also prevent educators from going beyond the curriculum requirements and creatively implementing EE.

Another important trend was that many of the educators were unsure as to what EE entailed but once the term was explained, they became aware of a variety of EE methods and initiatives that they themselves and the schools utilised. While this means that they were implementing EE, this lack of knowledge regarding EE makes it difficult to purposefully and effectively implement EE. Furthermore, the lack of knowledge regarding environmental dynamics and developments makes it difficult to conduct more intricate lessons that aimed to foster critical thinking and problem solving skills. This supports findings by Schudel *et al*. (2008) and Ramsarup (2013) who stated that educators did not possess the adequate knowledge or training to implement EE. Ramsarup (2013) further stated that South African teachers lack basic environmental knowledge, teachers could be overwhelmed by the variety of projects relating to school-based EE and inadequate learning and teaching methods in certain schools could hinder EE understanding and teaching and yield poor results.

Educators did feel that utilising certain EE methods proved to be disruptive, time consuming and expensive. Many educators from government schools felt that they did not possess the resources and support from the school or GDE to effectively carry out EE. Challenges in implementing specific EE methods (particularly fieldtrips, outdoor education, class debates and group work

activities) were commonly mentioned in all three school types. The teacher interview in this study agreed with the conclusions drawn by Ramsarup (2013). Ramsarup (2013) found that, in South Africa's implementation of a Decade of Education for Sustainable Development, South Africa fell short because of a lack of funding and resources to address the ESD themes in the curriculum. A variety of other studies found that a lack of teaching materials, time, funds and large class sizes hamper and deter educators from implementing EE (Ketlhoilwe, 2003; Ralph and Stubbs, 2013; Maharajh *et al.*,2016).

6.4. Learner outcome

Curriculum outcome

After assessing the curriculum it was necessary to determine if the curriculum (chapter 4 section 2) effectively translates into learner environmental literacy (chapter 4, section 4). Overall, it was found that the curriculum documents (as assessed in chapter 4, section 2) did not correlate with learner environmental knowledge, attitudes and behaviours. Life Science, physical science, geography, business studies and economics curriculum met most of the EE criteria and were the most commonly selected subjects (with business orientated subjects being more popular in private and upper quintile government schools). It was found that the choice of either life science or geography was not linked to enhanced learner environmental literacy. This could be explained by the curriculum not being sufficient for educators to effectively implement EE as Dube (2014) found that geography educators from the Western Cape had difficulties defining education for sustainable development and environmental education and found that the curriculum did little to clarify this. It may also be due to educators (specifically in upper quintile government schools) stating that the learners were more economically inclined in their decisions and often only selected life sciences or geography in order to fill a subject slot or because they thought that it would be easy.

It was further found that a combination of life sciences and geography did not correlate with enhanced learner environmental literacy, but was rather linked to a lower attitude score and a slightly lower knowledge score. Due to the positive outcome of the curriculum analysis, this outcome was unexpected but could be because of learners who selected both subjects having grown bored or complacent due to an overload of environmental information and too much exposure to in-class EE provided by these two subjects. This finding was in contrast to Walker and Leary's (2009) and Knogler *et al.*'s (2015) findings, who stated that repeated experiences related to complex problems (such as climate change) will allow the learner to create more solutions, enhance their interest and develop their knowledge rather than just completing the section and moving on.

It was found that in most cases business studies or economics linked to little variation in learner environmental literacy, but learners who selected either of these subjects did have a slightly lower sustainable behaviour score and some had a slightly lower attitude score. Again, this outcome was unexpected as the business studies and economics curriculum did incorporate EE extensively (according to the curriculum analysis, see chapter 4, section 2). This outcome could be because of learners who selected business studies or economics being more economically motivated in their decisions, opinions and outlooks. Furthermore, the variation could be due to another subject (which many of these learners did not select) inspiring positive environmental attitudes, as neither business

studies/ economics, life science or geography were linked to enhanced environmental attitudes or sustainable behaviours. It was noted (chapter 4, section 4) that the lower quintile government school learners who selected business studies or economics had a higher knowledge score, which could mean that lower quintile government school educators are more capable of integrating the environment into an economic context, but further research is needed.

Physical science was linked to increased knowledge and behaviours (chapter 4, section 4). Across all three school types learners who selected Physical Science received a higher behaviour score. This was unexpected as when examining the curriculum statements for the four subjects Life Science, geography and business studies/economics have an environmental section and integrate EE into other topics but physical science did not have either, rather mentioning environmental topics sporadically. The physical science curriculum met a moderate number of EE contents criteria (even though the curriculum did not have a dedicated EE section) and met most of the implementation criteria by utilising a variety of methods, touching on environmental topics each year, fostering problem solving and critical thinking skills and allowing learners to acquire practical skills (see chapter 4, section 2). In order to better understand the relationship between the physical science curriculum/ implementation and enhanced environmental literacy (as seen in chapter 4, section 4), further studies are needed.

The effectiveness of school EE programme

Overall it was found that there was a positive relationship between the schools' EE programmes and learner environmental literacy. This finding agreed with Kadji-Beltran *et al.* (2001) who stated that the schools' EE programmes have a great influence over environmental attitudes in learners and Erdoğan and Uşak (2009) found that enhanced environmental knowledge can be positively linked to pro-environmental attitudes and sustainable behaviours.

There was a positive relationship between learner environmental literacy and the schools' implementation of EE in upper quintile government schools, while there was no relationship between the schools' EE programmes and learner environmental literacy the in the private schools, and within the lower quintile government schools there was a negative relationship between the schools' EE programmes and learner environmental literacy. A variety of studies have shown that socio-economic factors impact the way in which EE and the curriculum is implemented and received therefore the effectiveness of the school's EE in influencing learner environmental literacy could be due to socio-economic factors (see section 6 of this chapter, Fortes and Tchantchane, 2010; Reid, 2013; Edsand, 2019; Edsand and Broich, 2019; Knutsson, 2020). Another factor that could influence how the school's EE programme is received by learners is the use of specific EE methods which will also be further discussed later (see section 8 of this chapter, Kostova and Atasoy, 2008).

The number of extracurricular methods (such recycling programme, environmental committee, vegetable garden, etc.) offered at schools were positively related to learner environmental attitudes and behaviours, while the number of in-class EE methods and the number of Tbilisi principles met by each schools had a positive relationship with learner environmental knowledge. Therefore it can be seen that varying aspects of a school's EE programme have varying effects and impacts on the

three components of a learner's environmental literacy, this will also be further discussed later (in section 8 ad 9 of this chapter).

