

The integration of green economy content into the Life Sciences curriculum

by

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Abstract

This study was conducted to investigate the extent to which the Life Sciences curriculum integrates green economy content, as functional green economy knowledge amongst South African citizens could address socio-economic challenges in South Africa. Primarily, document analysis of the Grade 10-12 Life Sciences Curriculum and Assessment Policy Statement (CAPS) was conducted to determine whether green economy content was prescribed in the CAPS document and to what degree. Secondly, Grade 10 Life Sciences teachers completed questionnaires and participated in interviews to reveal their opinions on the integration of green economy content in the Life Sciences curriculum, their understanding of green economy and its implementation, as well as their opinions on the relevance of the current Life Sciences curriculum's content for afterschool use.

The research findings revealed that the Life Sciences curriculum can serve the purpose of introducing students to green economy aspects, however changes must be made to the curriculum so that functional green economy content is integrated. Currently, the curriculum does not provide guidelines for teachers on how to educate learners in such a manner that they will be able to participate in a green economy. Much of the content related to green economy topics is prescribed as extra content without the inclusion of student investigations or skill development activities. Furthermore, content on plants and human anatomy are prescribed and assessed in much greater detail than the environmental studies strand, resulting in the exclusion of much green economy related content. Findings indicate that socioscientific issues such as green economy are not linked to the environmental studies subject content, which means that daily-life application of content remains unclear to students. In addition to this, teachers revealed that they have knowledge of environmentally green practices but are unsure of how these relate to the economy.

The researcher proposes that curriculum designers completely integrate green economy content into the Life Sciences CAPS document, including not only content for discussion purposes but also investigations and activities which will lead to skills development, compelling learners to modify their behaviour and seek solutions to the urgent problems faced by humanity in terms of environmental degradation and economic collapse.

Keywords: Life Sciences, green economy, socioscientific issues, curriculum, content relevance

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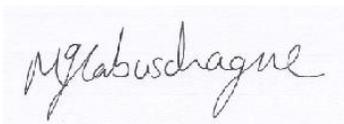
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Kind regards,

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Dedication

I lovingly dedicate this dissertation to my family, Suwil and Jean Rudolph, Marguerite and Roux Aitchison, Nicole and Drik Joubert, and my husband Ferdi Wolff. You hold my fondest memories, shared my adventures through these past three years and supplied me with love, laughter and joy. May God bless and keep you always.

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Contents

Abstract	i
UP Ethical Clearance Certificate	ii
Declaration of Originality	iii
Certificate of Language Editing	iii
Dedication	v
Acknowledgements	vi
List of figures	x
List of tables	xi
Chapter 1: Foundations of the Study	1
<i>1.1 Introduction</i>	<i>1</i>
1.1.1 Green Economy	2
1.1.2 Education and the Economy	3
1.1.3 Green Economy in Life Sciences	5
1.2 Problem Statement	7
1.3 Rationale	10
1.4 Research aims and objectives	12
1.5 Research Questions	12
Chapter 2: Literature Review	14
2.1 Introduction	14
2.2 The Curriculum	15
2.2.1 Curriculum Theory	15
2.2.2 Curriculum in Practice	21
2.2.3 Curriculum and Socioscientific Issues	23
2.2.4 The South African School Curriculum	25
2.3 The Rise of Green Economy	28
2.3.1 Green Economy as Socioscientific Content	30
2.4 Theoretical Framework	32
Chapter 3: Research Methodology	36
3.1 Introduction	36
3.2 Research Design	36
3.3 Sample	37
3.4 Data Collection	39

3.5	<i>Instrument Design</i>	41
3.6	<i>Instrument Quality Assurance</i>	43
3.7	<i>Data Analysis</i>	46
3.8	<i>Ethics</i>	48
Chapter 4: The CAPS for Life Sciences and Green Economy		50
4.1.	<i>Introduction</i>	50
4.2.	<i>Results: The CAPS for Life Sciences Analysis</i>	51
4.2.1.	<i>The Purpose of Life Sciences</i>	51
4.2.2.	<i>Organization of the Life Sciences Curriculum</i>	52
4.2.3.	<i>The Aim of Life Sciences</i>	53
4.2.4.	<i>Content Analysis of the Grade 10-12 CAPS for Life Sciences</i>	54
4.3.	<i>Conclusion</i>	65
Chapter 5: Teachers' views of Green Economy		66
5.1.	<i>Introduction</i>	66
5.2.	<i>Results: Analysis of Life Sciences Teacher's views</i>	66
5.2.1.	<i>Teachers' views of Green Economy Content within the LSC</i>	66
5.2.1.1	<i>Descriptive data</i>	67
5.2.1.2	<i>Qualitative data</i>	71
5.2.2.	<i>Teachers' Understanding of the Implementation of Green Economy</i>	75
5.2.3.	<i>The Relevance of the Life Sciences Curriculum's Content</i>	77
5.3.	<i>Summary</i>	80
Chapter 6: Discussion and Conclusion		84
6.1.	<i>Introduction</i>	84
6.2.	<i>Alignment of Literature and the Research Findings</i>	84
6.3.	<i>Recommendations for Future Research</i>	87
6.4.	<i>Limitations</i>	88
6.5.	<i>Conclusion</i>	88
References:.....		90
Appendices:.....		102
<i>Appendix 1: Document Analysis Protocol</i>		102
<i>Appendix 2.1: Green Economy Questionnaire</i>		104
<i>Appendix 2.2: Preliminary Green Economy Questionnaire</i>		108
<i>Appendix 3.1 Interview Schedule</i>		112
<i>Appendix 3.2: Preliminary Interview Schedule</i>		115

Appendix 4: Consent letters 117
Appendix 5: GDE Research Request Form 121
Appendix 6: GDE Research Approval Letter 134

List of figures

Figure 1. Socioscientific elements of functional green economy literacy	33
Figure 2.1. The LSC encourages learners to Respect Differing World Views	67
Figure 2.2. The LSC prescribes content on Energy Saving	68
Figure 2.3. The LSC prescribes content on South African Recycling Projects	69
Figure 2.4. The LSC prescribes content on Minimising Pollution	69
Figure 2.5. The LSC prescribes content on Scientific Methods undertaken by Scientists.....	70
Figure 2.6. The LSC prescribes content on Employment in Existing Green Economy Careers.....	71
Figure 3. I would feel comfortable Teaching Learners about Green Economy	76

List of tables

Table 1. Crosstabulation of the sample’s age and their years of teaching experience	38
Table 2. Crosstabulation of the sample’s level of education with their schooling areas	39
Table 3. Summary of research methods	48
Table 4.1. Summary of the Grade 10-12 Life Sciences Cultural Issues Content.....	55
Table 4.2. Summary of the Grade 10-12 Life Sciences Case-based Issues Content.....	57
Table 4.3. Summary of the Grade 10-12 Life Sciences Nature of Science Issues.....	59
Table 4.4. Summary of the Grade 10-12 Life Sciences Discourse Issues Content.....	63
Table 4.5. Summary of the Grade 10-12 Life Sciences Economic Issues Content.....	64

Chapter 1: Foundations of the Study

1.1 Introduction

In 2013, South Africans celebrated a matric pass rate of 78.2% where the Minister of Basic Education boasted about the increase from 19.9% of matriculants who had qualified for Bachelor's studies in 2009, to 30,6% in 2013 (Motshekga, 2014). Very few members of the public are, however, aware that in order to pass Grade 12 and obtain a National Senior Certificate, learners must achieve a mere minimum of 40% in their Home Language, Life Orientation and two elective subjects. Additionally, they must achieve a minimum of 30% in their First Additional Language, Mathematics or Math Literacy and an additional elective subject (Department of Basic Education, 2009). The researcher believes that the level of knowledge and skills obtained by learners who achieved only these grades may not be sufficient to prepare them for life after schooling. This concern is shared by Jansen (2012) who argues that the South African education standards fail to provide learners with sufficient conceptual knowledge and skills to prepare them for tertiary education or employment. He points out that there is a gap between what the National Senior Certificate claims learners have mastered and that which learners are able to accomplish in everyday life.

This research project was therefore continuously shaped by an interest in education which prepares learners for everyday life. Carpenter and Hughes (2011) believe that for decades, education for everyday life has been developed for four broad purposes, namely human relationship, citizenship, self-realization and the advancement of economic efficiency (which has become the main focus the past decade). The afore mentioned purposes are realised through the minimum standards and selection of content prescribed in a curriculum, with the level of their achievement depending on the degree of relevance the content will have in a student's life (Chamany, Allen & Tanner, 2008; Fraser, 1993, in Fraser, Loubser & van Rooy, 1993; Johnson, 1997). Strengthening the factor of content relevance is the integration of learners' social contexts into the learning process (Chamany *et al.*, 2008; Fraser, 1993, in Fraser, Loubser and van Rooy, 1993). For instance, Chamany *et al.* (2008) state that through learning Biology (known as Life Sciences in South Africa) learners should be made aware that Biology does not exist in isolation, but is influenced by social dynamics and psychological paradigms as this could promote their mastery of biological concepts and processes.

Therefore, one of the biggest challenges for education in developing countries like South Africa is to address social issues such as unemployment and poverty. This is because these issues in turn have a significant effect on other socioscientific issues (SSI), such as HIV/AIDS and environmental degradation, which are arguably the biggest challenges facing the developing world today (Naidoo, nd). For example, hundreds of South African youths in possession of a National Senior Certificate with Life Sciences do not have jobs and do not qualify for tertiary education. One of the strategies that could be used in this regard is exposing these youths to green economy as a way of addressing poverty and unemployment (Borel-Saladin & Turok, 2013). “The concept of a green economy seems to promise an attractive orientation out of the crisis of neoliberalism that became manifest in 2008 and has hit vulnerable countries and social groups” (Brand, 2012:28). On account of this, the researcher attempted to determine the extent to which green economy education is represented in the South African Curriculum and Assessment Policy Statement (CAPS) for Life Sciences. It is the researcher’s belief that green economy education is one of the most socially, environmentally and economically relevant topics that should be included in curricula in terms of curriculum content relevance.

1.1.1 Green Economy

Due to the threat of global warming, countries worldwide are making changes to their economic practices in order to adopt a greener approach to economic advancements. A green economy refers to one which is based on sustainable development and financial systems founded on environmentally friendly and socially inclusive approaches (United Nations Environment Programme, 2011a). This entails technological innovation, managing resources efficiently, lowering carbon emissions, recycling and addressing issues such as climate change, poverty eradication and job creation in an attempt to contribute to the country’s economic growth and development (Brand, 2012). Capital can be generated by means of natural assets such as the country’s biodiversity, renewable energy, forestry, agriculture and tourism, while attempting to preserve the environment for future generations (United Nations Environment Programme, 2011a).

In South Africa, the term “green economy” has become increasingly important after the seventeenth Conference of the Parties (COP17) in Durban in 2011, as governmental attempts are being made to create job opportunities while lowering carbon emissions and environmental degradation (Mowzer, 2011). For many decades, the country relied on unsustainable methods to generate capital, with the mining industry being at the forefront (Statistics South Africa, 2011). Fortunately, there has been a shift in the economy, as the finance, real estate and business

services have started contributing the most to the GDP in 2013. The agriculture, forestry and fishing industry, as well as the electricity, gas and water industries however were deemed insignificant in their increased economic contributions (Statistics South Africa, 2013). Should South Africa succeed in adopting a green economy, the focus could move to ecotourism and sustainable water and energy industries as well as already growing industries such as manufacturing, among others (Statistics South Africa, 2013).

In this study, *green economy* will be used as an overarching term to cover economic initiatives aimed at sustainable land, water and waste management; recycling; sustainable economic management; renewable energy projects; and addressing youth unemployment in South Africa (Development Bank of Southern Africa, 2011). When addressing green economy as curricular content, the researcher will focus specifically on content which develops learners' knowledge and skills in the above mentioned economic initiatives. This will include content on cultural, case-based, Nature of Science (NOS), economic and discourse issues (these are discussed in detail in Section 2.4; Theoretical Framework). Collectively, these SSIs promote problem solving, critical thinking, decision making, and innovation skills, ultimately leading to relevant and interrelated learning (Zeidler *et al.*, 2005).

1.1.2 Education and the Economy

One of the key issues in the 21st century relates to the significance of education in addressing social challenges. For instance, Hanushek and Wößmann (2007) suggest that it is not enough that learners simply enrol for and attain senior certificates at the end of their schooling. Instead, there must be education of such a quality that it provides learners with skills that will lead to increased individual earnings, as well as the overall distribution of income amongst the population and therefore the economic growth of the country (Hanushek & Wößmann, 2007).

Since 1964, international student testing programmes, such as FIMS (First International Mathematics Study), SISS (Second International Science Study), SIRS (Second International Reading Study), TIMMS (Trends in International Mathematics and Science Study) and PISA (Programme for International Student Assessment) have been administered in various countries to draw comparisons between students' knowledge. The Organization for Economic Co-operation and Development (OECD) has found, through comparing the student scores to the economic positions of the respective countries, that there is a significant correlation between the prosperity of a country and the quality of its education. Of greater importance is the discovery that the countries with higher mathematical and science skills, produce more innovative

students who generate new technologies and ideas and report higher rates of productivity (OECD, 2010).

Although there are various opinions on what exactly science cognitive skills entail, the knowledge areas addressed by DeBoer (2000) were used for the purpose of the current study. Knowledge of the natural world (understanding and remembering) and knowledge generation skills (problem-solving, scientific inquiry, independent thinking and decision making) all form part of the science cognitive skills and scientific literacy which learners should develop in the science classroom (DeBoer, 2000). Laugksch (2000) also argues for the promotion of science literacy amongst learners as it will lead to the enhancement of a country's economic status. In terms of a micro view and individual benefits, science knowledge further gives individuals the chance to discover, construct and create new inventions through intellectual creative activity (Laugksch, 2000).

Regrettably, South Africa was one of the countries that exhibited very low mathematics and science scores during its time of participation, as examined by PISA and TIMSS. Out of 77 countries tested for their learner's mathematics and science cognitive skills, South Africa ranked as follows between 1995-2003: 77th in terms of the average test scores obtained by primary and secondary school learners, 74th in terms of learners who achieved the basic literacy standard as determined by their average test scores, and progressively 65th in terms of top-performing learners (Hanushek & Wößmann, 2009).

Perhaps South Africa needs a new approach to promoting science cognitive skills amongst learners, by using content which is of more relevance to the learners in terms of context and everyday application. Carl (2009) argues that in order to supply quality human capital in South Africa, a curriculum must be developed which links learners' daily reality to the classroom and is relevant to learners in terms of preparing them for employment and self-empowerment. In line with Carl's statement, Taylor (1997) maintains that the practical application of knowledge learnt at school can be promoted through creating a link between activities in the classroom and social, political and economic issues. Latourelle, Poplawsky, Shamaefsky and Musante (2012) have identified socioscientific issues education as a teaching and learning approach which can be implemented in order to teach content in such a manner that it links to socially-relevant issues which learners may experience on a daily basis. Green economic issues as an SSI are relevant in 21st century schools and apply to the learners' immediate environments. The skills mentioned by DeBoer (2000) are the type of skills the researcher envisages for learners to achieve through the stimulation of green economy education, as they are very similar to those

required for economic prosperity. Green economy education calls for the development of innovative and environmentally conscious entrepreneurial skills, renewable energy creation skills and energy efficiency implementation skills (Pop, Dina & Martin, 2011).

A green-economy driven school curriculum could readily be implemented in a country such as South Africa. The country has a diversity of natural resources (CSIR, 2010), the top banking system and infrastructure in Africa (Panerai, 2011) and is based on democratic principles which aim to empower all individuals (Department of Basic Education, 2011). In a study conducted in 2011, South Africa was estimated to have approximately 20 000 plant species and 60 000 animal species, making it the country with the third highest biodiversity worldwide (Driver, Sink, Nel, Holness, Van Niekerk, Daniels, Jonas, Majiedt, Harris & Maze, 2012). The South African government has already taken steps to protect this biodiversity by implementing the National Biodiversity Strategy and Action Plan (NBSAP). The goal of NBSAP is to conserve and manage this biodiversity in such a manner that it will bring sustainable benefits to South African citizens (Lutsch, 2008). Through green economy education, the government's noble attempts can be furthered by serving as a link between environmental management and the economic empowerment of the youth.

1.1.3 Green Economy in Life Sciences

Green economy is rooted in environmental, social and economic fields that are aimed at fostering sustainable development (United Nations Educational, Scientific and Cultural Organization (UNESCO), 2012). In South Africa, the Life Sciences curriculum (LSC) is the ideal platform for introducing green economic ideas to learners for the reasons discussed below.

Firstly, the Curriculum and Assessment Policy Statement (CAPS) Grades 10-12 for Life Sciences (2011), states that one of the objectives of Life Sciences is to furnish learners with functional knowledge and skills which are necessary for everyday life. The Life Sciences content framework is also divided into four knowledge strands, of which Environmental Studies is one (Department of Basic Education, 2011). It is important to note that Life Sciences is the only school subject in which Environmental Studies is addressed. Thus there is a foundation on which green economy education can be built in order to enhance the relevance of Life Sciences to South African learners. Functional or *actionable knowledge* refers to context specific knowledge which learners can use in everyday life contexts. According to Merriam-Webster (2012) "actionable means capable of being acted on" and "subject to or affording ground for an action". Posner (2009) maintains that in order for knowledge to be transformative, it must be

actionable. She further states that it is knowledge which addresses current issues that leads to effective practice in society. Knowledge can only be deemed actionable if it has relevance to and leads to practice in the daily world (Argyris, 1996). Thus the knowledge taught in Life Sciences should be useful to learners such that it can be practically applied in their daily lives.

Secondly, the curriculum which was introduced to Grade 10 learners in 2012 integrates content necessary to create awareness amongst learners of socioscientific and economic challenges, within the South African context. Learners are made aware of issues such as global warming and the depletion of natural resources (Department of Basic Education, 2011). By incorporating green economy education, learners could be equipped with functional knowledge and the skills necessary to develop possible solutions to these challenges, which will be of benefit to the environment, the learners, their communities and ultimately the whole of South Africa.

Thirdly, the LSC provides learners with information about renewable energy sources, such as harnessing methane from local dumpsites for domestic lighting and heating (Department of Basic Education, 2011). Through green economy education, the learner's attention therefore can be brought to the fact that renewable natural resources such as wind power, solar energy and hydropower could address one of the biggest economic development problems facing developing countries, i.e. providing rural communities with electricity (Economic Development Department, 2011). Air pollution, deforestation, respiratory diseases and desertification, which are some of the negative effects of biomass burning, could be eradicated if learners knew of different ways in which to generate clean electricity (United Nations Environment Programme, 2011a).

Lastly, "a potential long-term benefit of greening the economy is innovation" (Borel-Saladin & Turok, 2013:1) therefore, through the LSC, learners can be made aware of the entrepreneurial opportunities related to green economy. Examples of how other countries benefit from green economy could be integrated into classroom activities (United Nations Environment Programme, 2011a). This could encourage learners to think of innovative ways in which to create their own employment while contributing to a greener economy for South Africa. South Africa already provides endless opportunities for young environmentally aware entrepreneurs to utilise its diverse natural resources, be it as tourism potential, seeing that 6,100,270 tourists visited South Africa from January to September in 2011 (SAT, 2011), or through new innovative job creations such as waste management or water purification, which could help manage the resources in a manner which is beneficial to all South Africans.

Changes are already being made to the South African education system to focus its curricular reformation on improved skills development and higher performance achievement. The Outcomes-Based education curriculum is being adapted into an enhanced curriculum, called Schooling 2025 (Hofmeyer, 2010). Were the content of the LSC to be directed by visions of sustainable development, environmental management and stimulating learners' awareness of generating their own green jobs, the ideals of a South African green economy could be more readily reached. With the worldwide youth population being larger than ever before in history and natural resources reaching their limits, environmental and sustainability education must be implemented to empower learners to address these issues (UNESCO: 2012).

Thus, the purpose of this study was to determine the extent to which green economy content is integrated into the Grade10-12 Life Sciences curriculum. In this regard, the researcher firstly explores how the LSC addresses green economy content. Thereafter, Life Sciences teachers' knowledge about green economy and its implementation was investigated. The researcher also attempted to investigate Life Sciences teachers' opinions regarding the relevance of the current Life Sciences curriculum's content for learners' everyday use, particularly in relation to green economy. The findings of this research study may contribute to necessary changes being made in the curriculum in relation to Schooling 2025 and the incorporation of more green economically driven content.

1.2 Problem Statement

South Africa faces problems of poverty and rising unemployment rates (Statistics South Africa, 2011), environmental degradation (Cape Town Environmental Resource Management Department, 2011) and an ever present gap between rural and urban peoples in terms of quality of education, income and standards of living (Statistics South Africa, 2011). When taking an in depth look at the CAPS for Grade 10-12 Life Sciences (2011), it is apparent that through education all of the above mentioned problems could be eradicated. After all, curriculum is intended to equip learners with the skills to address the needs of society (Dewey, 1902). Yet, despite continual revision of South Africa's educational system, these problems remain increasingly persistent (Edigheji, 2010).

South Africa has had a turbulent history when it comes to its education system. It was used as a political tool for oppression and racial segregation before 1994. A democratically founded education system (Outcomes-Based Education) was adopted in 1997 in order to restore justice, equality and prosperity (Msila, 2007). The influence of Johann Heinrich Pestalozzi contributed to

the development of an educational curricula which serves the purpose of providing equal opportunities for all to obtain wealth in society (Soëtard, 2000). This Outcomes-Based Education system, known in South Africa as Curriculum 2005, had many challenges to overcome such as an uneven divide of human resources, a severe lack of English language proficiency amongst teachers and learners, limited knowledge of teaching styles and, most importantly, theoretical inadequacies (Leibowitz, 2000). Due to problems experienced with its implementation and underlying philosophy, Curriculum 2005 was revised in the year 2000 (Chisholm, 2003).

The Revised National Curriculum Statement for Grades R-9 was then implemented in 2004 and the National Curriculum Statement for Grades 10-12 in 2006 (Mahomed, 2005). Christie (2003) identified three weaknesses within these policies, the first being that they do not address the diversity of South Africa's socio-economic statuses. Secondly, Christie (2003) observed that South Africa does not possess the necessary infrastructure required to implement these policies. Therefore, schools from impoverished areas with limited resources were rather burdened than supported by these policies (Christie, 2003) and finally, academic aspects such as the completeness of the curricular content and age appropriate standards of the curriculum were questionable. The National Curriculum Statement for Life Sciences in particular also received strong criticism prior to its implementation in 2006 (Johnson, 2009).

Muller (2006, in Young and Gamble, 2006) argues that the Life Sciences Revised National Curriculum Statement was similar to that of Curriculum 2005 in terms of its under-specification of essential content which could lead to learners having gaps in their Life Sciences knowledge and understanding. While Doige *et al.* (2008) also found that the NCS lacked detailed descriptions of the content which teachers had to cover, as well as an uneven divide in the content framework. Curriculum should however guide teachers in preparing learners for daily life, through scientific content and activities which encourage mental, physical, spiritual and social development (Dewey, 1902).

It would seem that the South African curriculum planners had moved to the very opposite pole of where the LSC had originated. Initially, NATED 550 (the interim curriculum used after 1994) followed a content-based theoretical framework, which was very rigid in terms of its pedagogy and content. The National Curriculum Statement in contrast was based on the achievement of set outcomes rather than prescribed content. This led to a weakly framed curriculum which only briefly stated what teachers had to cover, leaving them to decide on content and instructional strategies (Doige *et al.*, 2008).

Throughout the history of the Life Sciences curriculum's review, it remains critical that the curriculum should make science relevant to the lives of learners (Department of Education, 2002; Department of Education 2003; Department of Basic Education 2011). Since 2009, curriculum planners have been working on a new Life Sciences content framework encapsulated in the Curriculum and Assessment Policy Statement (Department of Basic Education, 2011). The latest revision of the curriculum incorporated multiple learning theories, including social constructivism, science and technology in society and science for all (Doige *et al.*, 2008). The main reason for the multiple frameworks is that curriculum planners aim to equip learners with meaningful knowledge and skills that relate to their contexts (Department of Basic Education, 2011). The knowledge and skills should be meaningful in the sense that they furnish learners with the knowledge, skills and values necessary for meaningful social participation (Dewey, 1902).

Specifically, Aim 3 of the Life Sciences curriculum is related to learners' understanding of Life Sciences applications in their everyday lives (Department of Basic Education, 2011). It is aimed at making learners aware of the relevance Life Sciences content can have outside of classroom through teaching learners about SSI and career opportunities (Department of Basic Education, 2011). Learners are expected to learn how to access, organise, apply, use and evaluate information in different ways and in relation to new contexts (Department of Basic Education, 2011). Clearly the aims of the new LSC can contribute to the effective education of learners, yet the content must be in line with these aims if learners are to be able to apply what they have been taught in the classroom in their daily lives. If all South African learners are not equipped with a thorough understanding of green economy, its financial benefits will remain in the hands of corporate companies and the social interests of marginalized groups will remain unaffected by the opportunities which green economy has to offer (Brand, 2012).

Unfortunately, Mnguni (2011) maintains that the LSC only includes socioscientific content as extra content. This results in the limitation of learners' ability to learn and apply the context-specific knowledge and skills to everyday life situations. Learning outcomes, such as the application of knowledge, are therefore not being sufficiently supported by the content taught in the LSC (Mnguni, 2011). Topics related to green economy content, including sustainability, environmental management and ecotourism, may also have been incorporated into the LSC as extra content which, according to Van Laren (2008), could mean that the detail is superficial and therefore insufficient for context-specific application.

To conclude, the South African curriculum has undergone many changes, preceding the current CAPS documents which were implemented in Grade 10 in 2012. Yet the problem remains that the intended aims of the Department of Basic Education are not translating into reality. There has been a steady decline in learners interested in Life Sciences as a subject and career choice (Prokop, Prokop & Tunnicliffe, 2007). Msila (2007) states that education should contribute to an individual's enrichment and should allow learners to become resourceful citizens. The researcher is of the opinion that green economy education could do exactly that, while jointly addressing South Africa's problems of unemployment and environmental degradation. Therefore the extent to which green economy content is integrated into the LSC was investigated.

1.3 Rationale

The researcher wished to conduct a study on the incorporation of green economy content into the LSC because she believes South Africa is an ideal developing country in which to promote sustainable living and innovative thinking to address socio-economic issues. Furthermore, the study could have an impact on the South African Life Sciences curriculum in terms of the integration of socially and environmentally relevant content, such as green economy content. Pop *et al.* (2011) suggest that moving towards a greener economy holds the opportunity of creating many new resourceful jobs, which is what the researcher believes the South African education system should empower learners to obtain. More than half of South African learners who begin schooling do not complete their matric (Grade 12) year and of the few that do enrol at tertiary institutions, nearly 45% drop out (Lancaster & Kirkaldy, 2010). What is needed therefore is the incorporation of content which provides learners with actionable knowledge and skills that will enable them to seize the opportunities which South Africa offers in terms of self-empowerment irrespective of whether they attain tertiary education or not.

According to the South African National Treasury (2011), South Africa's economy will no longer grow if its youth continues to display the inadequate skills and experiences necessary for employment. Services, cleaner technologies, products and activities which minimise environmental hazards and reduce resource use as well as pollution are but a few examples of the green jobs that could be created (OECD, 2004) once South Africa initiates green economic initiatives. Accordingly, the youth will need to have mastered the skills and knowledge necessary to be employed in these occupations. The aim of this study was therefore to explore the extent to which the Life Sciences curriculum integrates green economy content, so that, if

necessary, modifications can be made to the curriculum in order to empower learners to explore green economic opportunities. Education is what will bring about change, responsibility and leadership amongst youth (Dewey, 1902).

There is a desperate need for economies to become more sustainable globally, which requires that education undergoes a process of greening too (United Nations Environment Programme, 2008). With South Africa already being blessed with an abundance of natural resources, a diversity of peoples and the potential to prosper economically (U.S. Department of State, 2012), greening its education could be a reality in the near future. Green economy education could serve the purpose of maximising South Africa's assets and minimising its liabilities by incorporating content which addresses environmental issues, such as global warming and effective natural resource management as well as social issues, such as poverty and high unemployment rates.

It was at an expo for young scientists in South Africa that the researcher became aware of the education gap that still exists between learners from poorer rural areas and those from urban areas. Although South Africa's curriculum is founded on the Constitution Act 108 of 1996 which attempts to eradicate past divisions left by the Apartheid era and to improve all citizens quality of life (Department of Basic Education, 2011), it seems that mostly the already advantaged groups are still favoured by it (Christie, 2003). The learners who came from a wealthy background had projects on topics currently being researched internationally and were often of academic orientation. Learners from more rural areas had research topics that were context rich and which bore practical application within their communities. Their knowledge in the fields they had researched was astounding as they had immersed themselves in the projects, often studying organisms and phenomena within their immediate environment. Yet they received lower scores as their projects were not academically correct or deemed as contributory to the whole of society as that of their urban counterparts.

However, it was the researcher's opinion that with the correct guidance, the learners from rural areas would contribute more to their communities, seeing that within them lay researchers, entrepreneurs and innovative thinkers who were attempting to address the needs of their communities. It is by means of the LSC that the researcher wishes to empower learners with the ability to use their talents and passions, which arise from living in close connection with their environment, to employ the green economy opportunities in their surroundings.

It is hoped that the findings of this study can be used to enhance the Life Sciences curriculum's relevance to learners' everyday lives and that curricular specialists may feel compelled to incorporate green economy content to the extent that it will enhance learners' ability to apply the knowledge and skills learnt in the classroom in their daily practices. Through this study, the integration of green economy content into the LSC may reach a degree where it better prepares learners for everyday life issues such as employment and environmentally sustainable practices.

1.4 Research aims and objectives

The aim of this study was to determine the extent to which the LSC integrates SSI's, specifically green economy content knowledge into the prescribed content, as it could address socio-economic challenges in South Africa. Additionally, the researcher aimed to establish the extent to which Life Sciences teachers understand the concept of green economy as they are expected to teach it to learners. The researcher further intended to establish Life Sciences teachers' opinions regarding the relevance of the current Life Sciences curriculums' content to learners' everyday lives. Through conducting this study, provision was made for teachers, who associate with learners on a daily basis, to voice their views on any gaps or shortcomings in terms of the value which Life Sciences may have for learners once they have completed schooling.

1.5 Research Questions

Emanating from the above aims, the following primary research question was asked: *To what extent does the Life Sciences curriculum integrate green economy content?*

The following secondary research questions were asked in order to respond to the primary research question:

- *To what extent does the CAPS Life Sciences curriculum integrate green economy content?*
- *To what extent do Life Sciences teachers understand green economy and its implementation?*
- *What are Life Sciences teachers' opinions regarding the relevance of the current Life Sciences curriculum's content for everyday use?*

The methods used to respond to these questions are presented in Chapter 3 of this proposal. However, it is necessary to establish from the literature some of the key issues regarding the integration of green economy content into curricula. This is done in the following chapter.

Chapter 2: Literature Review

2.1 Introduction

Schools are the institutions in which parents entrust their children to be equipped with knowledge and skills for everyday life. The curriculum prescribed to schools determines much of the content, teaching strategies, learning activities and assessment which are used to educate learners throughout the education system. In this chapter, the researcher will discuss the curriculum, various curricular theories, curricular practice, recent curricular trends and the South African curriculum in particular.

Furthermore, the concept of green economy will also be discussed. As a result of the global environmental degradation, global warming and global slowdown in economic growth (The Conference Board, 2012), most countries are now striving towards economies which generate sustainable jobs. Initiatives include better environmental management, attempting to run renewable energy projects, managing waste sustainably and developing clean transport (Development Bank of Southern Africa, 2011). The field of education can be used as a platform to equip citizens with the skills required by a green economy.

Lastly, Green economy as an SSI will be discussed. Socioscientific education has become a popular way of regaining learners' interest in sciences. It entails using contextual content which is relevant to learners' immediate environment and their lives outside of schooling. Green economy education may well be one of the most relevant and contextual topics to include in secondary education programmes as it relates to the problems currently faced by many South African school leavers in terms of unemployment and unsustainable living (Borel-Saladin & Turok, 2013). Green economy as SSI has the potential to provide learners with an opportunity for effective learning.

According to the researcher, effective learning is that type of learning which will empower one to operate effectively in society once formal schooling has been completed. This entails equipping learners with the knowledge and skills necessary to not only obtain academic achievement, but also prosper socially and economically. Although many South Africans, including ministers, educators and learners are of the opinion that effective learning means achieving high scores in school grades, the researcher wishes to point out that this view does not necessarily relate to success beyond the classroom. Through equipping learners with knowledge of green economic

initiatives within the LSC, learners could be provided with the skills necessary to create their own work as green economy is still a young field which is open to innovative thinkers for development.

2.2 *The Curriculum*

Van der Horst and McDonald (2005) are of the opinion that appropriate educational policies and practices have the power to increase the quality of life of South Africans. They believe education has the potential to provide the youth with an array of cognitive, motor and affective skills which could prepare them to actively take part in society, leading to the improvement of South Africa. Consequently, after socio-political reform took place in South Africa, the South African education system adopted an outcomes-based curriculum. This curriculum gives policy designers control, to a large extent, over educational outcomes while providing educators with a freedom of choice regarding content selection and teaching methods. The aim of this curriculum was to promote lifelong learning, problem solving, critical thinking and social reform through contextually relevant education (Van der Horst & McDonald, 2005).

A new curriculum is however not easily implemented and takes effort from all role players to achieve its success. The government, policy planners, curriculum developers, teachers and parents, as well as the learners all have to responsibly and actively play their part in developing and maintaining an effective education system in South Africa (Van der Horst & McDonald, 2005). Essential to the effective design and implementation of any curriculum, is an in-depth understanding of curriculum theory and practice (Carl, 2009). Knowledge of the field of curriculum and curriculum paradigms, domains and foundations, which all contribute to curricular theories or approaches, is therefore essential (Ornstein & Hunkins, 2009). In this chapter, the current author will therefore discuss curriculum theory in detail in order to provide the reader with a scope of curriculum development and design, and the various historical and current purposes curriculum has served.

2.2.1 *Curriculum Theory*

Curriculum theory supplies curricularists with conceptual tools necessary to analyse proposed curricula and informs curricular practice and guides curriculum reform (Glatthorn, Boschee & Whitehead, 2006). Ornstein and Hunkins (2009:18) maintain that theory serves the function of establishing “the field’s framework and helps researchers and practitioners analyze and synthesize data, organize concepts and principles, suggest new ideas and relations, and

speculate about the future.” Curriculum theory is most often informed by philosophy, psychology and sociology (Ornstein & Hunkins, 2009). Good curriculum theory therefore guides practice; and describes, explains and predicts principles, concepts and relationships existing in the curricular field (Glatthorn *et al.*, 2006; Ornstein & Hunkins, 2009).

The challenge faced by curricularists is the successful integration of a proposed theory into the school’s context. Diversity amongst learners in terms of culture, class, race and economic conditions, as well as technological advancement has proven very daunting when designing curricula which must address social and individual needs (Glatthorn *et al.*, 2006). Due to the demand for curricular change in a dynamic society, curriculum leaders and school administrators must possess a well-rounded understanding of the relationship existing between curriculum theory and practice (Carl, 2009; Glatthorn *et al.*, 2006). Theory will not only depend on, but must also inform needs analysis, educational processes, teaching methodologies, learner assessment and curricular evaluation (Glatthorn *et al.*, 2006).

Based on the inquiry domains of curricular theories, Glatthorn *et al.* (2006) have chosen a four category classification system. Firstly, they identified *Structure-orientated theories*. These descriptive and exploratory theories are grounded in their focus on the analysis of curriculum components and the interrelationships that exist between them. Secondly, *Value-orientated theories* were distinguished based on their focal point of analysing curricula’s and curriculum developers’ values and notions. These are theories which are critical in nature and are often aimed at reconceptualising curricula. Thirdly, *Content-orientated theories* were identified based on their prescriptive nature of determining curricular content. Lastly, *Process-orientated theories* were distinguished based on their focus of curricular development and proposals on how curricula should be developed. These theories can be either descriptive or prescriptive in nature (Glatthorn *et al.*, 2006).

The researcher will use the classification system proposed by Glatthorn *et al.* (2006) to distinguish between the Behavioural, Academic, Humanistic and Reconceptualist curriculum theories, to reveal the defining characteristics of each as well as their influence on schooling. Each of these curricular theories has, in turn, influenced the South African curriculum as curricularists aim to develop curricula which will serve the educational needs of society. The influence of these theories often directly impacts the teaching strategies, content and assessment prescribed to educators (Glatthorn *et al.*, 2006). Glatthorn *et al.* (2006) do not rigidly attempt to place these theories within a particular classification, but rather allow for overlapping within these four categories.

The Behavioural Approach

The behavioural approach is one of the oldest and most commonly used approaches in school systems, dating back to the 1920s. Its founder, Frederick Taylor based his views on the efficiency with which factories produced goods. He advocated schools to be operated as a machine which delivers large numbers of well-trained learners into society (Ornstein & Hunkins, 2009). Behaviouristic psychology formed part of the approach's foundations, placing prominence on the ideas of Aristotle, Thorndike and Rousseau. Their emphasis was placed on behavioural conditioning and optimising a learning environment so that learners portray desired responses (Ornstein & Hunkins, 2009).

The aim was for learners to achieve set behavioural objectives taught through practice, drill and direct instruction in order to gain a maximally efficient education system. Content was emphasised and learning took place in a structured, logical and prescriptive manner (Ornstein & Hunkins, 2009). Learning was seen as knowledge gained through stimulus-response associations which once combined would result in understanding of complex structures. "Thorndike defined teaching as arranging the classroom to enhance desirable connections and associations" (Ornstein & Hunkins, 2009:109).

Tyler and Taba differed from Thorndike on his view that only particular stimuli would lead to particular responses (Ornstein & Hunkins, 2009). They felt that learning should not be limited to memorization and rote learning but that a well-structured set of learning conditions could provide enough stimuli for knowledge mastery. Learners were therefore seen as being capable of adding new information to already existing prior knowledge. This led to Taba developing problem-solving and inquiry-discovery as teaching methods which are currently implemented by practitioners making use of the behavioural approach (Ornstein & Hunkins, 2009).

Behaviouristic principles implemented by curricularists have led to an emphasis being placed on organising and structuring curriculum so that learners can effectively master subject matter. The approach to curriculum design and development is therefore very prescriptive, following step-by-step methods and placing emphasis on structured learning. Classroom practices depend on the needs analysis of learners and the sequencing of their behaviours. Testing and drilling are still prominent while the monitoring of learners progress and feedback are stressed (Ornstein & Hunkins, 2009).

Therefore, the behavioural approach can be classified as a Content-orientated theory under the subdivision of knowledge-centred theories. As content-orientated theory it is very prescriptive in

nature and involves the identification of chief sources which influence curriculum content selection and organisation (Glatthorn *et al.*, 2006). In this particular case, disciplines and the nature of knowledge within them, drive decisions about what is taught, how it is taught and in what sequence (Glatthorn *et al.*, 2006). It can further be classified as a Structure-orientated theory because it empirically researches curriculum phenomena and is descriptive in analysing curriculum components and the interrelationships that exist between them (Glatthorn *et al.*, 2006).

The Academic Approach

The academic approach is based on the ideas of John Dewey, Boyd Bode and Henry Morrison who focused their studies on epistemology, that is, the nature and justification of knowledge. This approach is used to analyse and create concepts and trends in curriculums. It is philosophical in nature, contributing to curriculum development being theoretical and scholarly. The construction, deconstruction and reconstruction of knowledge is what mainly interests “academic” curricularists. They focus on historical, political, social and philosophical influences on curricula, studying curricula in its broadest overview (Ornstein & Hunkins, 2009).

Cognitive psychology formed part of the academic approach’s foundations, as it is focused on the generation of theories that provide insights into how people learn, understand, reason, solve problems and generate ideas (Ornstein & Hunkins, 2009). The works of psychologists such as Montessori, who developed the principle of structured play; Piaget, responsible for the development of the cognitive stages of development theory; Vygotsky, who proposed the theory of language and cultural transmission; Gardner, founder of the theory on the existence of eight multiple intelligences; and Sternberg, who proposed the development of critical thinking, all form part of cognitivist psychology (Ornstein & Hunkins, 2009).

This led to curricula being very academically rational, systematic and theoretically logical. Curriculum specialists therefore firstly focus on the formulation of goals and objectives determined by the needs of learners and society, by subject discipline objectives and by philosophical and psychological foundations; secondly, they focus on content selection and its classification; thirdly, on the design of appropriate teaching methods and learning approaches; and lastly, on the assessment and evaluation of the curriculum’s components and its outcomes (Carl, 2009).

Thus the academic approach can be classified as a combination of Content-orientated theory (knowledge-centred sub-division) and Process-orientated theory as it not only places emphasis

on the mastery of various disciplines which promote various ways of knowing (Glatthorn *et al.*, 2006), but also on either prescribing or simply describing the curriculum development process (Glatthorn *et al.*, 2006).

The Humanistic Approach

The humanistic approach arose after curricularists started focusing on the curricular aspects which were more social and personal. Aspects which had been neglected in the extremely logical and rigid approaches were now to be emphasised, for example: subject matter which included the arts, learners' physical development and cultural education; skills development such as internal motivation, reflection and self-awareness; as well as classroom dynamics such as socio-psychology and inclusive education. Progressive philosophy and humanistic psychology constituted the foundations of this curriculum approach (Ornstein & Hunkins, 2009).

As psychological foundation, humanistic psychologies lead to curricularists developing curricula that stress affective domains, e.g. value-laden curricula and humanistic curricula (Ornstein & Hunkins, 2009). Learners' needs, attitudes and feelings were emphasised in order to develop self-actualisation, as curricularists began to understand that learners' self-concepts influenced the way in which they construct their own realities and develop understanding (Ornstein & Hunkins, 2009). Abraham Maslow, a humanistic psychologist, proposed that educators view learners as whole persons who learn through personal experience (Ornstein & Hunkins, 2009). He argued that teachers should stress values, creativity and freedom of choice in their classrooms. Learners' worth as well as their full potential in terms of various psychological, cognitive and social factors should be valued and developed by educators (Ornstein & Hunkins, 2009).

The humanistic approach to curriculum development is flexible and allows for subjective decisions to be made, as it is driven by the notion of promoting self-fulfilment among learners. The learners' contexts and needs determine the objectives of the curriculum. Content would be selected in order to interest and empower learners. Various assessment strategies and different teaching methods would be implemented in order to stimulate learners' interests and to provide a diversity of learners with the opportunity to develop various learning domains such as the cognitive, psychomotor and affective domains (Ornstein & Hunkins, 2009). Accordingly, learners become active participants in the classroom, where teachers facilitate learning and encourage problem solving through cooperative learning. In order to develop the whole child, emphasis is placed on science and mathematics, as well as language, humanities, arts, and music among other subjects (Ornstein & Hunkins, 2009).

Therefore the humanistic approach can be classified as Content-orientated theory, in particular the Child-Centred orientation as it denotes learners as the main source which will determine which curriculum content is selected and how it is structured (Glatthorn *et al.*, 2006). Curriculum planners may be driven by the development of the whole learner, therefore planning curricular activities around the cognitive and social development of a learner; alternatively, learners' attitudes, values and feelings may be the main source being emphasised (Glatthorn *et al.*, 2006); or learners' developmental stages may determine the selection and structuring of content (Glatthorn *et al.*, 2006).

The Reconceptualist Approach

The 1970s marked a movement in curriculum development known as the reconceptualist approach. It was not only characterised by its aim to reform and change curricula, but also by its focus on the relationship between curriculum, politics, economics and society. This curricular approach was used by curricularists to investigate curriculum theory, rather than to focus on practice (Ornstein & Hunkins, 2009).

The aim of education according to these curricularists was to equip learners with the knowledge and skills necessary to change the ills of society. Reconstructionist philosophers such as Counts and Benjamin influenced reconceptualist curricularists in their decision to re-evaluate curricula, move away from rigidly prescribed approaches and to view curriculum as a tool to address discrimination, inequality, oppression and the like (Ornstein & Hunkins, 2009). Reconceptualists aim to use education as a change agent which can bring about social reform and improve society. Consequently, learning is seen as an active process in which learners develop skills necessary to identify and address social problems. Teachers therefore adopt the role of facilitator, providing learners with stimulating projects which require learners to reform and solve problems (Ornstein & Hunkins, 2009).