6.5. Socio-economic influences

The South African education system has made great strides to combat past inequalities (post-apartheid), but many inequality (race, gender, class, etc.) are still present (van der Berg 2007; Morrel *et al.* 2009; Sayed and Motala 2012; Spaull 2013). Therefore, it is important to examine EE implementation and reception in South Africa with respect to socio-economic factors. In order to do so, the EE implementation and learner reception in South African private (upper class), upper quintile government (middle class) and lower quintile government (lower class) schools was assessed.

Variation in EE programme:

The most common reason for EE implementation by private schools was that the educators felt that they had a moral duty and that their learners are sheltered and disconnected from the real world and environmental issues. The lower quintile government educators implemented EE primarily due to positive learner outcomes because they felt that their learners were personally affected by climate change and environmental degradation in the community and some stated that they wanted to open up new career opportunities for learners (although learners with environmental career aspirations did not display a higher environmental literacy). The reasons for inclusion of EE in upper quintile government schools varied; in two of the schools the educators felt that it was their moral duty to include EE, while the remaining two mainly implemented EE because the GDE stipulated that they should.

Within the government schools there was variation in the manner in which the schools approached EE (see chapter 4, section 3). The upper quintile government schools tended to place the least emphasis on EE outside of the curriculum, while the lower quintile government schools fell short in terms of their use of extracurricular methods. All lower quintile government educators acknowledged the immediate importance of EE for their learners and also stated that they implemented EE because of positive learner outcomes and learner enthusiasm during EE lessons, while not all upper quintile government educators acknowledged the importance of EE and mostly implemented EE due to a personal or GDE push. While the government educators mentioned many barriers to EE that pertained to lack of resources and funding, a large class size and a lack of support, the upper quintile government educators also mentioned learner disruptive behaviours as a prominent barrier to EE in their schools. The upper quintile government educators utilised fewer active teaching approaches because these educators did not find these methods attractive or effective as the learners were disruptive and distracted during these lessons, which hinders and distracts other learners (Arbuckle and Little, 2004). The disruptive behaviour of the upper quintile government school learners could relate to upper quintile government school educators reporting that the learners are marks-driven (chapter 4, section 3), therefore if they feel that they are participating in activities that will not be graded, they show less interest and put less effort into

these activities (Taylor, 2018). In contrast, the learners from the lower quintile government schools were respectful, participatory and obedient during practical EE lessons and the educators felt that the learners enjoyed EE lessons more than other topics.

The learners from the lower quintile government schools experience the effects of climate change in their everyday lives, therefore the educators focus on local environmental issues and also felt that learners are unable to visualise global issues, a finding also expressed by Knutsson (2020). Educators from upper quintile government schools and the private schools tended to focus on global environmental issues as their learners are highly influenced by social media and the internet, and they do not feel that the learners directly experience the effects of climate change in their home lives. The private and upper quintile government educators had to be creative in constructing examples as they, unlike the lower quintile government educators, did not have a lot of personal examples to draw from.

Although the curriculum documents guide what the educators teach, the analysis of schools from varying socio-economic classes allows one to see how the educators do attempt to tailor the curriculum to their school and their learners and that the educators have varying experiences and opinions regarding EE. The educators using their discretion to select examples could prove to be beneficial. This is because, as stated by McIntyre *et al.* (2001), Rea and Mercuri (2006) and Gay (2018), educators need to be aware of socio-economic and cultural differences in learners and adapt accordingly in order to use the learners' current knowledge and experiences as a foundation. Furthermore, Reid (2013) stated that sustainable development has incorrectly been used in poorer communities with the premise that the community needs to continuously change to meet the same standards as the rest of the world; as in reality sustainable development evolves differently in different communities. Therefore, this is more reason why the curriculum documents need to be re-evaluated with educator input so that the premise of EE and sustainable development/ behaviour will be updated and redefined for schools from varying socio-economic/ cultural backgrounds. Furthermore, the educators need EE training that particularly relates to how to tailor their lessons to their learners' needs.

Variation in learner environmental literacy

From the comparison of the three school types it was found that, while there was little difference in sustainable behaviours, the private school learners displayed a higher level of environmental knowledge than the government school learners and overall the lower quintile government learners expressed lower environmental attitudes. The increased environmental knowledge displayed by the private school learners supports the findings of Lin and Shi (2013) who stated that learners of a lower socio-economic status are less environmentally aware and Edsand and Broich (2019) who found that learners from private schools tend to possess greater environmental knowledge. Edsand and Broich (2019) also found that a low quality of educational resources were indicators of low environmental awareness in schools and this could account for the lower average knowledge scores of the government schools, particularly in the lower quintile government schools where lack of resources was a common barrier to the implementation of EE. The variation in environmental knowledge could be because of environmental awareness and knowledge being positively related to schools' availability of teaching resources and class size (Fortes and Tchantchane, 2010; Edsand,

2019). Private schools tend to have smaller classes and adequate access to teaching resources, while government schools have to spread their (already scarce) resources thinner due to their large class sizes (Renaud *et al.*, 2007). The enhanced environmental knowledge displayed by the private school learners could be related to their parents possessing a higher level of environmental knowledge when compared to the parents who have enrolled their children in government schools, as Makki *et al*. (2003) found that learner environmental knowledge is positively related to parent knowledge. Another explanation of the private school learners' enhanced environmental knowledge could be linked to the different approach these schools take to education as the IEB (private) schools do not teach the set work or assess the set work in the same manner as GDE (government) schools. Further assessment on the effectiveness of the IEB and GDE teaching structure is necessary.

With regards to the lower quintile government school learners expressing lower environmental attitudes, this finding was unexpected as the lower quantile government school educators did not list many barriers to developing positive environmental attitudes. Furthermore, the lower quintile government school educators listed more reasons for their inclusion of EE that linked to positive learner outcomes and effective EE methods and listed the least number of barriers to positive outcomes compared to the remaining two school groups. The low environmental attitudes could be linked to a low number of extracurricular EE activities offered by the schools (as discussed above, the number of extracurricular methods can be linked to environmental attitudes and behaviours) or could be linked to the lower quintile government school educators stating that they faced many barriers that relate to effective implementation of EE methods and activities. According to the educator interviews (chapter 4, section 3), the lower quintile government school learners live in township communities and are exposed to an array of environmental issues such as water pollution, land pollution and water shortages, therefore the low environmental attitude of the lower quintile government school learners contradicted papers that stated that individuals that live closer to environmental problems tend to be more concerned about the environment (Arp and Kenny, 1996; Bassett *et al.*, 1996). The low attitude could be linked to learner value systems as other papers have found that middle to upper class citizens tend to display a higher rate of energy conservation, recycling and green consumer behaviours which positively correlates to GDP per capita, and also found that learners of a higher socio-economic status had a higher environmental literacy and displayed a higher level of concern (Balderjahn, 1988; Howard *et al*., 1993; Laidley, 2011; Franzen, 2003; Edsand and Broich, 2019). This may be because of middle to upper class citizens and learners from these homes having adequate financial resources to practice green consumerism and are, therefore, more likely to possess post-materialistic values that could translate to pro-environmental attitudes (Fukuyama and Inglehart, 1997; Franzen, 2003). Therefore, this decline in pro-environmental attitudes in the lower quintile government school learner group could be due to learners being from lower class areas, thus having to worry about meeting their basic needs with limited funds and limited access to resources, which makes them less likely to possess post-materialistic values or concerns. People from a lower socio-economic status tend to have a lesser sense of personal control, therefore the lower quintile government school learners could feel helpless and insignificant in the face of environmental degradation (Manstead, 2018).