Progressive philosophy has also contributed to aspects of the reconceptualist approach. It led to curricularists viewing education as an agent which could advance democracy. Content is selected in order to appeal to learners' interests, address social problems as well as teach learners about equality, acceptance and self-empowerment. Scientific inquiry and problem solving form part of the teaching strategies implemented to develop learners' critical thinking skills (Ornstein & Hunkins, 2009). Worldly transformation, liberation and self-realisation are at the forefront of reconceptualists' theories for change. They deem that curricula should be relevant, learner-centred and founded on humanistic principles. Philosophers such as Freire and Greene have influenced reconceptualists in developing curricula which emphasise social

sciences, improve language and communication skills as well as develop interests in literature, art, drama and poetry (Ornstein & Hunkins, 2009).

This approach can be classified as Value-orientated as it encourages curricularists to become sensitive to the underlying values which form the curriculum (Glatthorn *et al.*, 2006). Glatthorn *et al.* (2006:79) use the term 'educational consciousness-raising' to define what it is that value-orientated theorists do. As value-orientated theory, the reconceptualist approach attempts to encourage curricularists to reconceptualise curricular objectives and to critically evaluate curriculum (Glatthorn *et al.*, 2006).

Clearly there are various theories which can be used as frameworks to guide practice (Ornstein & Hunkins, 2009). However, regardless of the underlying philosophy applied, even the most sound curriculum theory does not always translate into effective practice. In the realities of schooling and teaching, there are various factors which impede successful curriculum implementation. Teachers' ideologies, learner diversity and social pressures all have an influence on what is taught as curriculum in schools (Glatthorn *et al.*, 2006). Thus, although the South African curriculum makes use of various curricular theories to inform its practice, the factors affecting curriculum in practice must also be considered.

2.2.2 *Curriculum in Practice*

Curricula are not mere documents which are implemented and practised in schools, exactly as they were written. Between what was intended in theory and that which is taught in practice, many role-players interpret and influence the curricula which learners are taught. Curricularists such as Goodlad (Goodlad & Associates, 1979 in Glatthorn, Boschee & Whitehead, 2006) determined that at least five curricular forms existed instead of a simple planned and actualised curriculum. These included the ideological curriculum; the formal curriculum; the perceived curriculum; the operational curriculum and the experiential curriculum (Goodlad & Associates, 1979 in Glatthorn *et al.*, 2006).

Firstly, the ideological curriculum was described as being those ideal ideas which teachers and academics interpreted and understood as curricula. Secondly, the formal curriculum was said to be the curriculum which was accepted and permitted by the state as well as regional school boards because it represented the interests of society. Thirdly, the perceived curriculum was defined as that which parents, teachers and communities thought curriculum was. Fourthly, the operational curriculum was that which was practiced in classrooms and finally, the experiential

curriculum was stated to be that which learners experienced as curriculum (Goodlad & Associates, 1979 in Glatthorn *et al.*, 2006).

Glatthorn *et al.* (2006) refined these curricula types as they believed them to be poorly defined and classified. They suggested 6 curricular types which are more relevant to current curricularists and defined them as follows: Firstly, the recommended curriculum includes the policy recommendations made by scholars to convey concepts and skills which should be emphasised by educational institutions. Secondly, the written curriculum more specifically states educational goals in a comprehensive manner specifying the curricular objectives, their sequence of study and accompanying learning activities. It is important to note that CAPS serves as the written curriculum. Thirdly, the supported curriculum consists of resources which are used to deliver and reflect the curriculum, including textbooks, time spent on individual subjects and time spent on topics within the subject. Fourthly, the taught curriculum can be defined as that which is delivered to learners by the teacher. Fifthly, the tested curriculum entails the assessment of learners on their knowledge of the curriculum, through teacher constructed classroom tests or national curriculum-referenced or standardised tests. Lastly, the learned curriculum includes “all the changes in values, perceptions and behaviour that occur as a result of school experiences” (Glatthorn *et al.*, 2006:15) within learners. The learned curriculum therefore includes learners’ knowledge and understanding gained due to the influence of all the above mentioned curricula (Glatthorn *et al.*, 2006).

Implementing Reconceptualism in practice entails focussing on the development of the child, and incorporating their backgrounds and various cultures into the learning content and environment. The context, within which the school is based as well as the community surrounding the school, must be integrated into the taught curriculum as well. Teachers must stimulate learners to develop their inquiry and problem solving skills (Tzuo, Yang & Wright, 2011). Glatthorn *et al.* (2006) state that through incorporating the real-life problems of learners into curriculum and allowing learners to seek solutions to these problems, the curriculum will be significantly enriched. Furthermore, real-life problem-solving scenarios stimulate learners to use critical-thinking skills and increase strong brain networks (Glatthorn *et al.*, 2006).

For the purpose of this research study, the researcher was interested in the written curriculum; in particular the Curriculum and Assessment Policy Statement for Grade 10-12 Life Sciences because it is the document to which teachers refer for content guidelines. Therefore the LSC document was analysed to determine the extent to which it integrates green economy

education. Grade 10 teachers were interviewed to determine their understanding of green economy as endorsed by the written Life Sciences CAPS document, implemented beginning in 2012 in Grade 10, as this shed light on whether the written curriculum translates directly into the taught curriculum.

2.2.3 *Curriculum and Socioscientific Issues*

Curricula and schooling are essential to learners as they provide opportunities and experiences to participate in society using knowledge and skills learnt at school. However, the concept of social participation may vary from curricula to curricula as curriculum specialists' approaches to curriculum differ (Ornstein & Hunkins, 2009). In the past decade, a curriculum approach known as SSI education (Zeidler, Sadler, Simmons & Howes, 2005) became increasingly popular because it addresses many pressing issues pertaining to curricular relevance for learner participation as global citizens.

Latourelle, Poplawsky, Shamaefsky and Musante (2012) define SSI Education as a combination of subject content and socially-relevant issues experienced in the learner's everyday world, which encourages learners to actively engage in the learning processes. SSI education involves the construction of context specific knowledge. Economics, society, politics and other fields of study are explored in the science classroom, increasing learners' motivation and interest in the subject. Latourelle *et al.* (2012) further argue that research has shown that learners' higher order thinking skills development is enhanced through socioscientific teaching, as is their knowledge of the NOS and their intrinsic motivation regarding their science studies. Because the learners' social contexts are incorporated into the classroom, learning becomes more relevant, leading to learners taking ownership of their own independent learning (Latourelle *et al.*, 2012).

Schools today are still adopting approaches stressing cognition, and emphasise academic productivity and educational excellence, especially in fields of mathematics and science (Ornstein & Hunkins, 2009). However, Ornstein and Hunkins (2009) argue that education should not only focus on discipline development, but also that of interpersonal skills, as learning is a social endeavour in which learners personal identities must be developed. A curriculum which teaches learners the skills which they will one day apply in the world of work is therefore required (Van der Horst & McDonald, 2005). In relation to schools preparing learners for employment, Johnson (1977) suggests that curricula often over emphasise theoretical knowledge which is irrelevant to learners and the job market, resulting in learners disregarding

the information directly after completing their exams. He suggested that learners be taught actionable knowledge and skills which are necessary for learners to actively participate in society after school.

According to Van der Horst and McDonald (2005), curricularists have realised that it is not only content that is necessary in education, but that institutions need to move beyond over emphasising content and focus on development of application skills such as critical thinking. Jacobs and Chalufu (2000) support this notion by stating that schools should be places which provide learners with practical skills and thinking skills enabling them to access and utilise knowledge which is of relevance to society and learners' daily lives. According to Fraser (1993, in Fraser, Loubser & van Rooy, 1993) content incorporated into curricula should link to learners' cultural environment, context and existing frames of reference if effective learning is to take place. Socioscientific education may well be the curricular approach which is necessary to address the aforementioned curricular issues.

Socioscientific issues as an educational movement promotes the development of learners' scientific knowledge and skills through emphasising scientific literacy and NOS (Zeidler *et al.*, 2005). Through SSI, learners become knowledgeable about ethical and moral issues underlying science and its effect on society and the environment (Zeidler *et al.*, 2005). Learners are taught how to analyse, evaluate and synthesise information through critically looking at SSIs and the interconnectedness of all life's spheres. The aim is to encourage learners to make informed decisions, to think with an open mind, to inquire and ask relevant questions and to discover things for themselves (Zeidler *et al.*, 2005). Thus Reconceptualist principles form part of this approach as learners are developed holistically, expanding their cognitive development, character development and social development (Zeidler *et al.*, 2005).

As part of the LSC, SSI may be ideal to teach learners decision making and risk factors involved when science and society are combined. "Socioscientific issues aims at enabling students to identify, assess and form a reasoned opinion on a complex problem" (Simonneaux & Chouchane, 2011:211, in Yarden & Carvalho, 2011). Learners may learn to identify, analyse, and reason about the impact which certain decisions and actions taken by individuals may have on society and the environment, to the extent that they will be able to select the least hazardous course of action (Levinson, Kent, Pratt, Kapadia & Yogui, 2011, in Yarden & Carvalho, 2011). Dawson and Venville (2011, in Yarden & Carvalho, 2011) correspondingly found that SSI can be used to promote learners' argumentation skills. Through reasoning about SSIs such as

global warming or energy consumption, learners learn to rationally justify and defend decisions based on well-constructed arguments (Dawson & Venville, 2011, in Yarden & Carvalho, 2011).

The author therefore believes that green economy as socioscientific content is required to equip learners with the knowledge and skills to combat South Africa's environmental and economic challenges. There is a necessity to develop renewable energy projects and to sustainably manage the land, water and waste in South Africa (Development Bank of Southern Africa, 2011). This will require a Socioscientific approach to teaching which promotes scientific discipline development, cognitive development, the address of social and cultural issues, as well as moral development relating to our impact on the environment (Zeidler *et al.*, 2005). Through investigating a contextually relevant issue such as green economy expansion, these issues may be better addressed.

2.2.4 *The South African School Curriculum*

During 2012, South African Grade 10 learners began to follow the Curriculum and Assessment Policy Statement (CAPS) Grades R-12, which specifies South Africa's curriculum and assessment policy (Department of Basic Education, 2011). The curriculum is based on Outcomes-Based Education principles, with the aims of equipping learners with knowledge, skills and values that are valuable in everyday life contexts and which will assist learners in the transition from school to their place of work (Department of Basic Education, 2011). Principles underlying the CAPS include that learners should be active participants in the learning process, developing critical thinking rather than merely recalling information; and that social and environmental justice should be promoted (Department of Basic Education, 2011). The researcher believes that by integrating SSIs, such as green economy, into the Life Sciences content, these curriculum ideals could more readily become reality in South Africa, as the approach has had much success elsewhere in the world.

The history of South Africa's education is wrought with controversy and the manipulation of power by those in charge of curriculum development. South African curriculum originated as a means of preserving a national identity amongst colonialists as well as a divide between what were deemed superior peoples and 'savages' during the colonial era in South Africa (Kumar, 2010). The Dutch Curriculum, implemented in South Africa in 1658, was used as an instrument to enforce and maintain Christianity. The church determined what was taught, and how it would be taught, for example literacy was taught so that the Bible could be read by the Dutch settler children. The year of 1806 marked the rule of British Colonialists in South Africa, who

implemented an academically orientated curriculum, for the upper and middle-class, aimed at improving the South African economy. After diamonds were discovered in 1862, economic advancement began to take place and an educated labor force was required to expand it. Industrial training and limited reading and writing skills were taught, along with religion, to the lower classes (Kumar, 2010). Curriculum had therefore been used for the European political advantage in order to suppress the South African indigenous peoples (Kumar, 2010).

From the 1950s the South African government used curriculum to enforce Apartheid. Racial segregation took place in Universities, where education was provided as follows: White English speaking Universities maintained high intellectual and academic standards and were linked to large businesses which provided funding along with the state. Afrikaans Universities educated Afrikaners in becoming the apartheid state's civil servants, through rote learning, while the Black, Colored and Indian Universities presented a watered-down version of the Afrikaner curriculum (Kumar, 2010). In all educational institutions curriculum theory was viewed as a human science which possessed "its own terminology, points of departure, and methods of investigation, and verification based on the essential characteristics of teaching-learning phenomenon," (Kumar, 2010:5) for which the scientific method was seen as the only manner of examining education.

The 1970's marked the rise of the resistance against all that was Apartheid education. The People's Education for People's Power (PEPP) demanded an education system that would bring about social reconstruction. A curriculum was sought which was context rich, learner-centered, incorporated collaborative learning and addressed learner's needs. In 1992 the demands of PEPP were met, when the National Education Policy Initiative project was launched, which proposed a curriculum which was to promote unitary, racially and gender unbiased education. In 1995 the Outcomes-Based Education interim syllabus was introduced (Kumar, 2010), in order to replace a curriculum where development had been limited to macro-institutions, which promoted the passivity of learners, and which over-emphasised rote learning of rigid and non-contextual content (Van der Horst & McDonald, 2005).

Thus prior to 1994, much of the South African Education System had been founded on content-based curricular theories (Booi, 2000; Van der Horst & McDonald, 2005), which led to curricula in which the subject content prescribed to educators, the teaching methods and learning activities which were to be implemented in the classroom. Text-books served as rigid content sources for educators while mainly transmission approaches to teaching were adopted. Accordingly, learner evaluation took place in a strict and formal manner in order to test learner's

mastery of content knowledge (Van der Horst & McDonald, 2005). Mainly elements of the Behavioural approach (Section 2.2.1) to curriculum theory were evident, with learning taking place in a structured, logical and prescriptive manner through practice, drill and direct instruction in order to promote the mastery of content (Ornstein & Hunkins, 2009).

When the South African government attempted to reform socio-politically to a democratic society after 1994, a paradigm shift was made in order to reform the education system as well. A social-transformation schooling view was therefore adopted. Outcomes-Based Education was implemented with the intention to provide South African citizens with sufficient learning and training opportunities, so that all citizens would have an opportunity to fully develop their potential. Emphasis was placed on developing learners' problem solving skills and critical thinking abilities as means of empowering learners to become active participants in developing South Africa (Van der Horst & McDonald, 2005). Elements of the Academic approach and Reconceptualist approach were now to be incorporated into the curriculum theory as curricularists attempted to create curricula that would encourage learners to think for themselves while simultaneously thinking about their impact on society.

Current Outcomes-Based Education principles underlying the CAPS document are similar to those of Curriculum 2005; it is a learner centered curriculum approach which attempts to develop learners' critical thinking (Kumar, 2010), content knowledge, skills and understanding (Booi, 2000). The principles of social constructivism (Booi, 2000) and progressivism therefore serve as theories which underpin this curricular approach (Kumar, 2010). The role of the educator is that of a facilitator, who critically reflects on his/her practice in order to identify areas requiring improvement (Booi, 2000). Learning through active inquiry and problem solving has replaced the passive learning methods prescribed to learners in past education systems (Booi, 2000). Teachers make use of direct instruction, group work, co-operative learning and discovery learning strategies as part of their instructional methods, while the economic, cultural and environmental context of learners is taken into account when constructing curricula (Booi, 2000).

The Department of Basic Education (2011) states that the National Curriculum Statement for Grades R-12 is founded on the values and principles of social transformation; active and critical learning; high knowledge and skills; environmental justice, inclusivity, human rights and social justice; and quality, credibility and efficiency. Therefore, Structure-oriented theories, Value-oriented theories, Content-oriented theories and Process-oriented theories seem to be represented within the South African Outcomes-Based Curriculum. Elements of the

Behavioural, Academic, Humanistic and Reconceptualist curricular approaches (Section 2.2.1) inform the South African curriculum in order for its aim of developing fully socially and economically equipped citizens to be realised (Department of Basic Education, 2011).

However, the researcher is of the opinion that historically, the South African curricula successfully accomplished that which they were designed for, even though curricularists' motives were questionable. The current aims and objectives of the South African curriculum are worthy of accomplishment, being founded on democratic principles aimed at achieving the prosperity of the nation. Yet academics, such as Jansen (2012), have pointed out that they are not being achieved or accomplished in practice. Many learners still become citizens who live impoverished lives, being equipped with insufficient skills to contribute to South Africa's progress and personal wellbeing. The economic, environmental and social changes that can be brought about through promoting green economy awareness amongst learners may be what are necessary to help realise the just and worthy aims of the South African curriculum.

2.3 The Rise of Green Economy

The term 'green economy' was coined in 1991 but only became more universally known after the economic, financial, energy and food crisis's that occurred in 2008 (Environment Management Group, 2011). Many South Africans have some knowledge of what it means to be 'green' as this concept is endorsed by the media. This term is therefore often associated with being environmentally friendly, recycling, saving water and electricity, using sustainable products and limiting any forms of pollution (Holzer, 2012). Yet little seems to be known about the concept of green economy in its totality (Mabudafhasi, 2012).

"There is a need to foster better understanding of the green economy in the context of Africa, as a way to protect and sustain natural capital, improve resource efficiency, including innovative financing, and sustainable consumption and production, and enhance contributions to sustainable development" (Mabudafhasi, 2012:3). Green economy must be understood by its working definition of a long-term economic system of activities resulting in social equity and the improved well-being of humans, while substantially lowering ecological scarcities and environmental threats (UNEP, 2011b). An economy built on resource and energy efficient, low carbon, low pollution and socially inclusive practices are what a green economy demands (UNEP, 2011b).

When national economies were in a crisis in 2008, green economic initiatives were proposed as a means of reducing poverty, recovering the economy and lowering environmental degradation and carbon emissions in the long term. A new outlook on what economic growth should entail was proposed due to the growing human population, decrease of various natural resources and deterioration of numerous ecosystems. The economy would be driven by a workforce employed in new green jobs, transformed old jobs or through the substitution of eliminated professions. Jobs in research and development, agriculture, service provision and manufacturing would be altered to contribute to sustainably restoring and preserving the environment. Thus a people-centred economy in which resources are sustainably used to eradicate poverty and unemployment would be imposed (Environment Management Group, 2011).

Green jobs are now increasing due to the transition being made in economies which attempt to abandon the carbon-intensive energy practices and capitalise on waste and pollution free practices which contribute to the efficient management of natural assets (Hendricks, Light & Goldstein, 2009). These jobs will not be the result of a few new occupations which arise due to economic greening, but will rather consist of the full-time labour activities which are undertaken to decrease the dependence on non-renewable resources such as fossil fuels and increasing clean-energy practices and energy efficiency, to name but a few (Borel-Saladin & Turok, 2013; Hendricks, Light & Goldstein, 2009). Currently, unemployed local peoples will especially benefit from these jobs, as for example, steel workers and truck drivers who assist in the construction of wind farms; electricians and decorators who retrofit and green buildings; farm labourers who grow bio-fuels; installers of solar panels or recyclists who sell sorted refuse (Hendricks *et al.*, 2009).

In South Africa, focus will be placed on eight specific areas as part of the Green Economy Strategy. These include: forestry, food production and agriculture; energy efficiency and clean energy; sustainable waste management; greening the built environment and buildings; water management, sustainable production and consumption; resource management and conservation; sustainable transport; and research, skills development and awareness (Mabudafhasi, 2012). The African continent is leading in some of these areas as its wealth lies within the ecological capital found in its natural resources. There is ample opportunity for innovative thinkers and entrepreneurs to develop products, strategies or services (Biodiversity-based businesses) which help manage and protect the remainder of the natural reserves (Mabudafhasi, 2012).

A platform must be created through which to communicate this information to South Africans so that they can fully understand the concept of green economy. Already the media has been used as one of the mediums to create awareness of environmentally friendly practices and sustainability. The researcher proposes the Life Sciences curriculum as a potential platform through which to subject learners to the various aspects relating to a green economy.

2.3.1 Green Economy as Socioscientific Content

Ratcliffe and Grace (2003) define SSIs as those matters which have a scientific basis and also impact society largely. The development of new energy sources, research on sustainable practices, social benefits and disadvantages of nuclear plants (Ratcliffe & Grace, 2003), cloning, genome projects, stem cell research (Sadler, 2004) and finding solutions to the swine flu pandemic (Ratcliffe, 2009) are just a few examples of the media debated topics relating to SSI. The researcher believes that green economy meets the criteria of socioscientific content as it adheres to the definition of what SSI entails.

Socioscientific issues are further characterised by their foundations in science; the necessity for ethical reasoning and involvement of morals; the formulation of opinions; their focus on global, national and local issues relating to social and political frameworks; the requirement of understanding risk and probability; and often their reporting in the media (Ratcliffe & Grace, 2003). Green economy is currently part of many public debates as it concerns issues of employment, environmental management, low-carbon practices and resource efficiency (UNEP, 2011b). Furthermore, green economy has been in the South African media since the COP17 conference in Durban 2012 and is still being reported on due to the National Environment Month theme in South Africa in June 2012 which was 'Green Economy: Does it include you?', the 'Towards Rio+20: Local and regional action for green economy' conference held in June 2012 in which South Africa participated, summits such as 'The Green Economy National Youth Summit' of June 2013 and 'Sustainability week 2013: Youth and the Green Economy', held on 24-28 July 2013 (Mabudafhasi, 2012). Evidently green economy qualifies as a SSI based on the aforementioned characteristics.

If green economy were to be taught as SSI content, it could potentially hold many benefits associated with SSI education. Firstly, learners could be equipped with knowledge which enables them to participate in informed decision making. Secondly, learners could be empowered to confidently contribute in democratic decision-making processes, such as policies relating to science and society. Thirdly, learners will be able to make value judgments relating to

controversial topics as they have developed reasoning skills (Ratcliffe, 2009). Fourthly, learners' interest in science will be increased because these real-world issues give the content relevance (Latourelle *et al.*, 2012). Finally, learners' higher order thinking skills will be developed as well as their NOS understanding (Latourelle *et al.*, 2012). Thus SSI promotes conceptual and procedural understanding as well as the development of personal values and recognition of social values (Ratcliffe & Grace, 2003).

Latourelle *et al.* (2012) are of the opinion that SSI can be taught as either an individual exercise or as an integral part of subject curricula. They point out however that the most important aspect of SSI instruction is to ensure that current issues are used as it improves retention and comprehension of subject content (Latourelle *et al.*, 2012). As the LSC already contains SSI content such as climate change, the loss of biodiversity and waste management (Department of Basic Education, 2011), the researcher proposes that green economy be included with these related issues as subject content rather than a once off topic of discussion. Green economy is a current and evolving concept which includes the majority of the SSI content already present and has the ability to tie these concepts together in such a manner as to provide learners with the knowledge and skills to not only solve these problems, but to do so in an economically beneficial manner.