There was also a variation in environmental knowledge between male and female learners from different socio-economic backgrounds, while there was little to no variation in attitudes and behaviours. This agreed with a study conducted by Hayes (2001) who found that there is often a variation in environmental knowledge between genders but this variation does not translate into a

variation in attitudes or behaviours. It was found that in the government schools the female learners possessed a higher level of environmental knowledge while in private schools male learners possessed a higher level of environmental knowledge. This finding relates to a study conducted by Paramjit (1993) which found that, amongst learners from a low socio-economic class, females tend to possess greater environmental knowledge but amongst learners of higher socio-economic class males tend to possess higher environmental knowledge. It has been found in various studies that, while female learners produce positive results in a classroom setting, male learners perform better when they are able to interact with the course work practically and work outdoors, therefore by utilising a variety of methods and strategies, learners from a variety of different groups may be able to benefit (Taylor and Lorimer, 2002; De Gaer *et al*., 2007; Carrier, 2009). This could be the reason for the variation in environmental knowledge seen in this study as the private schools provided a greater number of practical EE methods.

Therefore it can be seen that not only do schools from varying socio-economic backgrounds implement EE differently with different motivations, but the environmental literacy of learners is affected by socio-economic factors and learners from varying socio-economic backgrounds received EE differently. Due to this, it is necessary to consider the educators, schools' and learners' socio-economic backgrounds when planning for and implementing EE.

6.6. Sources of Knowledge

The majority of the learners selected a combination of knowledge sources (ie. social media, school, news and word of mouth; see chapter 4 section 4). This was expected, as learners do not acquire their knowledge from one source but a variety of mediums (Tunnicliffe and Reiss, 2000). Overall, social media was the most commonly selected source of environmental knowledge, followed by news and school. Social media was the most common source of environmental knowledge amongst the private and upper quintile government school learners, while news was most commonly selected amongst lower quintile government school learners. When compared to the upper quintile government school learners, more lower quintile government and private school learners selected school as a source of environmental knowledge.

Less than 40% in each school type selected school as one of their sources of environmental knowledge. The overall sample group (more specifically, the lower quintile government school learners) who selected school as a primary knowledge source displayed a slightly higher knowledge score than the learners who selected social media. This could also be because the educators (specifically the lower quintile government school educators) attempt to make the EE lessons relatable to the learners' home lives and according to Eames *et al*. (2018) the learners tend to respond better when the environmental content is related to their home lives and social settings. The schools may be providing reliable information that is not bias or speculative like social media tends to be. An important observation is that the average knowledge, attitude and behaviour scores of the upper quintile government school learners that selected school as a knowledge source was lower than for learners who selected other sources. This could mean that the upper quintile government school learners respond more positively to other sources of knowledge.

It was further established that learners who selected school as their sole source of environmental knowledge displayed a lower pro-environmental attitude than those who selected school along with news or social media, suggesting that, while social media and news do not actually promote knowledge acquisition (as stated above), they do encourage pro-environmental attitudes. This does not seem to translate into enhanced sustainable behaviour. The positive outcome of school coupled with social media agreed with Mao (2014) who stated that learners display positive attitudes towards the incorporation of social media in school learning. Mao (2014) suggests that schools should utilise social media as an educational tool.

6.7. EE methods

The effectiveness of EE (chapter4 section 4) is strongly related to the teaching methods utilised by educators (Kostova and Atasoy, 2008). The most common EE in-class methods mentioned across all three school types were the use of pictures and posters as visual aids and reminders, outdoor education, excursions, group work activities, class debates, presentations and practical sessions. In terms of extracurricular EE, the private school group utilised the most extracurricular EE methods, mostly mentioning the use of an environmental committee, the presence of recycling bins around the school and the conduction of recycling drives. The most common extracurricular method utilised by government school groups was conducting school wide anti-litter drives. The lower quintile government school educators also mentioned that their schools had vegetable gardens on the premises (the learners did not work in the gardens but the garden was created for the community to harvest and consume; see chapter 4 section 3). This is beneficial as teachers and schools need to select a variety of education methods to address an array of learning strategies to ensure that the EE curriculum accommodates all learners with different learning styles: auditory, visual, verbal and kinaesthetic (Dreyer and Loubser, 2014).

From the teacher interviews and curriculum analysis it is seen that all schools implement EE, in a variety of forms and to varying extents. From the comparison of the learner environmental literacy levels and each school's EE programme, it was found that the learners from the schools that met the highest number of Tbilisi principles and utilised the highest number of in-class EE methods had the highest level of environmental knowledge and the learners from the schools that utilised the most extracurricular methods had the highest level of pro-environmental attitudes and sustainable behaviour. This finding contracdicted those by Borchers *et al*. (2013) who found that extra-curricular EE enhanced environmental knowledge. This finding does, however, show that varying EE methods have varying effects on learner environmental literacy. This supports Kostova and Atasoy's (2008) view that it is no longer adequate that educators are able to explain concepts, they need to be able to stimulate, challenge and encourage learners to engage with these concepts. The teacher needs to guide learners towards practical application, critical thinking, problem solving and independent thinking and learning (Kostova and Atasoy, 2008). Therefore utilising methods that relate to all three aspects of environmental literacy means that the EE implementation needs to more than simply convey information.