Curriculum Approach for Green Economy Education in South Africa

After reviewing the literature on curriculum theory and practice, SSI education and green economy, the researcher believes that green economy education would best be integrated into the Life Sciences CAPS if curricularists were to deal with curriculum using a Reconceptualist approach. The Reconceptualist approach contains educational values promoted by the Behavioural, Academic and Humanistic Approaches, all of which already form part of the South African curriculum foundations. However, the Reconceptualist approach extends beyond their aims to include a focus on all social elements influencing curriculum, i.e. politics, economics and society, with the aim of bringing about positive change (Ornstein & Hunkins, 2009). This will in turn serve as a basis for the use of SSI education by which means the instruction of green economy content and activities can be informed. The relevance of the Reconceptualist approach to green economy as an SSI education topic is that it will provide a curriculum platform which furnishes learners with the necessary skills to become active and effective participants in society who are able to address South Africa's economic and environmental challenges. Reconceptualists use curricula to bring about change in society to empower individuals (Ornstein & Hunkins, 2009). Through integrating content which is contextual,

relevant and of interest to learners, such as green economy, skills such as problem solving, scientific inquiry and critical thinking are developed through schooling (Ornstein & Hunkins, 2009).

2.4 Theoretical Framework

Socioscientific issues have become popular in science education classrooms because it empowers learners to reflect on science-based issues and to consider the effects of science in their own lives, their natural environment and their social worlds (Zeidler *et al.*, 2005). These issues are often complex, controversial and open-ended dilemmas to which no conclusive answers can be found (Sadler, 2004). Therefore, SSIs are used to encourage learners to make informed decisions, to analyse and evaluate information, to synthesise solutions to problems and to reason morally about ethical issues (Zeidler *et al.*, 2005).

Research on SSI in science education is fairly new (Sadler, 2004) and studies on the extent to which SSI content is represented in Life Sciences curricula are particularly limited. Zeidler *et al.* (2005) have developed a working model which illustrates conceptual and theoretical links associated with science education and SSI relating to developmental factors of learners, their sociology and their psychology. Four areas which are pedagogically significant to the instruction of SSI content and which can be viewed as science curriculum entry points have been identified, i.e. cultural issues, case-based issues, nature of science issues and discourse issues (Zeidler *et al.*, 2005). This model (Figure 1) was adapted and used as the criteria by which to measure the extent to which LSC incorporates green economy content, as well as for testing teachers' understanding of green economy.

Firstly, cultural issues which encourage learners to respect differing world views (Zeidler *et al.*, 2005) are an essential part of SSI education and therefore of functional green economy literacy promotion. Science classrooms and content must therefore reflect the context and society in which learners live in order for learning to be relevant and interrelated (Sadler, 2004). The Grade 10-12 Life Sciences curriculum was analysed according to the criteria of cultural issues incorporation in order to determine whether it incorporates green economy content relating to South African learners' differing world views and contexts.

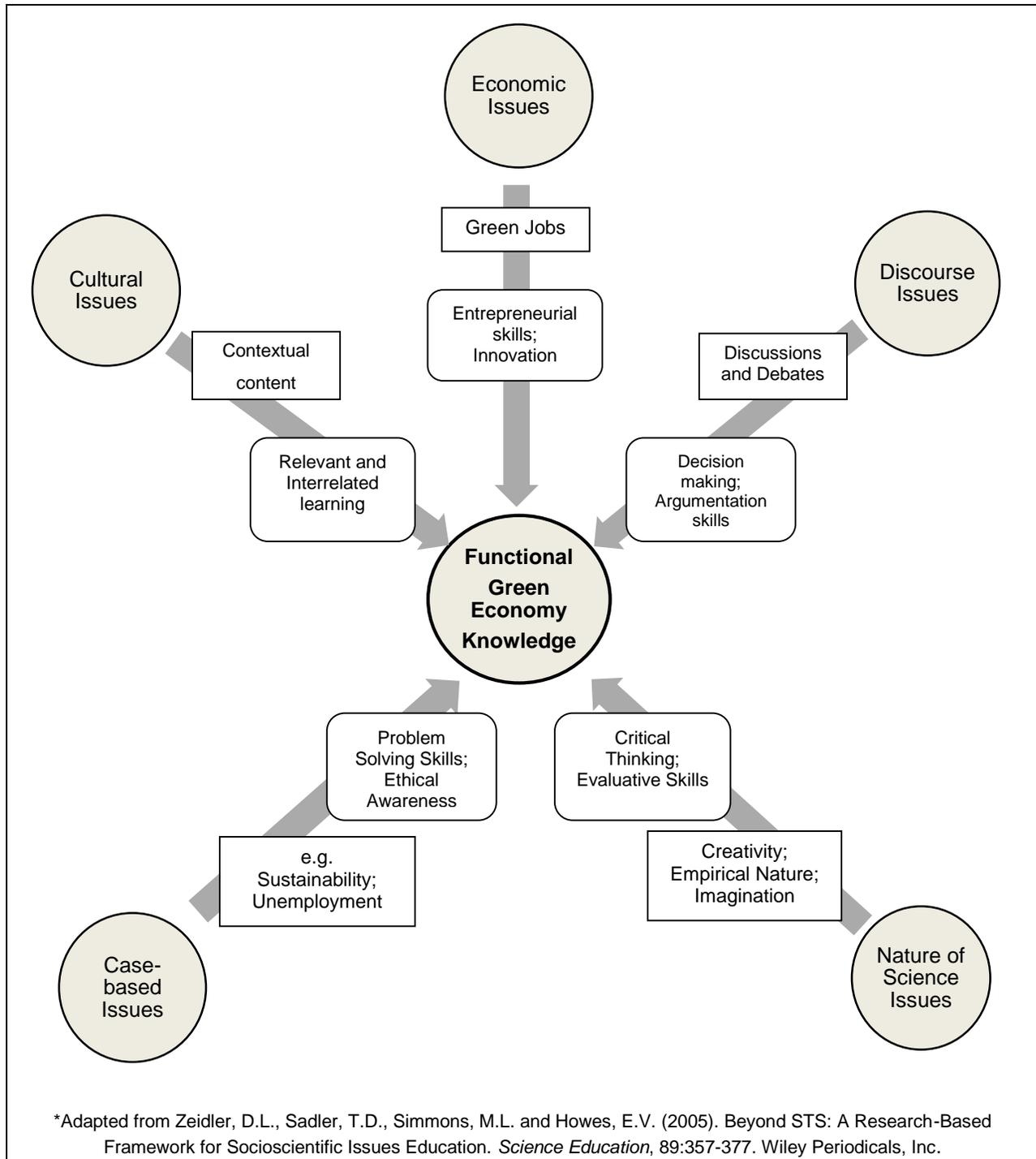


Figure 1: Socioscientific elements of functional green economy knowledge

Secondly, alternative fuel sources, recycling, sustainable economic practices, waste management, unemployment and water management are a few of the elements which have become commonly used in political debates and national vocabulary (Sadler, 2004). These

elements must be included as green economy content in order to mark the presence of case-based issues. Due to the explosion in human population size, environmental challenges will remain prominent presently and in the future newly evolving problems may arise (Sadler, 2004). Case-based issues must therefore be incorporated into SSI curricula in order to move beyond mere content on science, technology and society topics to the development of ethical awareness and problem solving skills amongst learners (Zeidler *et al.*, 2005).

Thirdly, NOS issues are essential foundations for the instruction of SSI content and assist learners in the development of critical thinking, innovation and evaluative skills (Zeidler *et al.*, 2005). Content describing the empirical nature of science is important to NOS issues, as is the discussion of its tentativeness and its sometimes subjective and creative nature due to scientists' prior experiences, values and imagination (Schwartz & Lederman 2008). Although science relies heavily on observation, experimentation and reproducibility, learners must also be taught about the socio cultural embeddedness of science as it is affected by the surrounding cultures and societies (Schwartz & Lederman 2008). Therefore the LSC was analysed in order to determine whether NOS issues relating to green economy are integrated into the curriculum.

Fourthly, discourse issues must be incorporated into an SSI classroom in order to determine learners' prior knowledge and beliefs, assess and improve learners' argumentation skills and to develop their reasoning abilities (Zeidler *et al.*, 2005). Therefore, discussions and debates on economic, social, and ecological issues should take place in the classroom in order to extend SSI content knowledge and assist learners in decision making, forming arguments and defending and justifying positions (Sadler, 2004). In order to determine whether green economy discourse issues had been incorporated into the LSC, Grade 10 teachers were asked, in questionnaires and during interviews, whether the CAPS for Grade 10-12 Life Sciences requires teachers to address green economy discourse issues.

Finally, economic issues were incorporated into the model, in order to fully assess the presence of green economy issues and teachers' understanding thereof. A green economy can only flourish once participation in green jobs takes place in order for the clean-energy transformation to occur (Hendricks *et al.*, 2009). Jobs pertaining to renewable energy production through solar plants and wind turbines, as well as expanding public transportation and improving the energy efficiency of buildings through retrofitting (e.g. installing energy saving light bulbs) (Pollin, Garrett-Peltier, Heintz & Scharber, 2008) are a few of the initiatives that will become part of the green jobs in which South Africans can participate. "Green jobs result from increased demand for full-time labor as we invest in increasing energy efficiency, improving environmental quality,

decreasing reliance on fossil fuels and other nonrenewable resources, and generally furthering our transition to a clean-energy economy” (Hendricks *et al.*, 2009:3).

Additionally, a green economy requires citizens with entrepreneurial skills who are innovative and creative in terms of seizing economic opportunities pertaining to waste management, recycling, ecotourism, water and energy saving, sustainable farming and the like (SEED Initiative, 2012). The LSC was therefore assessed on the extent to which it incorporates content on green jobs and creates awareness amongst learners of the entrepreneurial opportunities that await them once their schooling has been completed. A green economy transition can more readily take place if learners have knowledge of local entrepreneurs which advance solutions to issues such as food security, energy saving and climate change (SEED Initiative, 2012).

Were it found that the LSC contains and encourages the teaching of knowledge of green economy cultural issues, case-based issues, economic issues, NOS issues and discourse issues, the curriculum could be said to promote functional green economy literacy amongst Life Sciences learners.

Chapter 3: Research Methodology

3.1 Introduction

A social constructivist view forms part of the paradigmatic assumptions adopted by the researcher. Lev Vygotsky founded the concept of constructivism on the idea that knowledge is constructed through personally meaningful experiences and social interactions (Powell & Kalina, 2009). Constructivism has become integral to educational reform (Powell & Kalina, 2009) and is part of the South African Life Sciences curriculum's learning theory (Booi, 2000; Doige *et al.*, 2008). Therefore constructivism served as the research premise used in the determination of green economy education integration into the LSC. In this chapter, the research design, sample, data collection techniques and data analysis strategies will be discussed as influenced by the researcher's ontological and epistemological perspectives. Ethical considerations relating to the implementation of this study will also be discussed.

3.2 Research Design

An exploratory mixed methods research approach was used in the current study to qualitatively explore the topic before measuring it quantitatively. Through this mixed methods study, the researcher obtained knowledge through sometimes subjective interactions with texts (document analysis) and participants (interviews) (Caelli, Ray & Mill, 2003) using quantitative data (questionnaires) only to build on and further explore qualitative data. Mixed methods research is known to provide researchers with a better understanding of the research problem as the strengths of both qualitative and quantitative research can be combined (Creswell & Plano, 2006). Open-ended data was gathered in qualitative phases allowing a diversity of ideas to emerge during data analysis, while closed-ended information on participants' attitudes and views were collected and statistically analysed during the quantitative phase (Creswell & Plano, 2006).

The researcher conducted a case study (see Sections 3.3-3.7) on the integration of green economy content into the LSC. The case study was conducted by analysing the Life Sciences CAPS document, administering questionnaires to Grade 10 Life Sciences teachers and by conducting follow-up interviews with some of these Life Sciences teachers. This design was especially suited to this study, as it allowed the researcher to gain in depth understanding of context rich and complex phenomena (Barkley, 2006; Baxter & Jack, 2008). Elements of

quantitative methods were used to counter research bias which may have occurred during qualitative phases.

Case study research is mostly underpinned by a constructivist philosophical paradigm (Baxter & Jack, 2008). Accordingly, the researcher adopted the assumption that several realities, which are socially created by individuals, exist. The participants under investigation were therefore believed to create their own realities which are specific to the social circumstances in which they find themselves. The participants' subjectivity and internal experiences were recognised during the case study research, especially during interviews. As part of case study research, various participants (Section 3.3) and multiple data sources (Section 3.4) were investigated in order to ensure that the data gathered provided a view of the numerous facets of the phenomenon, holistically portraying a complete story (Baxter & Jack, 2008; Davies & Beaumont, 2007; Neale, Thapa & Boyce, 2006).

The data sources included the Grade 10-12 Life Sciences curriculum document, questionnaires and interview transcripts (details will be given on the design of the data gathering instruments in Section 3.5). In this particular case the researcher wished to focus on the South African context, which necessitated participants from well-resourced and under-resourced schools to best portray the diversity of schooling systems (see Section 3.3 for an elaboration on the sample).

The researcher used the adapted version of Zeidler *et al's.* (2005) theoretical framework (see Section 2.4) to construct a protocol and guide questionnaire and interview questions (Section 3.5 explains how the theoretical framework was used to aid in the instrument development), so as to determine whether the 5 areas of green economy education were integrated into the Life Sciences curriculum's content in its entirety (see Section 2.4). These 5 areas included cultural issues, case-based issues, economic issues, NOS issues and discourse issues.

Once the research design had been determined, the researcher proceeded to determine who and what the sample of this study would be. The sample as well as the sampling techniques applied in this study are discussed in the following section.

3.3 Sample

The CAPS document, implemented beginning 2012 in Grade 10 classrooms, was purposively selected and analysed to determine to what extent green economy content is integrated into the LSC. This document is the latest revision of the South African education curriculum and was

therefore deemed most relevant to identifying the extent of green economy content being taught to learners.

South Africa has schools of varying socio-economic settings which employ teachers from differing cultural, economic and educational backgrounds. These differences in teachers' histories result in them having different world views and different levels of exposure to currently debated topics such as green economy. Therefore the researcher proposed to conduct the study at twelve governmental Secondary Schools in Gauteng, six of which were from well-resourced areas (schools with access to resources such as laboratories, libraries, and computer facilities) and six from under-resourced areas (schools which lack resources such as laboratories, libraries and/or computer facilities). The selection of these schools was done in an attempt to capture data which depicts the differing views of the diverse teachers found in South Africa. Schools were therefore sampled purposively as all schools had to be Secondary Governmental Schools which teach Life Sciences to grade 10-12 learners, six of which were well-resourced and six of which were under-resourced.

The sample consisted of thirty-five Grade 10 Life Sciences teachers, nineteen were from under-resourced schools and sixteen from well-resourced schools. A stratified purposive sampling technique was used to select the participants for this study as they had to possess certain pre-determined characteristics (Maree & Pietersen, 2007). These characteristics included that the teachers were Life Sciences teachers who taught Grade 10 learners in 2012, following the CAPS document. Furthermore, sixteen teachers were teaching at well-resourced schools and nineteen at under-resourced schools at the time of the study. No restrictions were placed on the sample in terms of gender, experience or level of education of the teachers, as the researcher wished to portray the diversity of educators in South African schools (see Table 1 and 2).

Table 1: Cross-tabulation of the sample's age and their years of teaching experience

		Age					Total
		20-29	30-39	40-49	50-59	60-69	
Years (Experience)	1-5	10	1				11
	6-10		6	2			8
	11 or more			8	4	4	16
Total		10	7	10	4	4	35

Table 2: Cross-tabulation of the sample’s level of education with their schooling areas

		Education				Total
		Degree/ Diploma	Honours Degree	Master’s Degree	Doctoral Degree	
School	Well-resourced area	11	2	2	1	16
	Under-resourced area	13	5	1		19
Total		24	7	3	1	35

By selecting teachers from a diversity of schools, detailed descriptions of the differing cases were captured (Hoepfl, 1997) in order to provide various views on the issue under investigation (Marshall, 1996). It was hoped that the central themes which were captured across a variety of participants would reveal great commonality and shared patterns giving strength to the data depicted in this study (Hoepfl, 1997). The researcher distributed self-administered questionnaires to thirty-five Grade 10 Life Sciences teachers and then conducted a follow-up interview with five of the teachers (three from well-resourced and two from under-resourced schools) with the hope of further clarifying whether green economy education had been integrated into the LSC extensively or not. The teachers chosen to participate in the interviews were sampled through convenience sampling methods based on schools being located nearest to the researcher.

In order to gather information on the extent to which green economy is integrated into the Life Sciences curriculum, a data collection plan was determined. Section 3.4 explains the phases involved in the gathering of data.

3.4 Data Collection

Data collection took place in 3 phases, as discussed below:

The first phase consisted of document analysis of the Grade 10-12 Life Sciences curriculum as captured in the CAPS document. The curriculum was firstly read through 3 times in order to get a comprehensive scheme of the topics, content and outcomes prescribed to Grade 10-12 learners. Thereafter, green economy themes were identified in the data using the research protocol (Appendix 1) and deductively sought in the curriculum document. “A protocol is a list of questions, items, categories, or variables that guide data collection from documents” (Altheide, 1996:26). Lastly, summaries were made of the all the themes which relate to green economy

content which were represented in the LSC. This phase was necessary to address the first secondary research question on the extent to which the CAPS Life Sciences curriculum integrates green economy content. Section 3.5 provides a description on how the protocol was designed.

In order to further explore the results found through the document analysis (Hoepfl, 1997), and to address the second secondary research question on the extent to which Life Sciences teachers understand green economy and its implementation, the researcher conducted a second phase of data collection which constituted the administration of questionnaires to thirty-five Grade 10 Life Sciences teachers who had implemented the new LSC in 2012. A closed-ended questionnaire (Appendix 2.1) which made use of a five point Likert scale was used to determine the extent of green economy representation in the LSC as well as to assess teachers' understanding of green economy and its implementation. Using a five point scale allows the teachers to indicate if they feel unsure about a question, minimising the likelihood of teachers having to guess an answer (Drost, 2011). The questionnaire consisted of positive statements to which the teachers could respond that they strongly agreed, agreed, were uncertain, disagreed or strongly disagreed.

The third phase consisted of semi-structured interviews with five of the teachers that completed the questionnaire. A semi-structured interview schedule (Appendix 3.1) was used to probe, explore and clarify views expressed by teachers in the questionnaires (Nieuwenhuis, 2007a), as well as to allow teachers to give their opinions regarding the relevance of the current Life Sciences curriculum's content for everyday use therefore addressing the third secondary research question. Nieuwenhuis (2007a) suggests that semi-structured interviews are especially effective when used to corroborate data which has emerged from additional data sources, such as document analysis and questionnaires. "Interview guides ensure good use of limited interview time; they make interviewing multiple subjects more systematic and comprehensive; and they help to keep interactions focused" (Hoepfl, 1997:6). Furthermore, the data was recorded by making use of written notes and a tape recorder.

Hoepfl (1997) emphasises the necessity for data collection instruments to be constructed in such a manner that they address the primary research questions, yet allow for the exploration of emerging data. Therefore, topics necessary to teach comprehensive green economy education in terms of the four areas (cultural issues, case-based issues, NOS issues and discourse issues) identified by Zeidler *et al.* (2005), as well as the 5th (economic issues) added by the

researcher, were used throughout the construction and/or analysis of the three data collection instruments. The design process will be discussed in the next section.

3.5 Instrument Design

The document analysis protocol, questionnaire and interview schedule were designed to collect data in the three data collection phases of this research project. The instruments were designed as follows:

The document analysis protocol (Appendix 1) was designed in order to aid the researcher in the process of analysing the prescribed curricular content, skills and contextual topics. The adapted theoretical framework (Section 2.4) proposed by Zeidler *et al.* (2005) (on conceptual and theoretical links between science education and SSI) was used as a guide from which to construct checklist-type items relating to the five areas deemed important to the instruction of green economy as SSI. Checklist items relating to the presence of selected knowledge, skills and values which pertain to cultural, case-based, NOS, discourse and economic issues were developed as short representative statements which could be ticked off as being either completely, partially or insufficiently represented (see Section 3.7 on data analysis for a full explanation on the classification of green economy representation) within the CAPS document. A table was then drawn up consisting of the five areas as section headings, with a list of statements beneath each, which are necessary for the development of functional green economy literacy. These statements were constructed based on green economy literature published by the United Nations Educational, Scientific and Cultural Organization (2012), the United Nations Environment Programme (2011b), Zeidler *et al.*, (2005) and other relevant authors who address green economy and its related educational matters. These statements are inclusive of various green economy topics, content areas, necessary skills and attitudes, and possible investigations (activities) which could form part of the Grade10-12 Life Sciences content.

As conveyed in the theoretical framework section (Section 2.4), the researcher viewed each theme and its items as follows: Firstly, themes on cultural issues are those which encourage learners to respect differing world views (Zeidler *et al.*, 2005) and reflect the context and society in which learners live (Sadler, 2004). Secondly, case-based themes relate to alternative fuel sources, recycling, sustainability, environmental and waste management, and unemployment content which assist learners in realising the application of science in everyday life as a means to address social and environmental ills (Sadler, 2004). Thirdly, NOS themes relate specifically

to the methods of science which contribute to learners' development of critical thinking, innovation, problem solving and evaluative skills (Zeidler et al., 2005). Fourthly, discourse issues relate to themes which require teachers to engage learners in discussions and debates on ecological, economic and social issues to improve learners' decision making, reasoning abilities, argumentation skills (Zeidler et al., 2005), and ability to defend and justify positions (Sadler, 2004). Finally, themes on economic issues relate to content on green jobs and entrepreneurial skills which will encourage innovation amongst South African learners. These themes were included in the document analysis protocol.