From the learners that stated that their school implemented EE, the learners' answers regarding the specific EE methods provided by their school often agreed with the answers received during the teacher interviews. Overall the use of any of the EE methods provided positive results in at least one of the components of the learners' environmental literacy. Gardening, school clean-ups and the use of an environmental committee were linked to enhancing learner overall environmental literacy. As stated above, it was further shown that in-class EE was only linked to enhanced learner environmental knowledge (in private and lower quintile government school schools); this could be due to the learners needing more practical based methods to enhance environmental attitudes and behaviours. This being said, the upper quintile government school learners that stated that their schools utilised in-class EE did not display an enhanced level of environmental knowledge. This could be because of upper quintile government school educators stating that most of the learners are disinterested in (particularly classroom based) environmental topics and are more interested in other sections or other subjects all together (chapter 4, section 3), thus (as supported by Hawkins, 2013) this indifference towards EE creates a barrier to promoting pro-environmental knowledge. In terms of educator issues when implementing in-class EE, many educators acknowledged the importance of EE but also felt that they did not have the time or the knowledge to plan and carryout creative EE lessons. Many educators from the private and upper government school quintile schools stated that the learners tend to be disconnected from environmental issues, believing that they did not share any blame and one upper quintile government school educator stated that the learners lacked a basic understanding of environmental issues due to a general disinterest in the topic, making it difficult and time consuming for the educators establish what the learner's currently level of environmental knowledge is.

The extracurricular and practical EE methods had a greater influence on learner attitudes and behaviours. This is in agreement with the constructivist paradigm, as expanded on below, which places emphasis on active and learner driven methods of education in order to allow the learner to construct their own knowledge base and own understanding (Steffe and Gale, 2012). These active methods of learning are linked to not only enhanced knowledge but also seem to enhance pro-environmental attitudes and sustainable behaviours. It was found that most EE methods (excluding in-class EE and outdoor EE) significantly enhanced learner environmental attitudes. While outdoor education did not seem to improve environmental attitudes, the learners who stated that their school utilised outdoor education had a higher sustainable behaviour score. This contradicts the findings of Palmberg and Kuru (2000) who found that learners who were exposed to outdoor education displayed a higher frequency of sustainable behaviour; they also found that outdoor education was linked to a higher level of environmental knowledge. It was also found that recycling initiatives and placing recycling bins around the school was linked to learners having a higher sustainable behaviour score. Field trips enhanced both learner environmental pro-attitudes and sustainable behaviours. This being said, the teacher interview showed that implementing active methods of EE such (as fieldtrips, gardening, outdoor education and recycling programmes) were problematic.

Overall the use of encouragement and/or rewards to encourage sustainable behaviours was linked to enhanced environmental attitudes and sustainable behaviours in learners. This is in agreement with the behaviourism paradigm which states that reinforcement and conditioning can alter the frequency of a behaviour re-occurring and create positive attitudes towards the behaviour (Mwamwenda, 1995; Schulze, 2014). Drexler (2010) stated that a common educator opinion is that rewarding learners encourages participation. Overall it was found that, while encouraging and rewarding

sustainable behaviours enhanced learner sustainable behaviours, encouraging sustainable behaviours was found to be more impactful in enhancing pro-environmental attitudes. It was also found that learners who were both rewarded and encouraged possessed higher pro-environmental attitudes than learners that had received only rewards or encouragement. A common argument is that rewarding learners would decrease their intrinsic motivation, but many have found that this is true while others have found evidence to say otherwise (Akin-Little and Little, 2004; Cameron *et al.*, 2005; Davis *et al*., 2006; Drexler, 2010). In the case of this study, it seems that rewarding learner sustainable behaviours could diminish learner intrinsic motivations as rewarding sustainable behaviours did not have a significant impact on learner pro-environmental attitudes, therefore constant encouragement seems to be more effective to create long-term sustainable behaviours.

The lack of learner input in curriculum creation and lesson planning could create a possible challenge in aiding learners to surpass their current Zone of Proximal Development (ZPD). This is because lack of learner input may lead to educators leaving some of their learners behind and not properly adapting the curriculum content and choice of methods to a specific school or class. In order for the learners to surpass their current ZDP (which they could not do unaided), they need to be assisted and guided by a more knowledgeable individual (Khaliliaqdam, 2014). EE included in the curriculum also progresses in difficulty, starting simple and becoming more complex, thus allowing the learners to work through their ZPD, but many of the educators stated that they were not knowledgeable about environmental issues, current affair and developments, making it difficult for the educators to guide the learners through their ZPD. Guk and Kellogg (2007) stated that, due to large public (government) school classes, it is difficult to implement practices that relate to learner ZDP, and they often dismiss these practices. Yet many of educators from each of the three school types did make reference to adapting the curriculum by utilising examples that the learners would understand and relate to, as it was found that learner social and cultural background is important to make lessons more meaningful and relatable to their current ZDP (Guk and Kellogg, 2007). Many educators make use of co-operative EE methods which is beneficial as learners who are more comfortable and knowledgeable about EE topics are able to aid learners who are not as knowledgeable and may struggle to grasp the topic (supported by Ovando *et al.*, 2003).

An educator from one the government school had a background in a variety of fields (education, economics and science), consistently read about and discussed new advancements and, therefore, felt comfortable and confidence conducting debates and critical thinking activities. The learners from this school displayed a higher environmental literacy than the remaining sample. Looking at the curriculum and South Africa policy documents, a large issue with EE teaching methods is that educators are not encouraged to utilised creative teaching and assessment methods, and better tools are needed to monitor and assess EE tools and the impact of EE on learners (Ramsarup, 2013). Kostova and Atasoy (2008) stated that EE teaching requires a lot of time and research (on the part of the educator). In order to be innovative, we need qualified educators, educator and/or learner collaborations and involvement of parents.

6.8. Drivers of sustainable behaviour

In chapter 2 the behavioural pathway was introduced and explored. The main drivers of sustainable behaviours identified were knowledge and attitude along with values, beliefs, perceived behavioural control, subjective norms, habits and external forces (Ajzen and Fishbein, 1980; Ajzen, 1985; Hines *et al.*, 1987; Stern, 2000;de Groot and Steg, 2009; Matthies *et al.*, 2012). The influence of these behavioural drivers was assessed in terms of the learner questionnaire (see chapter 4 section 4) and teacher interview (see chapter 4 section 3) answers. The overall knowledge, attitude and behaviour scores of the total sample correlated across the three sections and the answers to questions that related across and within the questionnaire sections were found to have a positive correlation. The three sections displayed a positive correlation for both the government school groups which could only mean that the learners answered these questions truthfully (even with the small upper quintile government school sample) and could also mean that within the government school groups, knowledge and attitude are indicators and potential influencers of sustainable behaviour (Erdoğan and Uşak, 2009; Polonsky *et al*., 2012). However, the knowledge and behaviour scores of the private school sample group displayed a negative correlation. This might not mean that the private school learners were untruthful but could rather mean that in the case of private school learners, environmental knowledge may not lead to sustainable behaviours or that sustainable behaviour can still be displayed with a lack of environmental knowledge. As discussed in chapter two, the behavioural pathway is complex and the pathway between knowledge and behaviour is crowded with a variety of other possible drivers (de Groot and Steg, 2009). There have been a number of papers that concluded that there is little relationship between environmental knowledge and sustainable behaviours (Negev *et al.*, 2008; Braun and Dierkes, 2017; Otto and Pensini, 2017; Roczen *et al*., 2013). Yet Makki *et al.* (2003) found that, while learners could possess pro-environmental attitudes and sustainable behaviours in the absence of environmental knowledge, knowledge is still necessary to make informed decisions as willingness to take action without knowledge will not always create a positive outcome. It was stated above that extracurricular EE methods could be linked to enhanced pro-environmental attitude and sustainable behaviours, therefore to better understand this, the extracurricular EE methods and their outcomes need to be assessed in conjunction with the behavioural pathway and behavioural influencers.