The questionnaire (Appendix 2.1) was developed by adapting the content analysis protocol in such a manner that it could be used to gather information on the extent to which green economy content has been integrated into the Further Education and Training (FET) Life Sciences curriculum, and teachers' understanding of green economy and its implementation. Attention was paid to the questionnaire's appearance, the sequence of the questions as well as their wording and the response categories provided for the participants (Maree & Pietersen, 2007). The questionnaire consisted of 42 closed-ended statements which were divided into five sub-sections namely: the participants' background information; the FET LSC content; the FET LSC skills; the FET LSC context; and green economy understanding and implementation. Statements on the background information included gathering data on the age, highest level of education, years of teaching experience and school area in which the participant currently teaches (well-resourced or under-resourced area). A five point Likert scale was used for the remainder of the sub-sections, to allow the teachers to indicate whether they strongly agreed, agreed, were uncertain, disagreed or strongly disagreed with the statements. The use of a Likert scale allows for descriptive statistical analysis of the data to take place as the data can readily be graphically and numerically reported (Pietersen & Maree, 2007). The statements on the Life Sciences content, skills and context sections included assessing the extent to which knowledge, skills and values pertaining to cultural, case-based, NOS, discourse and economic issues were prescribed in the Life Sciences CAPS document. The final section on green economy understanding and implementation had statements which allowed the teachers to indicate whether they fully understood what green economy entails; whether they would feel comfortable teaching green economy content; and whether the curriculum required the teachers to engage learners in debates on ecological, economic and social issues. Section 3.6 explains how the validity and reliability of the questionnaire were improved.

The semi-structured interview schedule was designed to corroborate the data found in the curriculum document analysis and questionnaires (Nieuwenhuis, 2007a). In addition to this, it was used to determine the teachers' opinions on the relevance which they believed the LSC has for learners once they have completed schooling. Although predetermined questions were set, the researcher often further clarified answers or probed for additional explanations (Nieuwenhuis, 2007a). The preliminary interview schedule (Appendix 3.2) consisted of nine predetermined questions, two of which would be used to gather background information on the teachers while also serving the purpose of making them more at ease with the interview process. The remaining seven questions were developed in order to address the secondary research questions. After analysing the CAPS document and the questionnaires, the researcher added 21 additional questions to the interview schedule (Appendix 3.1) while also refining some of the existing questions. Additional questions included determining whether the teachers would consider themselves as well acquainted with the CAPS document as this would impact their ability to answer questions related to CAPS. They were also asked whether green economy topics were prescribed in the CAPS document, in textbooks or both; whether the curriculum includes content which explains to learners how they can participate in a greener economy; and whether the teachers felt that green economy should in fact be in the LSC content, amongst others (see Section 5.2.1 for a discussion on these and other results). Additionally, questions on teachers' knowledge of green jobs were also added as this is essential to the implementation of green economy (United Nations Environmental Programme, 2011b).

The validity and reliability of these instruments, as well as the trustworthiness of the results were improved by using strategies such as expert reviews, pilot studies and the use of multiple data gathering instruments to verify the findings. These and other quality assurance methods will be discussed in the next section.

3.6 Instrument Quality Assurance

Validating a research instrument contributes to the meaningfulness of a study as it strengthens the likelihood of the instrument measuring what it is supposed to measure (Drost, 2011). In this study, the researcher used two qualitative means of increasing the document analysis protocol, questionnaire and interview schedule's validity, namely, face and content validity. Drost (2011:116) defines face validity as "a subjective judgment on the operationalisation of a construct" while Haynes, Richard and Kubany (1995:239) define content validity as "the degree

to which elements of an assessment instrument are relevant to and representative of the targeted construct for a particular assessment purpose.”

The document analysis protocol’s validation took place by asking a panel of experts to review the protocol for content validity. Two Life Sciences Education specialists and one English-language specialist (University lecturers with Doctorate degrees in their respective fields) were selected based on their expertise in the respective fields, to provide recommendations and comments on the check-list statements (Mnguni & Abrie, 2012). The researcher discussed her proposed research project with the specialists and supplied each with a copy of the literature review and theoretical framework providing guidelines on the purpose of the data gathering instrument. The protocol was then revised by the researcher and all necessary corrections were made. This process was repeated twice ensuring that the check-list statements were inclusive of the content identified by the theoretical framework and literature review (Chapter 2) in order to fully address the primary research question. The researcher also critically self-reflected on her worldviews and conceptual orientations in order to prevent being biased when analysing the curriculum document for green economy themes.

In order to improve the validity of the questionnaire, it was reviewed by two Life Sciences and one English specialist. Additionally, a pilot study with 14 third year Life Sciences BEd students was conducted (Drost, 2011). Specialists and students were asked to indicate through written responses any suggestions, uncertainties or comments they had regarding question items (Kimberlin & Winterstein, 2008). Students were also monitored to determine whether they understood the questions, based on their responses, whether the time allocation was appropriate to complete the questionnaire and whether they could follow the instructions indicated on the instrument. Changes were made to the original questionnaire (Appendix 2.2) until the researcher and experts were satisfied with the finalised revised questionnaire (Appendix 2.1) as being suitable for collecting data that could help to respond to the research questions.

The following adaptations, based on the recommendations of the experts and pilot study results, were made: Firstly, as part of improving face validity and in order to prevent confusion about the administrative sections, all the blocks which must be filled in by participants were coloured grey. Secondly, an example of how to fill in a Likert scale question was added to provide guidance to participants. Thirdly, content validity was improved by removing one item (item 13 of the original questionnaire) “The Life Sciences curriculum prescribes content on consumption management”

as six out of fourteen pilot students indicated that they were unsure as to what the term 'consumption management' meant and one of the two Life Sciences specialists commented that, in terms of addressing aspects related to sustainable development, this item was unnecessary. Thirdly, the clarification of one item (originally item 14) was improved by specifying the focus of the statement to be "The Life Sciences curriculum prescribes content on sustainable economic development" and not merely sustainable development, contributing to higher content validity. Fourthly, the nature of science (originally item 24) was clarified by adding a brief explanation in order to prevent any misconceptions. Fifthly, an indication was made in the introductory statements and the relevant section headings that this questionnaire applies to the Further Education and Training (FET) phase in which this study takes place. Finally, some minor changes were made regarding the grammar used in the questionnaire.

In addition to improving the validity of the questionnaire, the researcher sought to determine the reliability coefficient of the questionnaire. The researcher focused on determining the level of internal consistency as it measures the inter-relatedness of the questionnaire items, i.e. to what extent all the items within the questionnaire measure the same characteristic, construct, concept or behaviour (Drost, 2011; Tavakol & Dennick, 2011).

A Cronbach's Alpha test was conducted, estimating the average inter-correlations between the individual questionnaire items (Drost, 2011). In order to increase the alpha, the researcher made use of a 5 point Likert scale which includes the option of participants indicating that they are *uncertain* about a particular test item. This provides participants with the choice of demonstrating their uncertainty instead of guessing an answer, which would lower the reliability levels due to the randomness at which answers may be provided (Drost, 2011). Additionally, the researcher attempted to include enough items in the questionnaire to fully address the investigated green economy constructs in order to prevent the questionnaire from being too short (Tavakol & Dennick, 2011) or the test items scarcely having any relation (Drost, 2011).

The reliability test on Cronbach's Alpha revealed a score of 0.891 on the final results collected from the study participants, which can be interpreted as good internal consistency (George & Mallery, 2003). Thus the researcher was satisfied with the questionnaire being suitable for data collection.

The preliminary interview schedule was reviewed by the research supervisor and co-supervisor to ensure that the questions would address the primary, secondary and tertiary research questions. After analysing the Life Sciences CAPS document and the questionnaires, the interview schedule was reviewed by the researcher to include additional questions which might clarify the document analysis and questionnaire findings. Validation of the reviewed interview schedule took place by allowing two Life Sciences specialists and one English-language specialist to assess the instrument. The specialists reviewed the questions to improve the instrument's ability to provide sufficient information on the three research questions allowing for various patterns to emerge from the data, contributing to a deeper understanding of green economy in the Life Sciences curriculum (Nieuwenhuis, 2007a). Once the interviews were transcribed, the participating teachers were given the opportunity to comment on the interview transcriptions which allowed them to provide comments or state queries which they wanted to bring to the researcher's attention.

The trustworthiness and credibility of the data gathered was enhanced through the process of crystallisation. Crystallisation of data entails using various data gathering instruments and analysis techniques to compare the research findings (Nieuwenhuis, 2007a). Through conducting the document analysis, administering questionnaires and conducting interviews, various sources of data were used to confirm the emerging findings. This enhanced the possibility of the findings reflecting the complexity and context of the phenomenon being investigated (Nieuwenhuis, 2007a). Through the interviews, the trustworthiness and credibility of the researcher's document analysis findings were validated. The process of data analysis is discussed in the following section.

3.7 Data Analysis

A characteristic of qualitative educational research is to use concepts from the chosen theoretical framework to analyse data by identifying patterns and categories which correlate in the text (Caelli *et al.*, 2003). The adapted theoretical framework of Zeidler *et al.* (2005) on Socioscientific elements of functional green economy literacy was used during the content analysis phase of the curriculum document in order to determine the extent of green economy content representation in the Grade 10-12 Life Sciences curriculum. Deductive analysis of the curriculum document took place, as the researcher searched for predetermined codes and themes. A summary was made of all the themes relating to green economy content in order to determine the extent of its representation in the LSC.

Once a summary of all the themes relating to green economy content, which were present in the Grade 10-12 Life Sciences curriculum, was made, the researcher determined whether green economy was “completely”, “partially” or “insufficiently” represented in the LSC. Complete representation required that the theoretical framework areas (cultural, case-based, NOS, discourse, and economic issues) were fully integrated into the LSC as curricular *content*, promoted *skills* and in representation of the South African *context*. Thus, complete content representation required the various topics of green economy content to be fully integrated and thoroughly discussed. Partial content representation entailed content only being added as extra information and briefly discussed. Insufficient representation meant that the content was lacking in its entirety. Complete skills representation required the curriculum to inform teachers on how to promote active participation relating to practical skills development. Partial skills representation entailed skills being mentioned, but no information being revealed on how to develop these skills. Incomplete skills representation entailed skills development being absent. Finally, complete context representation required most South African ethnic, cultural, socio-economic and religious groups to be represented in the content. Partial context representation entailed only dominant South African groups being represented, whereas incomplete context representation required the representation of non-South African contexts. The curriculum document results were then compared to the results revealed after questionnaire analysis, to determine whether they revealed similar results.

The questionnaire data, which was captured as interval data due to the use of a Likert scale, was statistically analysed using the *IBM SPSS (Statistical Process for the Social Sciences) Statistics Version 21 Inc.* programme in order to reveal descriptive information on the modes and frequencies of the captured data. The data were expressed in numerical and graphical ways to best summarise and organise the information obtained (Pietersen & Maree, 2007). Data relating to three themes, namely: content, skills and context were captured.

The researcher made use of inductive data analysis when analysing the interview transcripts, as it is an analysis technique which allows for the natural emergence of dominant, frequent and significant themes from the data instead of seeking predetermined themes (Hoepfl, 1997; Nieuwenhuis, 2007b). As a characteristic of qualitative research reports, the data was reported by means of participant quotes which best illustrated the identified themes (Hoepfl, 1997). The first step of content analysis for interviews was the word for word transcription of data from the tape recorder (Nieuwenhuis, 2007b). Secondly, open coding which entailed identifying patterns

appearing from the raw data was done. During open coding, raw data was placed into descriptive, meaningful and logical categories which emerged from the data so that it can be examined holistically (Hoepfl, 1997). These categories formed the preliminary framework used for the data analysis. Thereafter, the categories were structured in such a manner as to portray how they were related and linked to one another. Most often the links indicated relationships and commonalities between categories, however some also indicated conflicting evidence (Nieuwenhuis, 2007b). Finally, interpretation of the data extended beyond the mere coding and categorising of data to form descriptive summaries. Analytical understanding of the data was achieved by bringing the analysed data into context with the existing theory of Socioscientific elements of functional green economy literacy to reveal its corroboration with existing knowledge. By comparing the analysed data to the existing framework, a better understanding of the phenomenon was achieved (Nieuwenhuis, 2007b).

Table 3 provides a summary of the research methods employed in this study.

Table 3: Summary of research methods

	Data source	Data collection strategy	Instrument	Data analysis	Research question
Phase 1: Document Analysis	CAPS Document	Document analysis	Protocol	Deductive seeking of themes	(1)
Phase 2: Questionnaire Administration	Thirty-five Teachers	30 minute questionnaire	Closed-ended questionnaire	Descriptive statistical data analysis	(1); (2)
Phase 3: Interviews	Five Teachers	20 minute interview	Semi-structured interview schedule	Inductive generation of themes	(1); (2); (3)

- (1) To what extent does the Life Sciences curriculum integrate green economy content?
- (2) To what extent do Life Sciences teachers understand green economy and its implementation?
- (3) What are Life Sciences teachers' opinions regarding the relevance of the current Life Sciences curriculum's content for everyday use?

3.8 Ethics

The consideration of ethical issues took place during the research as it was deemed an essential part of respecting individual rights and adhering to norms of acceptable conduct. These norms included the promotion of truthful research; cooperative and collaborative research; researcher accountability; and social and moral values such as human rights, social

responsibility and safety in participation. Implementing research which was of high ethical standards prohibited the misrepresentation of research data or the falsifying and fabricating of information, while enhancing trustworthy and reliable data (Resnik, 2010).

In an attempt to protect the researcher and participants from any unethical practices throughout this study, the following procedures were implemented. Firstly, permission to conduct this study was obtained from the Gauteng Department of Basic Education (see Appendix 5; GDE Research Request Form and Appendix 6; GDE Research Approval Letter), the University of Pretoria and Gauteng schools' principals who were willing to allow their teachers to participate. The school principals and participants were notified that participation was entirely voluntary and that they had to agree to participate out of their own free will before the research commenced. Secondly, all participants were required to sign letters of informed consent (Appendix 4; Consent Letters). The teachers received these letters in advance, which allowed them to read and sign in due time, in order to confirm that the participants were aware of their rights as informants in this study.

The letters of informed consent informed teachers of the purposes and processes which formed part of the research study. Additionally, it notified participants that they could withdraw from the research at any given time. Thirdly, that participants were to remain anonymous throughout the study as well as in documents that stemmed from the research in order to protect their identities and privacy. Fourthly, that the data gathered during the research would be used solely for academic purposes. Fifthly, that their safety was first priority throughout the interview and lastly, that the researcher had no intention of deceiving or betraying the participant in any manner during the research or in published transcripts which could arise from the study.

Lastly, the researcher adhered to the following ethical principles as proposed by Resnik (2010): integrity, confidentiality, social responsibility, legality, honesty, respect for intellectual property, responsible mentoring and publication, non-discrimination and human subjects' protection.

Chapter 4: The CAPS for Life Sciences and Green Economy

4.1. Introduction

“Students rarely see a relationship between the science they learn in school and the science problems they encounter in everyday life. This narrowness is attributable not only to the generally recognized difficulty of transferring knowledge from one domain to another, but also to an active belief on the part of students that ‘school knowledge’ represents a distinct and special category of learning, separate from the common-sense solutions they develop in real-life contexts” (Burbules & Linn, 1991: 228).

The challenge of making learning relevant to the everyday lives of learners is faced by all involved in the field of science education. SSI education provides Life Sciences teachers with a method of adding relevance to science teaching through contextual topics which relate science to issues encountered in learners’ everyday lives (Lindahl, Roseberg, Ekborg, Ideland, Malmberg, Rehn, Ottander & Winberg, 2010). Green economy, in particular, is a SSI which provides solutions to some of the most pressing problems faced globally in terms of society and the environment (Henderson, 2007). Henderson (2007) proposes that policy models need to be re-examined if the non-viable and unsustainable practices of our society are to be reversed. Educational practices shaped by more than 300 years of fossil-fuelled industrialism, must now give way to an education system which develops learners’ abilities to seek ‘common-sense solutions’ in a design revolution where the sustainability of renewable resources will lead to employment of youth and the expansion of prosperity (Henderson, 2007).

In this chapter, the researcher will therefore discuss the extent to which the latest South African Life Sciences curriculum integrates green economy content and skills as revealed by the results of the curriculum document analysis.

4.2. Results: The CAPS for Life Sciences Analysis

The researcher followed the data analysis techniques (deductive content analysis) as stated in Section 3.5 by making use of the document analysis protocol (Appendix 1) to address the first research sub question: *To what extent does the CAPS Life Sciences curriculum integrate green economy content?*

Before addressing the matter of content, the researcher would like to discuss relevant segments of Section 2 of the CAPS document, *Approaching Life Sciences*, to provide background information regarding what the Department of Basic Education (2011) deem learners will gain from studying Life Sciences, the organisation of the LSC, as well as the Specific Aims prescribed.

4.2.1. *The Purpose of Life Sciences*

According to the CAPS Life Sciences document (Department of Basic Education, 2011:8), learners will develop the following knowledge, skills and attitudes by studying Life Sciences:

(The researcher has placed emphasis [bold print] on the sections which, in her view, are most relevant to actionable green economy education as they address knowledge, skills and attitudes pertaining to cultural, case-based, NOS, discourse, and economic issues.)

- “ **knowledge of key biological concepts, processes, systems and theories;**
- **an ability to critically evaluate and debate scientific issues and processes;**
- *greater awareness of the ways in which biotechnology and knowledge of Life Sciences have benefited humankind;*
- *an understanding of the ways in which humans have impacted negatively on the environment and organisms living in it;*
- *a deep appreciation of the unique diversity of past and present biomes in Southern Africa and the **importance of conservation;***
- **an awareness of what it means to be a responsible citizen in terms of the environment and life-style choices that they make;**
- *an awareness of South African scientists’ contributions;*
- *scientific skills and ways of thinking scientifically that enable them to see the flaws in pseudo-science in popular media; and*

- *a level of academic and scientific literacy that enables them to read, talk about, write and think about biological processes, concepts and investigations.”*

It is also stated that Life Sciences can be studied for three main reasons (Department of Basic Education, 2011:9), namely:

- *“to provide useful knowledge and skills that are needed in everyday life,*
- *to expose learners to the scope of biological studies to stimulate interest in and create awareness of possible specializations; and*
- *to provide a sufficient background for further studies in one or more of the biological sub-disciplines.”*

4.2.2. Organization of the Life Sciences Curriculum

Four knowledge strands have been included to assist teachers in organising the Life Sciences content framework (Department of Basic Education, 2011:9). These strands are:

- *“Knowledge Strand 1: Life at the Molecular, Cellular and Tissue Level;*
- *Knowledge Strand 2: Life Processes in Plants and Animals;*
- ***Knowledge Strand 3: Environmental Studies;***
- *Knowledge Strand 4: Diversity, Change and Continuity.”*

Of note is that “Knowledge Strand 3: Environmental Studies” is prescribed as content and for assessment (including assignments, investigations, tests and exams) in Grade 10 and 11, while content on the human impact on the environment which is taught and assessed in Grade 11 will only be examined at the end of Grade 12 without the contribution of additional environmental content in Grade 12 (Department of Basic Education, 2011). Thus, additional content on the Environmental Studies strand, which is essential to green economy education and has the potential to provide learners with knowledge, skills and attitudes that they can use to empower themselves in their everyday lives, is not taught as part of the Grade 12 curriculum content, yet the human impact content which was taught in Grade 11 on Environmental Studies is assessed at the end of Grade 12. The researcher is concerned that this may possibly have negative implications for learners, such as a lack of knowledge in environmentally orientated career choices and making environmentally conscious decisions in their daily practices.

4.2.3. *The Aim of Life Sciences*

The LSC ascribes to three broad subject-specific aims (Department of Basic Education, 2011:13), which include:

- “*Specific Aim 1, which relates to knowing the subject content (‘theory’);*
- *Specific Aim 2, which relates to doing science or practical work and investigations; and*
- *Specific Aim 3, which relates to **understanding the applications of Life Sciences in everyday life**, as well as understanding the history of scientific discoveries and the relationship between indigenous knowledge and science.”*

The curriculum document analysis revealed that “the skills that can be developed in the process of achieving Specific Aim 3 are cognitive rather than practical” (Department of Basic Education, 2011:17). These cognitive skills include but are not limited to the ability to access and recall information, organising knowledge, recognising patterns and trends, using knowledge in a new way, and analysing, evaluating and categorising information (Department of Basic Education, 2011). The results revealed no evidence to suggest that learners are expected to practically develop, explore, transfer and apply Life Sciences skills necessary in their everyday lives (skills beyond that of science classroom experiments), as part of the prescribed curriculum. As an example, none of the case-based issues investigations (see Table 4.2) prescribed to learners required of them to actively make changes in their daily lives, seek practical solutions to environmental crises experienced in their everyday lives or to apply practices which would positively impact on the environment. They were instead instructed to make observations of environmental problems or to conduct discipline-specific experiments which can rarely be used outside the school environment in daily life.

Furthermore, the results revealed that in the few cases where learners are taught about understanding how Life Sciences is applied in everyday life, teachers are required to briefly mention well-established careers such as science journalism, genetic engineering and plant pathology (Department of Basic Education, 2011), or medical breakthroughs such as stem cell research (Department of Basic Education, 2011). For example, the Department of Basic Education (2011:18) states that “...although learners should be made aware of career choices, it is not necessary to discuss or teach these in great detail”. Another example would be the prescription of content on Biotechnology in Grade 10 where learners are required to research one field of biotechnology, e.g. in vitro fertilization, cloning or stem cell research (Department of

Basic Education, 2011). The researcher therefore reasons that the learners will probably not become acquainted with the fields they did not research.

Moreover, the results revealed no evidence to suggest that teachers are instructed to teach a specific amount of career examples. Although this is acceptable given that the curriculum leaves room for teachers to practice choice (Mnguni, 2011), it may be problematic as some teachers could neglect to teach Life Sciences careers entirely. Additionally, many learners do not have the necessary infrastructure to conduct research on careers or jobs within the fields of Life Sciences, therefore making them dependent on the teacher for some form of guidance or introduction to these fields. Of greater concern to the researcher was that most of the suggested careers, such as “plant pathology...., environmental law, science journalism...., and genetic engineering” (Department of Basic Education, 2011:17-18) require tertiary education at Universities or Colleges which is often inaccessible to many South African learners, especially the poor (Macgregor, 2007). The results revealed no evidence suggesting the prescription of content related to entrepreneurial jobs created by innovative South Africans operating as green economists. This content could be essential to students who are unable to further their education beyond Grade 12.

The CAPS introduction section to the LSC revealed that there is a framework in place for the integration of green economy education, but that the prescription of theoretical scientific content is still receiving preference above that of actionable scientific knowledge and skills development for everyday life.

4.2.4. Content Analysis of the Grade 10-12 CAPS for Life Sciences

Section 3 of the CAPS Life Sciences document contains the prescribed content for Grades 10-12 respectively (Department of Basic Education, 2011:21-65). In Tables 4.1-4.5 and the subsequent paragraphs, the content relating to green economy topics and themes as identified within the CAPS document will be discussed.

The researcher wishes to point out that various content sections may not seem to reflect a particular SSI area or theme, but that the learner investigations and activities prescribed for the content may bare strong relations to the SSI themes and areas. Also, the representation of the data was only classified as complete representation if the theoretical framework areas

(cultural, case-based, NOS, discourse, and economic issues) were fully integrated into the LSC as curricular *content*, promoted *skills* and in representation of the South African *context* (see Section 3.7 for a full discussion on the classification of complete, partial and incomplete green economy representation).

Table 4.1: Summary of the Grade 10-12 Life Sciences Cultural Issues Content

~Adapted from the Department of Basic Education (2011:21-65)

Green Economy Themes	* Strand	Topic	Content	Investigations	Representation
Respect world views	1 (Gr10)	Cell Division: Mitosis	Cancer (p. 26)	Research and brief discussion on beliefs and attitudes	Partial
	2 (Gr11)	Animal Nutrition	Different diets due to culture, religion and health choices	None	Partial
	3 (Gr11)	Population Ecology	Population Size	Public survey on culling (only show results in graph)	Partial
	4 (Gr 12)	Human Evolution	Alternatives to evolution: different cultural and religious explanations (p. 65)	Research and discussion	Complete
Ethical awareness	1 (Gr10)	Plant and Animal Tissues	Applications of Indigenous Knowledge Systems and Biotechnology: Cloning (p. 28)	Research on one field of Biotechnology	Complete
Contextual content	1 (Gr10)	Plant and Animal Tissues	Applications of Indigenous Knowledge Systems and Biotechnology: traditional technology (p. 28)	None	Partial
	3 (Gr10)	Biosphere to Ecosystems	Biomes of southern Africa (p. 33)	Fieldwork	Complete
	4 (Gr10)	Biodiversity and Classification	Biodiversity emphasizing southern Africa species (p. 35-36)	Classification; Research; Presentations	Complete
	1 (Gr11)	Biodiversity and Classification of Microorganisms	Traditional technology to produce e.g. beer, wine and cheese (p. 39)	None	Partial
	1 (Gr11)	Reproduction in Plants	Endemic seeds in SA (p. 40)	Seed germination (Optional activity)	Partial
	3 (Gr11)	Human Impact on the Environment	Loss of Biodiversity: Indigenous knowledge and sustainability (p. 52)	Rhino poaching: research and prevention suggestions	Complete
	4 (Gr 12)	Evolution by Natural Selection	Formation of new species e.g. baobabs (p. 62)	None	Partial
		Human Evolution	Out of Africa hypothesis (p. 63); Importance of the Cradle of Humankind (p. 65)	Poster Presentation	Complete

Sensitivity to diversity issues	1 (Gr 12)	Meiosis	Consequences of abnormal meiosis e.g. Down's syndrome (p. 55)	None	Incomplete
	2 (Gr 12)	Responding to the Environment: Humans	Disorders: Alzheimer's disease and multiple sclerosis (p. 58); Hearing defects: Deafness (p. 59)	None	Incomplete

The analysis results revealed the majority of cultural issues to be partially represented in the LSC, while a few were completely or incompletely represented (Table 4.1). The classification of case-based issues by the researcher to partial representation is for the following reasons: Firstly, only the content prescribed on indigenous knowledge and sustainability, i.e. "Rhino poaching in South Africa: read articles and make suggestions on how it can be prevented" (Department of Basic Education, 2011:52) could be linked directly to green economy education as it addresses the conservation of animal species. Secondly, the theme of respecting different world views was classified by the researcher as partially prescribed because alternative views to evolution was the only content which required "research and discussion to share information about different explanations: cultural or religious explanations" (Department of Basic Education, 2011:65). Thirdly, ethical awareness was classified by the researcher as incompletely represented because it is only addressed in Grade 10 with regard to cloning and stem cell research. Fourthly, contextual knowledge, skills and values were classified by the researcher at times as completely, and at times partially represented. Yet, because four out of the eight cases of contextual content were only added as extra content (defined by Van Laren (2008) as content which provides only superficial detail which is insufficient for context-specific application), with no investigations being prescribed, the theme is classified by the researcher as partially represented. Finally, the theme of sensitivity to diversity issues was classified by the researcher as incompletely represented, as no investigations were prescribed and teachers were not required to develop learners' affective domain in terms of being sensitive to issues of disability, race, inequality or poverty.

The partial representation of relevant and interrelated learning can therefore be ascribed to some of the content being added as extra content which need only be mentioned briefly in classroom discussions; a lack of prescribed investigations and skills development; and insufficient guidelines in terms of representing multiple South African ethnic and cultural groups, developing ethical awareness and encouraging sensitivity to diversity issues.

Table 4.2: Summary of the Grade 10-12 Life Sciences Case-based Issues Content

~Adapted from the Department of Basic Education (2011:21-65)

Green Economy Themes	* Strand	Topic	Content	Investigations	Representation
Alternative fuel sources	3 (Gr11)	Human Impact on the Environment	Solid Waste Disposal: using methane from dumpsites for domestic use (p. 52)	None	Partial
Renewable energy production	X	X	X	X	X
Improving energy efficiency	X	X	X	X	X
Energy saving	X	X	X	X	X
Necessity of recycling	3 (Gr11)	Human Impact on the Environment	Solid Waste Disposal: Need for recycling (p. 52)	Solid waste recycling estimations	Complete
Steps of Recycling	X	X	X	X	X
SA recycling projects	X	X	X	X	X
Conservation	3 (Gr11)	Human Impact on the Environment	Loss of Biodiversity (p. 52)	Rhino poaching: reading articles and prevention suggestions	Complete
Sustainable economic development	X	X	X	X	X
Environmental management	1 (Gr10)	The Chemistry of Life	Inorganic Compounds: Need for fertilizers (p. 23)	None	Partial
	3 (Gr10)	Biosphere to Ecosystems	Ecosystems: Abiotic and biotic factors (p. 33)	Fieldwork: human impact	Partial
	4 (Gr10)	Biodiversity and Classification	Biodiversity: southern Africa species (p. 36)	None	Partial
	1 (Gr11)	Biodiversity of Animals	Role of invertebrates in agriculture and ecosystems (p. 41)	None	Partial
	2 (Gr 11)	Energy Transformations to Sustain Life	Improving crop yields (p. 42)	Photosynthesis experiments	Complete
	3 (Gr11)	Human Population	SA population growth and environmental consequences (p. 50)	Prediction of consequences	Partial
Human Impact on the Environment		The atmosphere and climate change (p. 51); Food Security (p. 52)	Practical observation	Partial	
Waste Management	3 (Gr11)	Human Impact on the Environment	Solid Waste Disposal (p. 52)	Waste analysis, recycling estimations, rehabilitation observation, waste management	Complete

				assessment	
Water Management	3 (Gr11)	Human Impact on the Environment	Water availability and quality (p. 51-52)	Practical observation	Partial

The researcher classified most Case-based issues as partially represented in the Grade 10-12 Life Sciences content, while some were incompletely represented and others completely represented (Table 4.2). Classifying case-based issues as partially represented was done, as firstly, the prescribed content largely dealt with environmental management cases which were often partially represented in Grade 10 and 11. Secondly, only one example of alternative fuel sources; the necessity of recycling; conservation; waste management and water management was addressed in Grade 11. Finally, renewable energy production; improving energy efficiency; energy saving; recycling steps and projects in South Africa; and sustainable economic development were all unaddressed.

The environmental management cases that were prescribed in the curriculum often had no investigations prescribed, or in the cases where investigations were prescribed, learners were not required to seek solutions to environmental problems, which is essential to managing the environment. The first example of this can be seen when Ecosystems is prescribed in the curriculum and a fieldwork activity is given for learners in which they are to observe the “positive and/or negative human impact on the ecosystem” (Department of Basic Education, 2011:33), yet no mention is made of encouraging learners to seek solutions to these problems as part of the assignment. Secondly, the section on Biodiversity includes prescribed content on Mass Extinctions, where mention is made that “the rate of extinction on the Earth at present is higher than at any time in the past” (Department of Basic Education, 2011:36) but no activity is prescribed for learners to investigate reasons for this crisis or to develop problem solving skills by proposing solutions for the problem. Thirdly, there was no evidence to suggest that, when learning about South Africa’s population growth and environmental consequences or food security, learners are expected to change behaviour or seek solutions to relevant problems. Developing these skills (i.e. behaviour modification and problem solving) is however essential to green economy education and the development of higher order thinking skills amongst South African Life Sciences learners.

Table 4.3: Summary of the Grade 10-12 Life Sciences Nature of Science Issues Content

~Adapted from the Department of Basic Education (2011:21-65)

Green Economy Themes	* Strand	Topic	Content	Investigations	Representation
Nature of science		Subject Orientation	How science works (p. 22)	Introduction not assessed, however relevant aspects incorporated into content are	Complete
Scientific methods/ Research processes		Subject Orientation	How science works (p. 22)	Introduction not assessed, however relevant aspects incorporated into content are	Complete
	1 (Gr10)	The Chemistry of Life Cells: The Basic Units of Life; Cell Division: Mitosis; Plant and Animal Tissues	Inorganic and Organic compounds (p. 23-24) Molecular Make-Up; Cell Structure and Function; Cell Cycle; Plant tissues; Animal Tissues; Organs (p. 25-28)	Construct models; Analyse information; Microscope investigations; Experiments; Research and presentation	Complete
	2 (Gr10)	Support and Transport Systems in Plants	Anatomy of Dicotyledonous Plants (p. 29)	Microscope investigations; Observation, recording, drawing, interpreting and describing; Dissection	Complete
		Support Systems in Animals	Skeletons; Human Skeleton; Functions of the Skeleton; Joints (p. 30-31)	Design own investigation	
		Transport systems in Mammals	Circulatory System (p. 32)		
		Support and Transport Systems in Plants	Transpiration (p. 29)	Design own investigation	Complete
	3 (Gr10)	Biosphere to Ecosystems	Ecosystems: Abiotic and Biotic factors (p. 33)	Fieldwork	Complete
	4 (Gr10)	Biodiversity and Classification	Classification Schemes (p. 35)	Classification	Complete
		History of Life on Earth	Life's History; Mass Extinctions; Fossil formation; Understanding Fossils (p. 36-37)	Research; Presentation; Examining	Complete
	4 (Gr11)	Biodiversity and Classification of Microorganisms	Biodiversity: Microorganisms: structure and characteristics	Growing cultures on agar plates	Complete
		Biodiversity of Plants	Bryophytes, pteridophytes, gymnosperms and angiosperms (p. 40)	Observation and drawing	Complete
		Reproduction in Plants	Flowers as reproductive structures (p. 40)	Flower dissection	Complete
Biodiversity of Animals		Body plan and grouping of animals (p. 41)	Calculations and observations	Complete	
2 (Gr11)	Energy Transformations to Sustain Life	Photosynthesis (p. 42)	Experiments	Complete	

Scientific methods/ Research processes cont.	2 (Gr11) cont.	Animal Nutrition	Human Nutrition (p. 43-44)	Stomach dissection; Nutritional value calculations	Complete
		Gaseous Exchange	Human Gas Exchange (p. 46-47)	Investigation; Demonstrations	Complete
		Excretion in Humans	Urinary system (p. 48)	Dissection	Complete
	3 (Gr11)	Population Ecology	Population size (p. 49)	Collect and record data; Case study	Complete
		Human Impact on the Environment	Climate change; Water; Food security; Loss of Biodiversity (p. 51-52)	Practical observation and written report	Complete
	1 (Gr12)	DNA: The Code of Life	DNA (p. 54)	Extract DNA; DNA profiling	Complete
		Meiosis	Meiosis (p. 55)	Observation and drawing	Complete
	2 (Gr 12)	Human Reproduction	Male and female reproductive systems; Aspects of reproduction (p. 56)	Microscope slide preparation, tissue identification	Complete
	1 and 4 (Gr 12)	Genetics and Inheritance	Genes (p. 57)	Solving genetic problems	Complete
	2 (Gr 12)	Responding to the Environment: Humans	Human nervous system (p. 58)	Observation	Complete
			Receptors (p. 59)	Dissection	Complete
		Human Endocrine System	Endocrine glands (p. 60)	Research and written report	Complete
		Homeostasis in Humans	Homeostasis (p. 60)	Observation	Complete
		Responding to the Environment: Plants	Geotropism and phototropism (p. 61)	Design investigations;	Complete
	4 (Gr 12)	Evolution by Natural Selection	Artificial selection (p. 61)	Research and report	Complete
Socio-cultural embeddedness of science	1 (Gr10)	Plant and Animal Tissues	Applications of Indigenous Knowledge Systems and Biotechnology (p. 28)	Research and presentation	Complete
	4 (Gr11)	Biodiversity and Classification of Microorganisms	Traditional technology to produce e.g. beer, wine and cheese (p. 39)	None	Partial
	3 (Gr11)	Human Impact on the Environment	Loss of Biodiversity: Indigenous knowledge and sustainability (p. 52)	Rhino poaching: research and prevention suggestions	Complete

Socio-cultural embeddedness of science cont.	4 (Gr 12)	Human Evolution	Alternatives to evolution: different cultural and religious explanations (p. 65)	Research and discussion	Complete
Problem solving skills	2 (Gr10)	Support and Transport Systems in Plants	Transpiration (p. 29)	Design own investigation	Complete
	2 (Gr11)	Energy Transformations to Sustain Life	Cellular respiration (p. 45)	Design an investigation;	Complete
	1 and 4 (Gr 12)	Genetics and Inheritance	Genes (p. 57)	Solving genetic problems	Complete
	2 (Gr 12)	Responding to the Environment: Humans	Human nervous system (p. 58)	Design an investigation	Complete
		Responding to the Environment: Plants	Geotropism and phototropism (p. 61)	Design investigations;	Complete
Innovative and creative thinking	2 (Gr10)	Support and Transport Systems in Plants	Transpiration (p. 29)	Design own investigation;	Complete
	2 (Gr11)	Energy Transformations to Sustain Life	Cellular respiration (p. 45)	Design an investigation	Complete
		Gaseous Exchange	Human Gas Exchange (p. 46)	Construct a model	Complete
	2 (Gr 12)	Responding to the Environment: Humans	Human nervous system (p. 58)	Design an investigation	Complete
		Responding to the Environment: Plants	Geotropism and phototropism (p. 61)	Design investigations	Complete
Decision making skills	2 (Gr10)	Support and Transport Systems in Plants	Transpiration (p. 29)	Design own investigation	Complete
	2 (Gr11)	Energy Transformations to Sustain Life	Cellular respiration (p. 45)	Design an investigation	Complete
	2 (Gr 12)	Responding to the Environment: Humans	Human nervous system (p. 58)	Design an investigation	Complete
		Human Endocrine System	Endocrine glands (p. 60)	Research and written report	Complete
		Responding to the Environment: Plants	Geotropism and phototropism (p. 61)	Design investigations	Complete
	4 (Gr 12)	Evolution by Natural Selection	Artificial selection (p. 61)	Research and report	Complete
Critical thinking	1 (Gr10)	The Chemistry of Life Cells: The Basic Units of Life; Cell Division: Mitosis; Plant and Animal Tissues	Inorganic and Organic compounds (p. 23-24) Molecular Make-Up; Cell Structure and Function; Cell Cycle; Plant tissues; Animal Tissues; Organs (p. 25-28)	Construct models; Analyse information; Microscope investigations; Experiments; Research and presentation	Complete

Critical thinking cont.	2 (Gr10)	Support and Transport Systems in Plants Support Systems in Animals Transport systems in Mammals	Anatomy of Dicotyledonous Plants (p. 29) Skeletons; Human Skeleton; Functions of the Skeleton; Joints (p. 30-31) Circulatory System (p. 32)	Microscope investigations; Observation, recording, drawing, interpreting and describing; Dissection	Complete	
	3 (Gr10)	Biosphere to Ecosystems	Ecosystems: Abiotic and Biotic factors (p. 33)	Fieldwork	Complete	
	4 (Gr11)	Biodiversity of Animals	Body plan and grouping of animals (p. 41)	Surface area to volume calculations	Complete	
	2 (Gr11)	Energy Transformations to Sustain Life	Photosynthesis (p. 42)	Experiments	Complete	
		Energy Transformations to Sustain Life	Cellular respiration (p. 45)	Design an investigation	Complete	
		Gaseous Exchange	Human Gas Exchange (p. 46-47)	Investigation	Complete	
	3 (Gr11)	Human Impact on the Environment	Solid Waste Disposal (p. 52)	Analyse solid waste; Assess effectiveness of waste management	Complete	
	1 and 4 (Gr 12)	Genetics and Inheritance	Genes (p. 57)	Solving genetic problems	Complete	
	2 (Gr 12)	Responding to the Environment: Humans	Human nervous system (p. 58)	Design an investigation	Complete	
		Human Endocrine System	Endocrine glands (p. 60)	Research and written report	Complete	
		Responding to the Environment: Plants	Geotropism and phototropism (p. 61)	Design investigations	Complete	
	4 (Gr 12)	Evolution by Natural Selection	Artificial selection (p. 61)	Research and report	Complete	
	Formulation and defending of arguments	2 (Gr 12)	Evolution by Natural Selection	Origin of ideas about origins (p. 61)	Class debate and discussion	Complete

The researcher classified NOS issues as completely represented in the LSC with the exception of one topic, which is partially represented. The NOS content is fully integrated into the curriculum as can be seen in Table 4.3 and requires a discussion by teachers, e.g. teachers are required to have a “discussion to share information about different explanations” (Department of Basic Education, 2011:65) for alternative views to evolution. Furthermore, learners are required to participate actively in skills development through the prescribed activities and investigations which are aimed at the development of learners’ observation, investigation,

research, dissection and analysis skills amongst others. For example, learners are often required to “observe, measure and record results” (Department of Basic Education, 2011:24) of various self-conducted experiments. It must be stated, however, that the researcher found that very few of the topics which address NOS issues in the LSC relate to green economy education topics of sustainable economic management, sustainability of land, recycling, water management, youth unemployment eradication and renewable energy projects.

Table 4.4: Summary of the Grade 10-12 Life Sciences Discourse Issues Content

~Adapted from the Department of Basic Education (2011:21-65)

Green Economy Themes	* Strand	Topic	Content	Investigations	Representation
Ecological Issues	3 (Gr10)	Biosphere to Ecosystems	Ecosystems: Human impact; Ecotourism: economics, ethics, opportunities (p. 33-34)	Discuss	Partial
Economic Issues	3 (Gr10)	Biosphere to Ecosystems	Ecosystems: Human impact; Ecotourism: economics, ethics, opportunities (p. 33-34)	Discuss	Partial
		History of Life on Earth	Fossil tourism (p. 37)	None	In-complete
Social Issues	1 (Gr10)	Cell Division: Mitosis	Cancer (p. 26)	Discuss beliefs and attitudes	Partial
		Plant and Animal Tissue	Applications of Indigenous Knowledge Systems and Biotechnology: Cloning (p. 28)	Discuss ethics and legislation	Complete

The researcher classified most of the discourse issues as partially represented in the Grade 10 LSC curriculum, while a few aspects were incompletely and completely represented (Table 4.4). As teachers are rarely encouraged to address ecological, economic and social issues in such a manner that it may improve learners’ argumentation skills, decision making skills or reasoning abilities, the researcher further concluded that discourse issues are partially represented. Only when discussing evolution are teachers required to engage learners in a “class debate and discussion” (Department of Basic Education, 2011:61) about the Origin of ideas about origins, however this topic has no relation to green economy education and may not assist learners in addressing issues which are currently faced in South Africa. In the cases where ecological and economic issues are prescribed, it is added as extra content which may not lead to learners developing argument formulation and argument defending skills.

Table 4.5: Summary of the Grade 10-12 Life Sciences Economic Issues Content

~Adapted from the Department of Basic Education (2011:21-65)

Green Economy Themes	* Strand	Topic	Content	Investigations	Representation
Youth unemployment	X	X	X	X	X
Self-employment in green economic fields	X	X	X	X	X
Existing green careers	3 (Gr10)	Biosphere to Ecosystems	Ecotourism: economics, and opportunities (p. 34)	None	Incomplete
		History of Life on Earth	Fossil tourism (p. 37)	None	Incomplete
	1 and 4 (Gr12)	Genetics and Inheritance	Genetic engineering: Genetically modified organisms and biotechnology (p. 57)	None	Incomplete
Local entrepreneurs	X	X	X	X	X
Entrepreneurial skills development	X	X	X	X	X

*Strand 1: Life at Molecular, Cellular and Tissue level

Strand 2: Life Processes in Plants and Animals

Strand 3: Environmental Studies

Strand 4: Diversity, Change and Continuity

^X The researcher found no evidence of related content

Economic issues (Table 4.5) were classified as incompletely represented as no content is prescribed on youth unemployment; self-employment in green economic fields; creating awareness of local entrepreneurs which advance solutions to green economic issues; or the promotion of entrepreneurial skills development amongst learners. Only content on employment in existing green economic careers of ecotourism, fossil tourism and genetic engineering is prescribed in an incomplete manner.

The ecotourism content (one of the few topics addressed in the curriculum which is relevant to green economy education), is given in bullet form in the CAPS document as follows: “Ecotourism: economics; ethics; opportunities” (Department of Basic Education, 2011:34). This suggests that the content has been added as extra content as no explanations on what must be taught, how it must be investigated, or what resources can be used is given (Van Laren, 2008). Fossil tourism, also of great relevance to green economy, is merely mentioned as “a source of income and employment in some localities” (Department of Basic Education, 2011:37). The content on genetic engineering does not prescribe any activities, such as that learners further investigate these careers or their academic requirements as potential fields of study. There is no

evidence indicating that teachers are encouraged to elaborate on these sections as no investigations are prescribed to assist teachers in actively engaging learners with the content. Thus, learners may not be equipped with entrepreneurial skills or innovative skills once they have completed the Grade 10-12 LSC.

4.3. Conclusion

The results indicate that the Grade 10-12 LSC partially represents SSI, as economic issues are incompletely represented; case-based issues varied between partial and incomplete representation while cultural and discourse issues are partially represented. Only NOS issues are completely represented. Green economy content as an SSI is incompletely represented as can be seen by the incomplete representation of economic issues, and partial to incomplete representation of case-based issues, both of which are essential to green economy education.