It can be seen from the socio-economic analysis (section 5.2) that learners with a lower socio-economic status (the lower quintile government school group) displayed a lower pro-environmental attitude, while he learners with a higher socio-economic status (the private school learners) possessed a greater level of environmental knowledge. There is a thus a clear link between the learners' socio-economic background and pro-environmental attitudes, possibly because of these learners with a lower socio-economic background being less likely to possess post-materialistic values (Balderjahn, 1988; Howard *et al*., 1993; Franzen, 2003; Laidley, 2011; Edsand and Broich, 2019). However, the decline in pro-environmental attitudes expressed by lower quintile government school learners did not translate into a decline in sustainable behaviour when compared to the other two school groups. This brings into question the influence of socio-economic status, as an external force, on learner sustainable behaviour. Further, brings into question the influence that pro-environmental attitudes have on sustainable behaviour and whether there may be a stronger driver for sustainable behaviours.

According to one of the private school educators, the learners tended to acquire their environmental knowledge and passions from social media but heavily influence each other to take part in environmental initiatives, therefore the subjective norm played a large role in creating sustainable behaviours. Two more private school educators stated that the educators at the school all shared the same passion for EE and environmental conservation, all encouraging the learners to recycle and take part in environmental initiatives. This being said, pro-environmental social norms created by teachers and learners had varied impacts on learner sustainable behaviours. Many of the educators did make particular reference to the importance of at-home support for learners and the power of parental influence in the creation of long-term sustainable behaviour. These educators also stated that the learners lacked support from home in terms of sustainable behaviours. A study done by Matthies *et al.* (2012) showed that sustainable habits (recycling and reusing) can be created through parent influence and support at home. Edsand and Broich (2019) showed that parental values and optimism have a significant influence on learner optimism (but not learner environmental knowledge). Therefore, parental support and influence could have a greater influence than learner or teacher influence but further exploration is needed.

From analysis of EE methods it was also found that active and extracurricular were more effective in enhancing sustainable behaviours than teacher driven in-class EE. The only two behavioural influencers that translated into sustainable behaviour were sustainable habits and perceived control. It was found that habitual sustainable behaviours in schools such as recycling and picking up litter were linked to a higher level of sustainable behaviour. These are behaviours that the learners display on a continuous basis and become void of thought or conscious effort, thus becoming routine or habitual (Abbaszadeh and Alavi, 2017; Littleford *et al*., 2014). These behaviours can be carried out in the absence of environmental knowledge or pro-environmental attitudes (Michalek *et al.*, 2019).

Perceived control could be linked to external environmental programmes such as school gardening projects because these programmes offer ongoing "hands-on" education and experience which allow the learner to understand how they are able to positively impact the environment through their actions and continuous involvement. Bryjegard (2001) stated that school gardens are an effective method of EE as it enhances learner sustainable behaviours and this method encourages learner sense of responsibility. These external environmental programmes included church initiatives, scouts, community clean-up programmes, environmental marches and estate programmes. It was found that learners who participated in external EE programmes had a higher attitude and behaviour score and learners who assisted in the school's gardens had a higher knowledge, attitude and behaviour score. During these programmes the learners are able to continuously be part of an environmental initiative that yields a visible positive outcome. The learners are able to display sustainable behaviours and understand the outcome of these behaviours and are, therefore, more likely to display these behaviours in the future. These programmes could lead to the learners possessing an internal locus of control. This finding relates to the findings of Tsevreni (2011) who found that after a year of participation in a community environmental project, the learners' outlooks changed drastically from being disconnected and unmotivated in the face of environmental issues to feeling that they play an important role in environmental management and possessing increased confidence when it came to solving environmental issues and displaying sustainable behaviours. This was also supported by Goldman *et al*. (2013) who found that, while external EE programmes did not enhance learner environmental knowledge, it did increase learner internal locus-of-control,

allowed them to locate themselves in nature and be more likely to display sustainable behaviours. This being said, Goldman *et al*. (2013) also stated that learner frequency of sustainable behaviour was lower when displaying sustainable behaviours entailed economic loss, therefore external forces could override the learners' perceived control.

It can also be assumed that learners that chose to take part in external environmental programmes and/or the school garden programme could have already possessed an internal locus-of-control that motivated them to take part in the programme; therefore it would not be the programme that influenced their locus of control. It could be possible that these learners were brought up in homes where parents set a norm that encouraged sustainable behaviours and displayed concern for environmental issues thus, encouraging the learners to take part in external environmental programmes. This could also mean that a learner's home life and upbringing could play a large role in learner's perceived control (as supported by Grønhøj and Thøgersen, 2017) but, again, further exploration is needed to understand the role that learner home life and parents have to play in the development of sustainable behaviours.

6.9. EE and C0VID-19

The COVID-19 pandemic could possibly have impacted EE in schools in three ways: restriction on creative EE teaching methods, lack of educator guidance and social inequality. The COVID-19 pandemic, social distancing and online learning have made it difficult for educators to utilise a wide range of teaching methods (eg. Recycling programmes, field trips, guided outdoor lessons) (Assaf and Gan, 2021). This is problematic as from this study it can be seen that there is a link between learner environmental attitudes and behaviours and these creative EE teaching methods. During the pandemic and online learning, educators have to teach online and record lessons which make it difficult to guide the learners through the lesson and see that no one gets left behind; therefore the learners and educators often rely on the aid of busy parents (Hamilton, 2020). This makes it difficult for educators to aid learners in overcoming their current ZDP, stunts leaner development and see some learners developing faster than others. The lack of resources and inequality between schools of varying socio-economic backgrounds has been further exacerbated by to the COVID-19 pandemic (Van Lancker and Parolin, 2020). Between schools there has been a greater inequality in terms of learner food security, educational outcomes and access to online resources (Hamilton, 2020; Van Lancker and Parolin, 2020). With regards to EE, government schools, particularly the lower quintile government schools, will face further struggles implementing EE and enhancing learner environmental literacy. Learners from township areas are less likely to have access to natural and safe areas, such as parks and gardens, than learners from private or upper quintile government schools. Educators cannot encourage learners as they would during in-school lessons, and due to lack of online facilities in townships the educators have to rely on the text books and struggle to relay passions and guide the learners though the lesson (Hamilton, 2020).