Moreover, the researcher found the sections which, in her opinion, are most relevant to actionable green economy education (Section 4.2.1-4.2.3) to be underrepresented in the Life Sciences content, as they are overshadowed by the sections emphasising general Life Sciences content knowledge development. These overshadowed sections included that learners develop “an ability to critically evaluate and debate scientific issues and processes; a deep appreciation of [...] the importance of conservation; an awareness of what it means to be a responsible citizen in terms of the environment and life-style choices that they make; and to expose learners to the scope of biological studies to stimulate interest in and create awareness of possible specializations” (Department of Basic Education, 2011:8-9).

In the few cases where green economy could have been fully integrated, much content is prescribed on historic events or occurrences in the past with little content driving learners to focus on the future, e.g. the current near-extinctions experienced. Often the content is prescribed as extra content which teachers can discuss at their own discretion and rarely are activities prescribed which will lead to problem solving or seizing green economic opportunities within South Africa.

Chapter 5: Teachers' views of Green Economy

5.1. Introduction

The following section will address the second and third phase of data analysis, i.e. the statistical analysis of the green economy questionnaire and the inductive analysis of the interview transcripts as explained in Section 3.7. The researcher made use of the *IBM SPSS (Statistical Process for the Social Sciences) Statistics Version 21 Inc.* computer programme to perform the statistical analysis, while the inductive analysis of interviews was done to allow significant themes to emerge naturally from the data (Hoepfl, 1997; Nieuwenhuis, 2007b). The data captured through the questionnaire (Appendix 2.1) were used to respond to the first, second and third sub questions: *To what extent does the CAPS Life Sciences curriculum integrate green economy content?; To what extent do Life Sciences teachers understand green economy and its implementation?; and What are Life Sciences teachers' opinions regarding the relevance of the current Life Sciences curriculum's content for everyday use?* The interviews were used to explore and clarify the teachers' questionnaire responses to the above mentioned sub questions.

5.2. Results: Analysis of Life Sciences Teacher's views

Questionnaires were given to 35 Life Sciences teachers to capture their opinions on the extent to which green economy content topics are present in the CAPS for Life Sciences as well as their understanding of green economy and its implementation. Thereafter, five Life Sciences teachers were interviewed to not only clarify the previously mentioned topics investigated through the questionnaire, but also to determine teachers' opinions on the relevance of the current Life Sciences curriculum's content for everyday use. In the following sections the results of the questionnaire and interview transcripts will be presented.

5.2.1. *Teachers' views of Green Economy Content within the LSC*

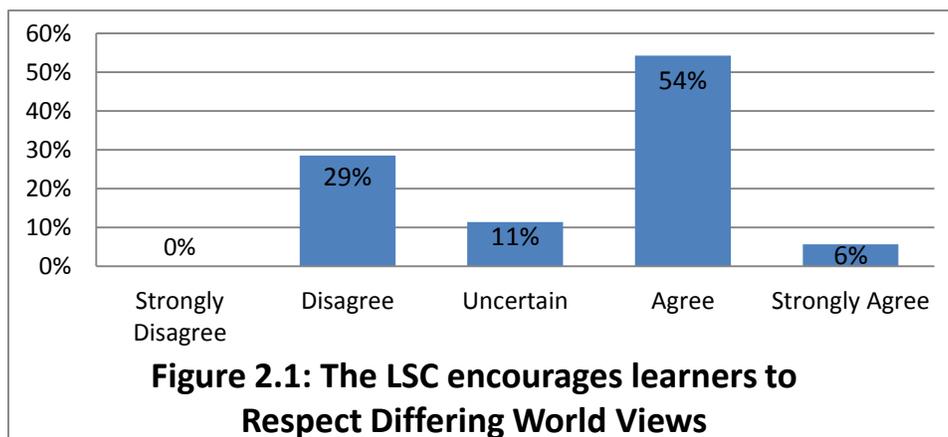
Teachers are expected to have knowledge of the CAPS document because they utilise it on a yearly basis and have been to CAPS training courses in preparation for the transition to this new

curriculum document (Department of Basic Education, 2011). Therefore, their views on the extent to which green economy content is integrated in the LSC is invaluable to the researcher. The results of the teachers' views will be addressed according to the five green economy SSI areas identified in the theoretical framework (Section 2.4), namely: cultural, case-based, NOS, discourse and economic issues.

5.2.1.1 Descriptive data

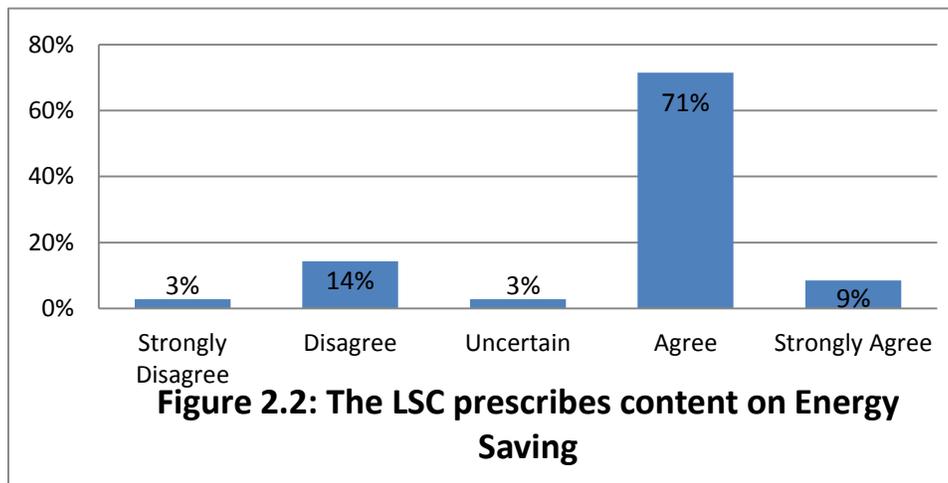
For the sake of brevity, the researcher grouped together responses of agreement (strongly agree and agree) to report statistics on question items which the teachers stated to be present in the CAPS document, while responses of disagreement (disagree and strongly disagree) were grouped together to report statistics on question items which the teachers stated to be absent in the Life Sciences CAPS document. The analysis of the questionnaires revealed the following:

Firstly, regarding cultural issues, which were addressed under the context section of the questionnaire (i.e. Questions 33-37 of Appendix 2.1); 60% (21 out of 35) of the participants agreed (combined agree and strongly agree) that the LSC encourages learners to respect differing world views, 55% (19 out of 35) agreed that the LSC encourages learners to be sensitive to diversity issues, while 51% (18 out of 35) agreed that the LSC encourages ethical awareness amongst learners. However, concerning whether the LSC reflects the social context in which learners live, 43% (15 out of 35) disagreed (combined disagreed and strongly disagreed), 40% (14 out of 35) agreed and 17% (6 out of 35) were uncertain. Forty-three percent (15 out of 35) of the participants disagreed that the LSC reflects the Constitution of the Republic of South Africa, 37% (13 out of 35) agreed, while 20% (7 out of 35) were uncertain. Figure 2.1 reveals the highest reporting of agreement for all the statements under the context section (i.e. Questions 33-37 of Appendix 2.1).

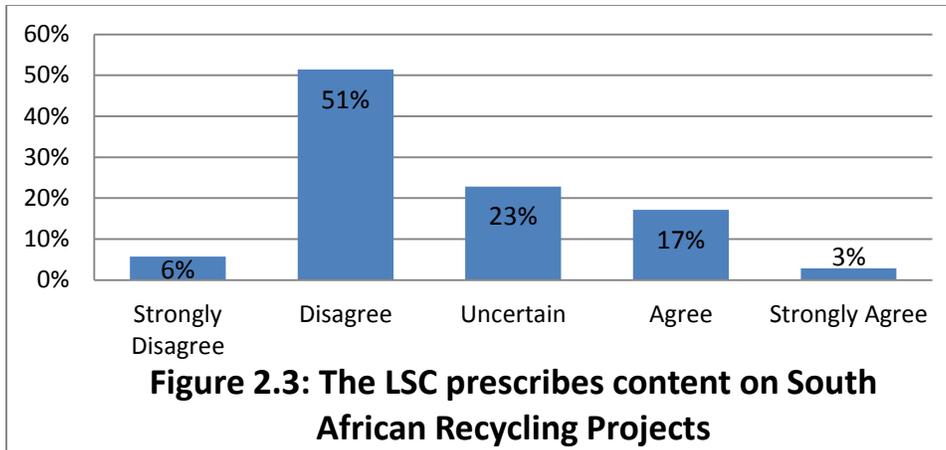


Secondly, case-based issues (i.e. Questions 5-18 of Appendix 2.1) will be addressed in the subsequent paragraphs under the topics: energy, recycling and sustainability. The researcher grouped the questions into these categories as four of the questions relate to energy, either regarding the saving thereof, the production thereof or improving its efficiency; three relate to recycling, addressing its necessity, steps and South African recycling projects; and seven relate to sustainability as they address various forms of environmental management.

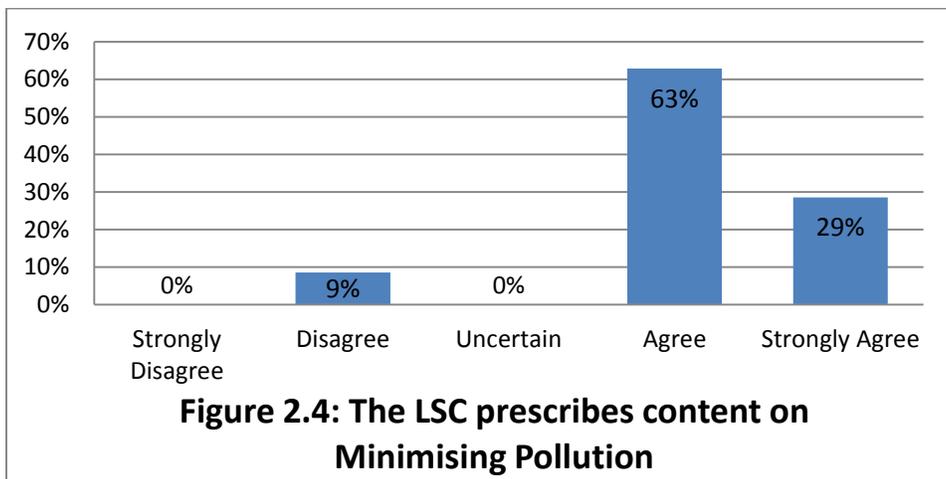
The analysis of the questions (i.e. Questions 5-8 of Appendix 2.1) related to energy revealed that 80% (28 out of 35) of the teachers agreed that the LSC includes content on energy saving as can be seen in Figure 2.2. Sixty percent (21 out of 35) of the teachers agreed that the LSC includes content on renewable energy production, while 58% (20 out of 35) agreed that alternative fuel sources were prescribed. However, 43% of the participants did not feel that the curriculum includes content on improving the energy efficiency of buildings or houses, while 32% (11 out of 35) agreed that the curriculum did, and 26% (9 out of 35) were uncertain.



On recycling, 82% (29 out of 35) of the teachers agreed that the curriculum prescribes content on steps of recycling such as reduce, reuse, repair and recover, while 65% (23 out of 35) indicated that the LSC prescribes content on the necessity of recycling items. However, 57% (20 out of 35) of the participants indicated that the LSC does not prescribe content on South African recycling projects such as buy-back centres, collection centres or deposits in sorting bins (Figure 2.3).

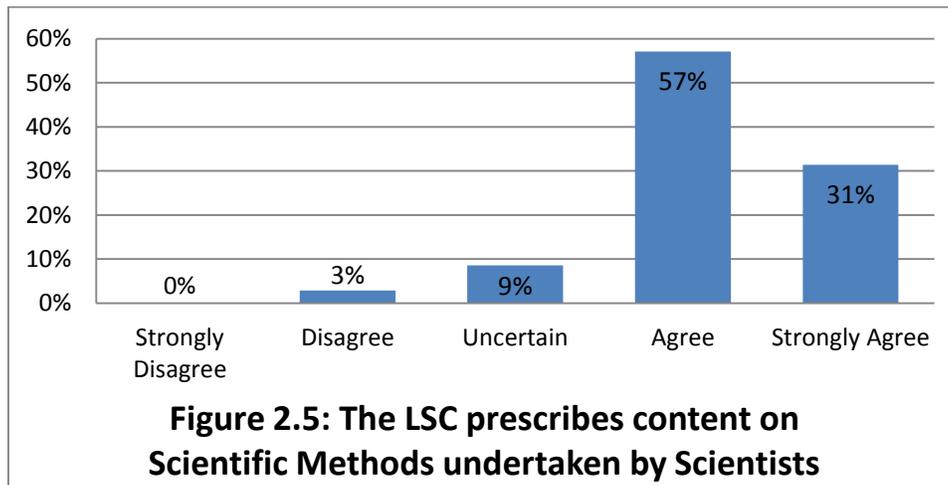


The participating teachers revealed the following on the topic of sustainability: 92% (32 out of 35) of the respondents agreed that content on minimising pollution is prescribed (Figure 2.4). Eighty-eight percent (29 out of 35) of the participants agreed that the LSC prescribes content on conservation, 80% (28 out of 35) agreed that content on water management is prescribed, while 74% (26 out of 35) agreed that content on environmental management is present. Lastly, 60% (21 out of 35) of the teachers agreed that content on sustainable economic development is prescribed in the LSC.



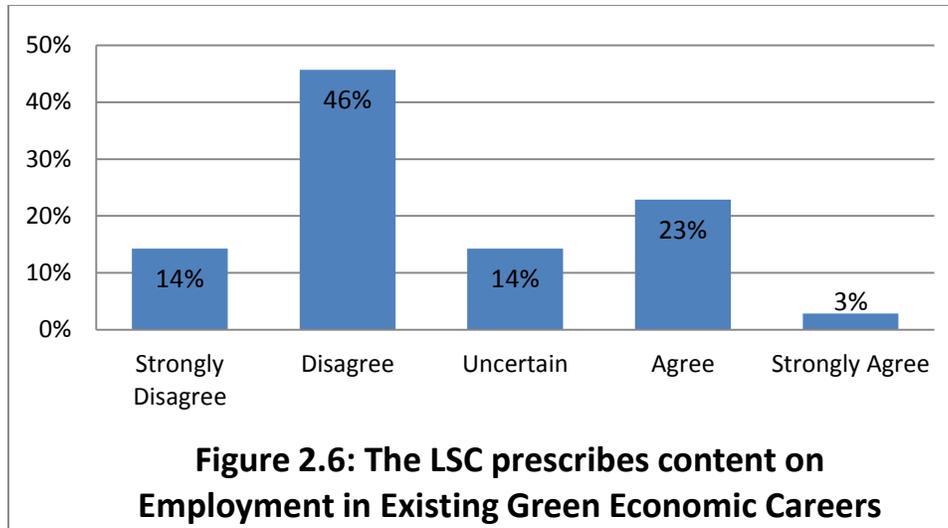
Thirdly, NOS issues (i.e. Questions 23-28 and 30-32 of Appendix 2.1) overall received the highest scores on its presence in the LSC. Eighty-eight percent (31 out of 35) of the participants agreed that scientific methods are included in the LSC content (Figure 2.5). Furthermore, 83% (29 out of 35) agreed that critical thinking skills are promoted through the LSC and that the LSC requires learners to formulate and defend arguments, while 77% (27 out of 35) of the teachers agreed that content on the NOS is prescribed in the CAPS document. Seventy-four percent (26 out of 35) of the teachers agreed that the curriculum promotes problem solving skills, 71% (25

out of 35) agreed that learners' decision making skills will be developed through Life Sciences, while 66% (23 out of 35) agreed that the LSC promotes creative thinking skills. The lowest percentage of agreement was 46% (16 out of 35) for the prescription of content on the socio-cultural embeddedness of science, as 37% (13 out of 35) disagreed with the statement and 17% (6 out of 35) were uncertain.



Fourthly, discourse issues (i.e. Questions 40-42 of Appendix 2.1), which included discussions and debates on ecological issues and social issues were considered to be prescribed in the LSC by 80% (28 out of 35) of the participants. While 71% (25 out of 35) of the participants agreed that discussions and debates on economic issues are prescribed in the LSC.

Finally, economic issues (i.e. Questions 19-22 and 29 of Appendix 2.1) overall received the lowest scoring on its presence in the CAPS for Life Sciences. Sixty percent (21 out of 35) of the participants indicated that the curriculum does not include content on existing green economic careers (Figure 2.6). A further 60% (21 out of 35) indicated that the LSC does not prescribe content on youth unemployment; 57% (20 out of 35) disagreed with the statement that the LSC promotes awareness amongst learners of local entrepreneurs which advance solutions to issues such as food security, energy saving and climate change; while 54% (19 out of 35) disagreed that content on self-employment in green economic fields is prescribed. Finally, 49% (17 out of 35) of the teachers disagreed that the LSC promotes entrepreneurial skills development amongst learners, while 32% (11 out of 35) agreed that it does, and 20% (7 out of 35) indicated that they were uncertain.



5.2.1.2 Qualitative data

As part of the third phase of data collection, the researcher interviewed five of the participants to gain clarity on the data gathered through the questionnaire analysis and to gather information on the teachers' views of the relevance which the LSC may have for learners once they have completed schooling.

The researcher asked the teachers to indicate to what extent they thought green economy content is integrated into the LSC and then to explain their reasoning. None of the teachers (5 out of 5) said that green economy content is completely represented in the LSC. Teacher 5 summarised it as follows:

Teacher 5: "Partially to incompletely. Either nothing is prescribed, or when it is prescribed it's mentioned briefly, maybe an assignment for research is given, nothing beyond that."

The researcher further probed the participants in order to clarify their opinions on the presence of green economy issues. The teachers were firstly asked where they get most of their content guidelines from, as this could have an impact on their views. The majority (4 out of 5) responded: "textbooks".

Teacher 1: "Textbooks, because the learners have that textbook so I make sure that whatever is prescribed to them, that I use that information."

Teacher 2: “Textbooks because the CAPS document is a guideline to where you can find information. It’s not really information itself, so it will tell you this and this has to be taught but then it doesn’t give you the information itself. So you have to go to textbooks or even internet sources or further than that to get your information.”

Teacher 3: “....I don’t like to just use one textbook, I like to use a number of textbooks and take the best out of perhaps three or four of them and then put it together for the children because I don’t find one textbook explains everything very well.”

Teacher 5: “I would say textbooks because that’s where the content is and what the students work from.”

The researcher then proceeded to ask the participants whether they believed that the green economy topics are prescribed in the CAPS document, in textbooks or in both. The teachers had very different answers based on the textbooks they used at their various schools. Teacher 1, 2 and 4 responded as follows:

Teacher 1: “Uhm, in the CAPS document. It’s definitely not in our textbooks yet.”

Teacher 2: “Yoh, it’s in the CAPS definitely, but not a lot. Like they only say you have to mention it or talk about it. In textbooks.... you can find some textbooks that actually discuss it in quite extensive ways but not all of them.”

Teacher 4: “I think it’s more in the textbook. The CAPS document is very vague.”

Thirdly, the teachers were given the opportunity to give a few examples of green economy content which they feel is part of the LSC.

Teacher 2: “....If I think about looking at the Life Sciences curriculum, they do mention sustainability of water and sustainability of natural resources and not cutting off trees so much and so....”

Teacher 3: “They do mention a little bit in the curriculum about recycling. They do mention a little bit in the curriculum about pollution, but there’s nothing in the curriculum about how to combat them and that’s what’s lacking.”

Teacher 4: “Pollution is present in the Life Sciences curriculum, but it mainly focuses on sources, where the pollution comes from and not how we can limit the pollution, how we can reduce the pollution.”

Teacher 5: “I’d say recycling, and maybe some water and waste management.”

Sustainability of natural resources, water management, recycling and pollution were content areas mostly mentioned by teachers. Of note was that although these teachers indicated that content on energy saving was present, none of them mentioned it as an example. Also, two of the five teachers commented that although content on pollution was prescribed, learners were not being taught how to solve this problem.

Therefore the researcher fourthly asked the participants whether they thought the LSC prescribed teachers to teach learners how to develop solutions to our current environmental crises, the following information was captured:

Teacher 1: “No, not the grade that I teach (Grade 10) and I can’t think of another grade.”

Teacher 2: “No, never. I think they are always tested on how you would be able to solve a problem like pollution or water sustainability and there is always a list of answers that they can give. It’s never how would you THINK it could be a possible way of solving the problem.”

Teacher 3: “They’re moving towards that as well, they are trying to implement that as well, where we have to get them (learners) to actually think about things and then they have to come up with solutions. Again, not in every single topic, certain topics.

Teacher 4: “No, in the CAPS document there are suggestions that you could encourage learners to make a poster or come up with ideas, but if the teacher can’t come up with her own ideas she won’t be able to motivate the learners.”

Teacher 5: “No, we teach learners to identify problems, to research problems, but not really to find solutions.”

Given the answers to the previous question, the researcher fifthly wanted to investigate whether the participants felt they were required to thoroughly discuss these green economy topics. Although the majority of the questionnaire participants had indicated that discussions and debates on social, environmental and economic issues are prescribed in the LSC (under the topic of Discourse Issues), all of the participants stated that they were not required to engage in a thorough discussion, as the content is often added as extra content which is to be briefly discussed or mentioned.

Teacher 2: “....no, it’s usually that there is a topic you have to discuss, let’s say plants and so on, the xylem and phloem... and all of a sudden at the bottom there would be like sustainable water, just like mention it. It’s more like in a mentionable way, rather than in a thorough discussion.”

Teacher 3: “No. I don’t think it’s a thorough discussion. I think it’s a small part of the syllabus that’s often glossed over. I don’t think it’s thoroughly covered at all.”

Teacher 5: “No, it’s mentioned at the end of some important topics as something we could briefly discuss.”

Finally, essential to green economy is the integration of economic content into the LSC. Therefore the participants were asked questions regarding economic issues during the interviews. In accordance with the questionnaire results, the interviews revealed that teachers thought economic issues to be incompletely integrated into the LSC. Teachers were asked whether they thought the curriculum included content which explains to learners how they can participate in a greener economy. All the participants responded that the curriculum did not educate learners on green economy participation.

Teacher 1: “No.”

Teacher 3: “No, I don’t think so.”

Teacher 4: “No, if there is any green job kind of leadership, its from the school itself and not from the curriculum.”

Thereafter the participating teachers were asked whether, in their opinion, once learners had completed the LSC (i.e. have obtained the senior certificate), they would be empowered to seize green economic opportunities within society. Once again, all the teachers responded that they did not think the Life Sciences content was currently of such a nature that students would be able to utilise green economic prospects. Teacher 5 best explained his answer:

Teacher 5: “Definitely not. How could they if they don’t know what it is or where to find it.”