While global levels of air and water pollution has decline during the pandemic, it is still necessary to focus on EE because unsustainable behaviours have not been eliminated and the pollution levels will begin to increase again as the economy is rebooted (Science Media Centre, 2020). Environmental education (EE) is about adapting and evolving to crisis, therefore in the face of the

COVID-19 pandemic EE needs to be adapted and evolved to be implemented via distance learning (Assaf and Gan, 2021).

Chapter 7: Conclusion

7.1. Limitations of this study

There were five main areas of limitation in this study. The first being the lack of prior research available on the subject, specifically in a South African context, and the available research had proved to be contradictory. This made it difficult to draw comparisons and effectively explain the findings of this study.

Another limitation pertained to the sample group (the small number of schools participating in this study, the few educators interviewed at each school and the small number of upper quintile government school learners that responded). The school sample group was smaller than expected, as it proved difficult to persuade schools and educators to participate in this study. This was mainly because of educators not wanting to dedicate time to the learners having to submit a signed consent and assent form in order to complete the learner questionnaire. Another reason for the schools' reluctance to participate in this study was a general lack of trust in researchers. From the schools that agreed to participate, only one or two educators were interviewed at each school and most often the educators interviewed were Life Science educators. It would have been beneficial to interview more educators at each school to gain a true understanding of the EE programme at each school across a range of subjects. Few learners from the upper quintile government schools completed the questionnaire. This made it difficult to create a realistic picture of learner environmental literacy in upper quintile government schools.

The final limitation pertained to the learner questionnaires. Questions to measure environmental attitude and behaviours can lead to untrustworthy results, as the answers to attitude and behavioural questions are situational and may not be a reflection of reality. While the answers to the knowledge sections of the questionnaire have a definitive correct answer, the participants may lie in the attitude and behaviour section to make themselves appear more environmentally conscious.

7.2. Key findings and recommendations for future research

Objective 1: To determine the extent to which global EE legislation and policies are incorporated at a South African level in South African policy, initiatives and curricula. The local EE documents and the South African grade 10-12 curricula met many of the criteria set by the global EE documents. While the local and curriculum documents combined included the aims, steps government and organisations should take and EE content stipulated in global documents, the South African documents fall short in terms of specific steps of EE implementation. The local documents lack information regarding the creation of and criteria for EE programmes and the South African curriculum lacked detail regarding the specific EE methods that should be used to cover the set content. While the South African curriculum was much more detailed than other local documentation (such as EEPI, 1992; the White Paper on Education and Training, 1995; the White

Paper on Environmental Management, 1997; NEMA, 1998; NFSD, 2008; NSSD1,2011), the curriculum documents also did not make reference to educators needing to vary the methods utilised to implement EE. The curriculum lacked both teacher and learner continuous input, which would be crucial to updating the curriculum. Educator and learner input are also important in a South African context to gain the perspectives of both parties regarding the current state of EE in order to tailor the curriculum accordingly to suit a variety of socio-economic and cultural backgrounds and educator and learner needs. This could lead to the creation of more detailed curriculum documents that contain an assortment of effective implementation methods of EE.

Objective 2: To determine to what extent EE is incorporated in Gauteng secondary schools (grade 8-12) by assessing the grade 10-12 syllabus and engaging with grade 11 learners. Gauteng schools implemented both curricular and extracurricular EE. While many of these aspects in which the curriculum fell short were also not met by the Gauteng schools, the Gauteng schools managed to surpass these limitations, as the educators emphasise the complexity of environmental issues and, more importantly, utilise a variety of EE methods which the curriculum did not stipulate. This means that the content of the curriculum was being well implemented in schools through educator and school creativity and most of the Gauteng educators acknowledge the importance of EE and go beyond the curriculum requirements. This being said, not all methods implemented proved to enhance learner environmental literacy.

Objective 3: The educators from the different school groups had differing motivations for implementing EE at their schools. The lower quintile government school educators utilised EE methods because of the educators' and learners' close proximity to the effects of climate change, therefore learners had immediate use for environmental knowledge and skills, while the private and upper quintile government school educators utilised EE methods due to personal motivation and for learners to utilise skills and knowledge in the future.

Objective 4: To identify challenges associated with EE and various EE methods in terms of teaching practices and school management protocols. In terms of challenges that educators faced when implementing EE during in-class lessons, generally a prominent challenge that educators reported was that they did not have the time or the appropriate amount of knowledge to conduct effective, in depth and relevant EE lessons. The upper quintile government school educators mentioned many issues that pertained to learner behavioural issues and general disinterest when conducting in-class/ active EE lessons which lead to educators not utilising certain EE methods. Educators from the private and upper quintile government schools stated that they had issues relating to the learners as the learners were disconnected from environmental issues, believing that they did not share any blame. There were also many challenges that educators faced when implementing extracurricular and practical EE. All of the government school educators stated that funding was a prominent barrier in terms of implementing extracurricular and practical EE and many of the educators (particularly the lower quintile government school educators) stated that lack of support from the school and the government was a prominent barrier. EE methods, such as field trips, recycling, outdoor education and the creation of a vegetable garden, all proved to have problems when implementing. Although the educators experienced challenges implementing EE (inside and outside of the classroom), many of the educators still chose to implement EE as they felt that the learners benefited.

Objective 5: To determine the effectiveness of EE programmes in promoting environmental literacy in learners at Gauteng high schools. In terms of the EE content in the South African curriculum, subjects with the highest EE content did not translate into enhanced environmental literacy in learners. The learners who selected physical science displayed higher environmental knowledge and sustainable behaviour, therefore further exploration of the physical sciences curriculum and classroom implementation is required, as the physical science curriculum analysis did not explain this. It was found that there was a correlation between the school's implementation of EE and learner environmental literacy. In-class EE enhanced learner environmental knowledge, while extracurricular EE enhanced learner environmental attitudes and behaviours. The most effective EE methods were found to be gardening, school clean ups and the use of an environmental committee, as they were all linked to enhanced learner environmental literacy. Agreeing with the behaviourist paradigm, encouraging and (to a lesser degree) rewarding sustainable behaviours enhanced learner pro-environmental attitudes and behaviours. It was also found that the most common sources of environmental knowledge amongst Gauteng learners were found to be social media and the news. This being said, learners who selected school as a primary source of environmental knowledge had a higher environmental knowledge score than learners who selected social media. It was also found that learners who selected school in conjunction with social media and news did possess a higher pro-environmental attitude than learners who only selected school.

As discussed in Chapter 1, the behavioural pathway is complex, non-linear and accompanied by other behavioural drivers therefore in order to encourage sustainable behaviours various behavioural drivers need to be targeted. It was found that socio-economic external factors (which were found to influence environmental knowledge and attitudes), learner values and the subjective norm created by learners and educators did not translate into sustainable behaviours. Habitual sustainable behaviours (such as school clean ups and recycling programmes) and perceived control (possibly created by school gardening programmes and external environmental programmes) had a positive effect on learner sustainable behaviour. In future studies the effects of learner home lives and parental influence on habitual sustainable behaviours, perceived control and subjective norms need further exploration with regards to the adoption of sustainable behaviours.

From this study it can be recommended that the schooling curriculum be re-evaluated to provide educators with guidelines and outline specific of methods that can be utilised to effectively implement the EE component of the curriculum. This would aid educators in effectively implementing more practical methods of EE and would avoid altering the intention of the curriculum through educators' beliefs and values (an issue mentioned in chapter 1). Along with this, monitoring of how the curriculum is implemented and learner outcome is needed to allow the curriculum to achieve its desired outcomes and translate into enhanced learner environmental literacy. It can also be recommended that schools encourage learners and educators to implement and participate in EE extra-curricular activities, such as the creation of an environmnetal committee or the creation and maintenance of a vegetable garden, as this method was proven to be effective in enhancing learner environmental attitudes and sustainable behaviours. Encouraging learner participation in environmental initiatives (such as through school competitions) could create an environment where sustainable behaviours are more frequently displayed and approved of by other learners.

To conclude, Gauteng has made many strides towards implementing EE at school level through a range of subjects and both the schools and educators have taken further initiative to implement EE within and outside of the curriculum. Enhancing learner environmental literacy through EE is complicated as there are a plethora of factors that must be considered if EE is to be implemented effectively. Further exploration of EE planning and practice is needed to explore how EE lessons are conducted and EE practices are implemented. This fell outside of the scope of this study but would prove useful in filling in the gap between teacher lesson planning and learner outcome. While South Africa has a long history of implementing EE much is still to be learnt, especially with regard to how EE implementation differs and how it should differ amongst schools set in varying socio-economic or cultural backgrounds. Therefore further research is needed, in specifically a South African context, in order to understand the factors that influence learner environmental literacy and, more specifically, sustainable behaviours.

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Appendix

Appendix 1: teacher interview (chapter 3)

Teacher Interview Guide

Environmental Education in Gauteng Schools

Section A: curriculum content and methods

1. How does the environmental education provided at your school look at the environment in its totality?
   Guideline questions:
   a) Does it concern not only the natural environment and science but also the man-made environment?
   b) Is it incorporated across a range of subjects?
   c) Is it related to economy, society and technology?
2. How is environmental education incorporated in the syllabus at every age/grade?
3. Within the prescribed curriculum, how are environmental issues discussed and tackled?
   Guideline questions
   Does the environmental education curriculum have a special focus on:
   a) Exploring past, present, and future issues?
   b) Looking at environmental issues at varying scales (local, regional, national, international), with emphasis on community issues?
   c) Looking at the root causes of environmental issues?
   d) Understanding the complexity of environmental issues?
   e) Exploring possible solutions to environmental issues?
4. How does learner-feedback, response and engagement with the curriculum influence future curriculum and lesson planning?
5. What environmental educational techniques, resources and environments does your school utilise? Could you show me an example of resources that you utilise environmental education?

Section B: perspectives and commitment

1. What is your opinion on environmental education in the schooling curriculum? What is the attraction and repulsion of environmental education in the schooling curriculum?
2. What is the motivation behind the school and its staff utilising the environmental education methods stated above?
3. Why does the school incorporate environmental education at all?
4. Do you feel that your school does enough to effectively incorporate environmental education in the curriculum, is it high enough of a priority and what could be of more importance? Are there any changes that you would like to see in terms of how environmental education is focused on at the school or in terms of the prescribed syllabus?
5. Is your school part of the eco-school programme?
   5.1.If yes, why? To what extent? What do you find is the limitations of the programme?
   5.2.If no, why?

Appendix 2: learner questionnaire (chapter 3)

Learner Questionnaire

Environmental Education in Gauteng Schools

Section A: Personal Questions

1. Name of high school:

2. Gender (please tick):

Male	
Female	

3. Subject choices (excluding compulsory subjects: mathematics, English and additional language)

•
•
•
•

4. Potential career pathway

5. Are you considering attending a tertiary education institute?

Yes	
No	

6. Does your school provide environmental education (in the classroom and /or outdoors) and /or co-ordinate environmental initiatives and programmes (e.g. In-class education, recycling, vegetable gardens and environmental committee)?
   6.1.

Yes	
No	

6.2. If yes, explain:

7. Provide examples of "eco-friendly" behaviour that your school encourages:

8. Does your school or teacher reward you for eco-friendly/ sustainable behaviour?

Yes	
No	

9. Have you received external environmental education or been part of external environmental initiatives or clubs?
   9.1.

Yes	
No	

9.2. If yes, explain.

Section B: Environmental Knowledge

1. From where do you get most of your information regarding the environment and environmental issues?

1.1.

School	
Newspaper/TV news	
Social media	
Word of mouth	
Other	

1.2. If you selected "other", explain:

2. Which of the following materials can be recycled indefinitely?

Paper	
Glass	
Plastic	
All of the above	

3. Global warming is caused by a hole in the ozone layer.

True	
False	

4. Sustainability only concerns the environment.

True	
False	

5. We have already approached the limit of the number of people that the earth can support.

True	
False	

6. What gas contributes most to the concentration of atmospheric greenhouse gases?

7. All animals and plants can adapt to cope with climate change.

True	
False	

Section C: Environmental Attitude

1. Even though scientists wrongly predicted global cooling in the 1970's, we should still believe scientists' claims about global warming.

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

2. Human society has the right to alter the natural environment to fulfil their needs.

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

3. Human inventiveness and intelligence will ensure that humans never make the earth unliveable.

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

4. Global warming and climate change have been greatly exaggerated by environmentalists to scare the public into making life style changes.

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

5. Animals and plants have the same right as humans to exist and therefore should be able to co-exist.

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

6. Humans are the dominant species and are meant to rule over nature.

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

Section D: Sustainable Behaviour

1. I recycle at home.

	1	2	3	4	5	
never	○	○	○	○	○	always

2. I often boil a full kettle of water for one cup of hot water.

	1	2	3	4	5	
never	○	○	○	○	○	always

3. If find a spider in my house, I…

kill it.	
leave it.	
take it outside.	

4. I consciously do not buy cosmetic products or toiletries that are tested on animals.

	1	2	3	4	5	
never	○	○	○	○	○	always

5. Since the beginning of the drought I have implemented water saving strategies (strategies include closing taps when I brush my teeth, recycling grey water, putting a bucket in the shower and reducing shower times).

	1	2	3	4	5	
strongly disagree	○	○	○	○	○	strongly agree

Appendix 3: scores received for each of the GDE/IEB subjects that included EE in its syllabus (chapter 4)

	mathematics	mathematics literacy LO	life science	geography	physical sciences history	economics	business studies CAT	IT	consumer studies tourism
Content for subject EE									
includes:	**0,5**	**1**	**2**	**2**	**2**	**0,5**	**0,5**	**2**	**2**	**1**	**1**	**1**	**2**
own topic (1)			1	1	1			1	1	1	1		1
in other topics (1)		1	1	1	1			1	1			1	1
mentioned (0.5)	0,5					0,5	0,5						
holistic coverage (6)	0,5	0,5	0,5	0,67	1	0,83	0,33	0,83	0,83	1	0,67	0,67	0,67
economy	1	1		1	1	1	1	1	1	1		1	1
society	1	1	1	1	1	1	1	1	1	1	1	1	1
environment	1	1	1	1	1	1		1	1	1	1	1	1
sustainability/ integration			1	1	1	1		1	1	1			1
technology					1					1	1	1	
development					1	1		1	1	1	1	0	
creative content (1)	0	1	1	1	1	1	0	1	1	0,5	1	1	1
progress in difficulty (1)	0	1	1	1	1	0	0	1	1	0	1	0	0
touch on legislation (2)	0	0	0,5	0	0,5	0	0,5	1	0,5	0,25	0	0	0
global/ local	0	0	1		1		1		1	0,5			
both (2)	0	0						2					
examples (4)	0,75	0,75	0,5	0,5	0,75	0,63	1	0,75	0,25	0,5	0,25	0	0,75

	mathematics	mathematics literacy	LO	life science	geography	physical sciences	history	economics	business studies	CAT	IT	consumer studies	tourism
has specific examples	1	1	1		1	1	1	1	1	1	1		1
South African issues	0	1	1	1	1	1	1	1					1
global issues	1	0				0,5	1	1		1			1
different temporal scales	1	1		1	1		1						
whole issue (4)	0	0	0,75	0,88	1	1	0,25	1	0,875	0,625	0,5	0,5	0,75
cause	0	0	1	1	1	1	1	1	1	1	1		1
effects	0	0	1	1	1	1		1	1	1		1	1
solution	0	0	1	1	1	1		1	1	0,5	1	1	1
complexity	0	0		0,5	1	1		1	0,5				
encourages current affairs (1)	0	0	1	0	1	0	1	1	1	1	0	0	0,5
allows for teacher to relate to learners (1)	0	1	1	1	1	1	0	1	1	1	1	1	1
informative for educator (1)	0	1	1	1	1	1	0	0,5	0,5	0,5	0	1	0,5
content total	**1,25**	**5,25**	**7,25**	**6,04**	**8,25**	**5,46**	**3,08**	**8,08**	**6,96**	**5,38**	**4,42**	**4,17**	**5,17**
Implementation (6)													
varying methods		1	1	1	1	1	0	0	0	0	0	0	0
incorporated every year		1	1	1	1	1	0	1	1	0,5	0,5	0,5	0

	mathematics	mathematics literacy	LO	life science	geography	physical sciences	history	economics	business studies	CAT	IT	consumer studies	tourism
encourages action		0	1	1	0,5	0	0	1	0	1	0	1	1
acquire practical skills	1	1	1	1	0	1	0	0	1	1	0	0	0
critical thinking		0	1	1	1	1	0	1	1	0,5	0	0	0
problem solving		1	1	1	1	1	0	1	1	0,5	1	1	1
implementation total	**1**	**4**	**6**	**6**	**4,5**	**5**	**0**	**4**	**4**	**3,5**	**1,5**	**2,5**	**2**
total	2,25	9,25	13,25	12,04	12,75	10,46	3,08	12,08	10,96	8,88	5,92	6,67	7,17

Appendix 4: the scores received by each school for the 10 principles (chapter 4)

School	Principle									
	1	2	3	4	5	6	7	8	9	10
IEB1	80,00	75,00	83,33	75,00	33,33	0,00	70,00	100,00	66,67	0,00
IEB2	100,00	100,00	100,00	100,00	100,00	100,00	100,00	80,00	33,33	100,00
IEB3	100,00	100,00	83,33	75,00	33,33	100,00	100,00	60,00	0,00	100,00
IEB4	80,00	75,00	100,00	50,00	0,00	100,00	60,00	50,00	33,33	0,00
Average IEB	90,00	87,50	91,67	75,00	41,67	75,00	82,50	72,50	33,33	50,00
GDE-U1	70,00	75,00	50,00	37,50	33,33	50,00	20,00	40,00	0,00	0,00
GDE-U2	100,00	100,00	100,00	100,00	66,67	100,00	100,00	100,00	100,00	100,00
GDE-U3	100,00	100,00	66,67	100,00	16,67	100,00	60,00	80,00	0,00	50,00
GDE-U4	100,00	75,00	100,00	50,00	16,67	100,00	60,00	60,00	0,00	0,00
total GDE45	92,50	87,50	79,17	71,88	33,33	87,50	60,00	70,00	25,00	37,50
GDE-L1	90,00	100,00	100,00	62,50	16,67	100,00	80,00	80,00	33,33	100,00

School	Principle									
	1	2	3	4	5	6	7	8	9	10
GDE-L2	70,00	75,00	0,00	75,00	16,67	100,00	50,00	80,00	33,33	0,00
GDE-L3	80,00	100,00	66,67	87,50	33,33	100,00	80,00	80,00	33,33	100,00
total GDE123	80,00	91,67	55,56	75,00	22,22	100,00	70,00	80,00	33,33	66,67
TOTAL	87,50	88,89	75,46	73,96	32,41	87,50	70,83	74,17	30,56	51,39