Finally, when participants were asked whether the content prescribed in the LSC was of such a nature that it can address some of the socio-economic challenges faced in South Africa, they responded as follows:

Teacher 1: “No, I’ve never ever taught that to my learners. We’ve never even spoken about that in class, to me it feels like all that we do is discuss the human body and plants and that’s all we do. We don’t talk about different groups of people or things like that.”

Teacher 2: “No, you could talk about it if you want to talk about it in class. You teach the content and want the kids to have the content, but in the exams they aren’t asked about how does this socially or economically affect the world.”

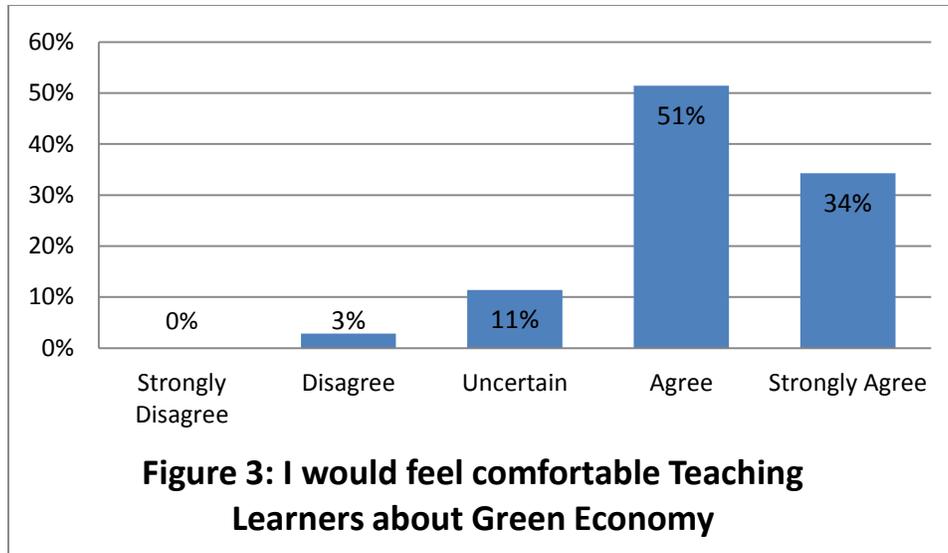
Teacher 4: “No, I don’t think so. I think Life Science explains the impact of poverty, it explains the impact of your actions but it won’t help you out of the situation.”

The 35 Life Sciences teachers who participated in the questionnaires revealed quite different responses to the questionnaire items, while the five Life Sciences teachers who participated in the interviews often revealed great similarities in their responses to the interview questions. The researcher therefore wanted to investigate whether the teachers understood the concept of green economy and its implementation. The results of this investigation will be addressed in the following section.

5.2.2. Teachers’ Understanding of the Implementation of Green Economy

Although all the Life Sciences teachers could easily answer questions on the presence of green economy content within the LSC, due to their use of the CAPS document, the researcher wanted to further investigate whether the teachers knew what green economy holistically necessitated, as the teachers could have answered the questions addressed in Section 5.3.1 without having knowledge of what green economy entails. Consequently, two questionnaire questions and two interview questions were structured to answer the second sub question: *To what extent do Life Sciences teachers understand green economy and its implementation?*

Data collected by the questionnaires revealed that 85% (30 out of 35) of the participants indicated that they would feel comfortable teaching learners about green economy (Figure 3). Likewise, 80% (28 out of 35) of the teachers agreed that they fully understand what green economy entails.



Amongst the 28 teachers who agreed that they understood what green economy entails and who indicated that they would feel comfortable teaching learners about it were the five teachers who participated in the interviews. Some of them, however, revealed very different views during the interview phase. These sometimes contradictory views will be discussed in the following paragraphs.

Firstly, the teachers were asked to describe their understanding of green economy. Their responses were as follows:

Teacher 1: “Uhm, I don’t know.”

Teacher 2: “How to live sustainably, to sustain our natural resources that there will be a future for our kids.... So if you are sustainable with water and you are sustainable with your natural resources.... Living cleaner with electricity, so using that in a more wise way. Hum, recycling....”

Teacher 3: “Green economy, to me it means that you need to teach your society to use resources sustainably and the actual inhabitants of the country have to know what recycling is about, why we are in the situation we are in, why it is important to recycle, why it is important to lower the carbon footprint. Things like that.”

Teacher 4: “Green economy, I think, has to do with recycling, but also our impact on other resources such as water and these days a lot also getting rid of electronic equipment because they dominate our life styles and how to make being green viable to people.”

Teacher 5: “I know about being green. Not so much about the economic bit. Being green involves recycling, saving electricity, not wasting water and resources etc.”

The researcher found teacher 5 summarises the other teacher’s views on what a green economy is. The teachers seem to have an idea as to what ‘being green’ entails, such as living sustainably and recycling, but not so much on how that relates to economic matters, such as green jobs. This notion was further explored by asking the participants to explain their understanding of green jobs. The teachers responded in the following manner:

Teacher 1: “Jobs where like maybe people who collect recyclable stuff.... anything to protect our earth. People in that type of job.”

Teacher 2: “I could maybe say that like... hum, yoh, no. Is it people that maybe, uhm want to... like make people aware of green economy? Or is it more like people in recycling businesses?”

Teacher 3: “No, well what are they? People who teach people about green economy possibly?”

Teacher 4: “People who help to limit our impact. Like people who facilitate recycling or measure emissions of factories. That kind of thing?”

Teacher 5: “Green jobs, uhm... I’m not really sure.”

The data revealed that these teachers are unsure what green jobs are as the majority of the interview participants felt that green jobs were connected to recycling or rather limited thereto. Evidently, although the teachers would feel comfortable teaching green economy, some of them do not yet fully understand what green economy and its implementation entails. This is of concern, as the success of a green economy depends on the participation of citizens in green jobs (Hendricks *et al.*, 2009:2).

5.2.3. The Relevance of the Life Sciences Curriculum’s Content

Throughout this research project, the researcher has tried to convey the importance and relevance of green economy education for South African Life Sciences learners. Yet by no means does the researcher wish to imply that other content contained within the LSC is not relevant to learners as well. As society’s needs change, curricular content must change to meet

those needs in the workforce (Henderson, 2007). Therefore the researcher believes that in order for the LSC to remain an indispensable subject for learners, green economy content should form a large part of the prescribed content. The last phase of data collection comprised the investigation of the final sub question: *What are Life Sciences teachers' opinions regarding the relevance of the current Life Sciences curriculum's content for everyday use?*

During the interviews, the teachers revealed that they believed certain topics within the current Life Sciences curriculum's content to be relevant to learners' everyday lives, especially content on the human body. Other topics however, although deemed relevant, seemed to receive less positive feedback as the teachers felt that the content could be discussed less extensively, such as that of plant tissues and evolution. The teachers were asked what their views are on the relevance of the current Life Sciences curriculum's content for learners' everyday lives. The following answers were recorded:

Teacher 1: "Uhm, I think it is beneficial. If they (learners) can apply it in their everyday lives... I think especially when you learn about the human body and the diseases that come with the different parts of the body and how to prevent diseases."

Teacher 2: "Not all of it is relevant. You teach them (learners) about the xylem and phloem of a tree and they hate it and you teach them about different tissue types and they hate it, but they love learning about the heart and the human body and things like that. So kids don't like learning about plants. So that will help none of them, except if you have a teacher that is passionate about teaching plants. But some of the topics, sjo, not relevant hey."

Teacher 3: "I think it is quite relevant because the human body and how it functions is pretty relevant for the learners in their everyday life. Today and in the future. The evolution is relevant but it can be less because the evolution section is not going to teach them anything or help them in any way in their future lives. That just tells us about our ancestry, so that content can be made smaller so that they are still made aware of it and then the green economy could actually form a much bigger part of the curriculum because the evolution is not going to help them in the future."

Teacher 4: "Currently we discuss many of the current diseases or health issues that's prevalent amongst our learners like TB, malaria, AIDS. I think in that sense it's relevant. We also do a very big section on nutrition, which helps them with their diets because the learners eat a lot of junk."

Teacher 5: “I would say the sections on the human body are very relevant.”

However, when probed with the question whether the teachers believed that the prescribed activities assist learners in seeing a relationship between the science they learn in school and the science problems they encounter in everyday life, the responses were varied.

Teacher 1: “....I don’t think so, no.... Not at the age that they are now, maybe in the future it can help them, I don’t think the experiments and stuff that they do.”

Teacher 2: “No. if you’re not that type of teacher to connect the outside world to what they are learning, they will never ever, ever learn it. I think they (curriculum planners) want, to some extent, have you do it, because there is mention of it, but doing it, that’s the problem. It always feels like the CAPS document is a choice. If you want to, do it. If you don’t, don’t.”

Teacher 4: “A lot of their homework questions or homework sections are application type sections but the learners struggle to apply the science to what they actually have to do.”

The participants were further asked whether they thought the content prescribed in the LSC is of use to learners once they have completed school. Again, three out of the five teachers listed content on the human body as information which learners could utilise every day. The remaining two teachers responded as follows:

Teacher 2: “No, once again, if you as a teacher don’t teach them, this and this has to do with what is out there, this is the type of job you can go into or this is the type of field you can work in and you should go into that field to enhance it and if the kids don’t ask questions about it you will never go further than that. You will teach content and that’s it.”

Teacher 4: “For them (learners), Life Sciences is a classroom subject. They don’t take it out with them.”

Finally, the researcher asked the teachers whether they felt that there are any shortcomings in terms of the value which Life Sciences may have for learners once they have completed schooling.

Teacher 1: “....I think there is so much work to be done in higher grades and you have to finish things in a certain time period that stuff like this, like environmental stuff is last

on our list. So we don't really get to that. Well leave it for self-study and maybe we'll have five questions in the exams about it, nothing to worry about....”

Teacher 2: “Well, they have the information about how the heart works, but I don't think all of them are going to go out there and use that information every day. They have information about the inner workings of a plant, but still they don't know enough, or they know how mitosis works or meiosis but if you don't go into a medicine field or a veterinary sciences or a BSc science.... then most of it just goes away. So tertiary education is required to make it more relevant.”

Teacher 4: “Life Science needs to be more practical for them. They need to be able to apply it to their daily lives and the curriculum at this stage is very theoretical, it's not a practical curriculum, it's all theory.”

Teacher 5: “Look, any curriculum has its shortcomings. I'd say Life Sciences has lost a bit of focus in terms of... what is currently relevant and pressing issues in our society. There might be a little... less plants and repetition of irrelevant things and more on our environment and stopping its destruction.”

As teacher five indicated, all curricula have their shortcomings. Based on the data gathered, the teachers believe that the Life Sciences curriculum has many aspects which make it relevant to learners outside the schooling environment, especially studies relating to the human body. The curricular content may however need some revision in terms of the inclusion of social issues as well as the manner in which it prescribes to teachers how to address certain topics which are briefly mentioned for discussion purposes.

5.3. Summary

Teachers' views on the Life Sciences curriculum's content

The questionnaire and interview analysis revealed that this group of teachers greatly agreed on the prescription of NOS issues in the LSC. This data, together with the results of the researcher's analysis of the Grade 10-12 Life Sciences CAPS document, verifies that the CAPS document prescribes NOS content in such a complete manner that learners' knowledge and skills are developed in this field.

Overall, economic issues were indicated to be least prescribed in the CAPS for Life Sciences by the participants. These results are in agreement with that of the researcher who found economic

issues to be incompletely represented in the CAPS document. The researcher is most concerned with the results on economic issues representation in the LSC, which revealed that the document lacks content on employment within existing green economy careers and self-employment in these careers.

Overall, the results on teachers' views of the presence of cultural issues in the CAPS document collaborate with that of the researcher's CAPS document analysis, which revealed cultural issues to be partially to completely represented. It was interesting to note that the participants were rather evenly divided on their opinions of the reflection of learners' social contexts and the South African constitution in the LSC. Although the aim of the study is not to investigate this phenomenon, further research could be conducted as to why such a close division has occurred.

The most notable topic was the case-based issues, which the researcher found to be partially to incompletely represented in the CAPS document, while the teachers revealed contrasting opinions in their questionnaires and during the interviews. The interview results revealed that although the CAPS document gives some guidelines on case-based content prescription, as Teacher 2 acknowledged: "the CAPS document is a guideline" these teachers prefer to make use of their prescribed textbooks instead as it is "what the students work from" (Teacher 5). All the teachers mentioned that green economy content is in the CAPS document albeit vague and not much. However, one teacher commented that their school's prescribed textbook contains no content on green economy, while another mentioned that their prescribed textbook discusses it quite extensively. This is concerning as it would seem that the textbooks do not align with the CAPS document. A further implication is that, as there are various different textbooks, a large variety of versions of the Life Sciences content is being taught (Schmidt, Raizen, Britton, Bianchi & Wolfe, 1997). This could impact especially the Grade 12 students negatively as not all will be equally prepared for the final exams.

Thus, the analysed data revealed that the Grade 10-12 LSC partially represents SSI. Green economy content as an SSI, on the other hand, is incompletely represented as indicated by: the researchers' findings of incomplete representation of economic issues during the document analysis, the negative feedback during the interview on the presence of economic content and the level of teachers' disagreement with statements on the presence of economic issues during questionnaire completion; the acknowledgement that thorough discussions on economic, social and environmental issues are not prescribed, but that these discussions and debates are rather added as extra content which was revealed during the interview phase and which is in

agreement with the researcher's findings of partial representation of discourse issues in the CAPS document. Finally, the conflicting data on the presence of case-based issues, deemed partially to incompletely represented by the researcher's document analysis, and heavily debated by the teachers who revealed that they rather rely on their textbooks for case-based content than the CAPS document as it merely encourages teachers to engage in brief discussions on some case-based topics.

Teachers' views on their understanding of green economy and its implementation

The researcher found no evidence to suggest that these teachers fully understand the concept of green economy and how it can be implemented within society. The questionnaire and interview data analysis revealed that although the participants indicated that they would feel comfortable teaching about green economy, they are not yet fully cognisant of what a green economy entails, especially in terms of green jobs. Topics which relate to green economy, such as recycling, energy efficiency, minimizing our carbon footprint and the like, are taught by Life Sciences teachers in the classroom in an attempt to save our planet and to prevent environmental destruction. This in itself is a very positive aspect of Life Sciences education, however, learners are not being taught of the economic benefits which going green can have for them.

Thus, elements which would make Life Sciences more relevant to the typical South African learner are lacking because of teachers' unfamiliarity with green economy and gaps in the Life Sciences CAPS document in informing learners of these career opportunities. The implication is that learners are not being taught about the millions of green jobs which are currently being created by the government, such as at solar plants or wind turbines; nor are they being educated about careers in improving the energy efficiency of houses or decreasing our reliance on fossil fuels. Finally, learners may not be equipped to seize entrepreneurial opportunities within ecotourism and waste management, nor will they possess the skills necessary for providing solutions to issues of climate change or food security, to list but a few.

Teachers' views on the relevance of the current Life Sciences curriculum's content for after-school use

All the teachers specified that there are certain topics, such as that of the human body and nutrition, prescribed in the Life Sciences content which learners could use throughout their adult lives. However, some topics are thought to be discussed too extensively, such as the repetition on plants and the extensive content on evolution which may not "help (learners) in their future

lives” (Teacher 3). What some teachers have made clear is that a lot of responsibility lies with the teacher to draw links between the school curriculum and everyday life as well as to convey the content in such a manner that it will be of practical use to learners once schooling has been completed. The interview participants indicated that the curriculum does not always provide exact guidelines as to how teachers can relate the prescribed content to everyday life issues, making the application thereof very difficult for teachers.

The researcher found similar results during her document analysis concerning certain aspects of the curriculum being left to teachers as “a choice”, to put it in Teacher two’s words. The researcher is of opinion that teachers should be provided with more guidance within the CAPS Life Sciences document regarding maintaining the relationship between the science learnt in school and the science problems encountered in everyday life. Green economy topics could especially assist in this issue, as it qualifies as an SSI (see Section 2.3.1).

One teacher additionally revealed that content on environmental matters is not prescribed in as much detail as she thought necessary. She indicated that Life Sciences teachers do not consider environmental studies as important as other content as very few questions are posed on it in the exam. Therefore, learners are expected to do self-study on environmental content. Of further note was that another teacher mentioned learners will have to attain tertiary education on many of the content fields in order for it to be of any relevance to the learners once schooling has been completed. Once again, if learners were to be made aware of entrepreneurial opportunities within green economic fields, this problem may be alleviated for students who cannot afford or qualify for tertiary education.

Finally, the teachers consider relevant content to be that which learners will use outside of school and the classroom environment; content which deals with current topics which learners deal with on a daily basis; and lastly, the type of content which can address problems or issues experienced in society. These teachers’ descriptors of relevant content reflect the views of Ratcliffe and Grace (2003) on topics which qualify as SSI (Section 2.3.1). Seeing that green economy education adheres to all these descriptors of an SSI and are therefore relevant content, the researcher deems it worthy of more extensive inclusion into the Life Sciences curriculum in order to increase its relevance for learners’ daily lives, as Teacher 3 said: “green economy could actually form a much bigger part of the curriculum because...(it can) help them (learners) in the future”.

Chapter 6: Discussion and Conclusion

6.1. Introduction

In November 2011, South African President Jacob Zuma signed the Green Economy Accord which commits South Africa “to concrete steps to reduce our dependence on coal-based energy, to develop a local industry to produce the necessary technologies and to create more opportunities for workers and for small businesses and cooperatives in the process” (President Jacob Zuma in the New Growth Path: Accord 4, Economic Development Department, 2011:2). Educating the citizenry on green economy implementation is therefore essential, as Minister of Higher Education and Training, Blade Nzimande put it: “we need to ensure that we are actually able to produce the numbers of skilled people that we actually need” (Minister Blade Nzimande in the New Growth Path: Accord 4, Economic Development Department, 2011:4). The researcher believes that providing Life Sciences learners with the knowledge and skills necessary to enact these ‘steps’ will contribute to attaining green economy goals in the near future. A concluding discussion of the research findings, recommendations for future research and the limitations of this study will be addressed in this chapter.

6.2. Alignment of Literature and the Research Findings

“The government needs to focus on creating pathways of equitable development, environmental and social justice, community participation and leadership to foster much wider participation of South Africans in the green economy” (Hatting, 2013:2). Education is one such pathway (Din, Haron & Ahmad, 2013). The study findings have revealed that the Life Sciences curriculum has the potential to introduce students to green economy content and skills. There are, however, many issues which must be addressed in the LSC for functional green economy literacy to be reached by South African Life Sciences learners.

The curriculum analysis, questionnaires and interview findings revealed that currently, the curriculum does not provide exact guidelines for teachers on how to educate learners in such a manner that they will be able to participate in a green economy. The participating Life Sciences teachers indicated that content on plants and human anatomy were prescribed and assessed in much greater detail than the environmental studies strand. Often, Grade 10 and 11 content which relates to green economy topics are prescribed as extra content without the inclusion of student investigations or skill development activities. Grade 12 learners, on the other hand, are

not taught content related to environmental studies (Department of Basic Education, 2011). Curricular analysts such as Muller (2006, in Young & Gamble, 2006) and Doige *et al.*, (2008) made similar findings when analysing the NCS and RNCS curricula used in South Africa prior to the implementation of CAPS. They too criticised the curricular documents for lacking thorough descriptions of the content which teachers had to teach and also stated that the content is unevenly divided, which leads to essential content being overlooked.

The teachers' opposing views on the presence of green economy content also revealed that individuals interpret the CAPS document very differently. As Glatthorn *et al.* (2006) argued that there are various forms of the written curriculum being taught due to the teachers' differing interpretations thereof. This phenomenon of diverse taught curricula has been further complicated by the lack of exact instructions on what content must be taught as found in the current study. The findings revealed that teachers therefore rely on textbooks to prescribe which content they will teach and in what manner. Thus, the supported curriculum (Glatthorn *et al.*, 2006) or curriculum resources become the main source of content instruction. Van der Horst and McDonald (2005) maintain that this is characteristic of educational systems founded on outcomes-based education principles. The data revealed that some textbooks include content on green economy, while others do not, resulting in teachers teaching very different curricula to the Life Sciences learners. The full impact of this on learners' performance in nationally set exams is a topic which could be further investigated in future research.

The document analysis data revealed that currently, the LSC includes limited content on case-based issues (often added as extra content) which inform learners of only a handful of strategies used to minimise our impact on the environment. No links are currently being drawn between the environment and the economy or skills required to participate in a green economy. The Life Sciences teachers confirmed these findings by stating that they bore knowledge of environmentally sustainable practices, as this is what the LSC prescribes, but they are uncertain of how green economy relates to these environmental matters. Latourelle *et al.* (2012) have established that curricula must link socially relevant issues to subject content if functional knowledge is to be imparted. Mnguni (2011) had similar findings when analysing the South African Life Sciences curriculum for SSI content related to HIV/AIDS, commenting that content taught in the LSC is not adequately supporting the envisaged learning outcomes which should lead to knowledge application or behaviour changes. Similarly, Jansen (2012) criticised the curriculum for not equipping learners with such knowledge and skills that they would be able to apply it effectively as young adults in professional occupations. Ciocoiu (2011) maintains that it

is of utmost importance to firstly develop a full understanding of green economy before any steps can be taken to commence with its implementation strategies. It is only once learners fully understand green economy and possess the skills to participate in it that the benefits of environmental protection and financial profit will be realised by those who pursue it (Ciocoiu, 2011).

Furthermore, one cannot address the issue of green economy without addressing green jobs as they are considered to be one of the main forms of implementation of a green economy. Carl (2009) maintains that curriculum content must prepare learners for self-empowerment and provide the skills necessary for employment. The current study found that Life Sciences teachers were uncertain of what green jobs were and that the Life Sciences curriculum did not address green jobs as part of the prescribed content. Essential content on existing and self-employment careers within green economy in the LSC is lacking. This implies that the aims of the Economic Development Department (2011), which includes providing an “entry-point for broad-based black economic empowerment” (Economic Development Department, 2011:8), filling a new niche with young South African entrepreneurs and contributing to the effective inclusion of women in significant positions in the green economy, may not be efficiently reached if the youth have little knowledge of green jobs. “These jobs are pivotal for achieving economic and social development that is also environmentally sustainable” (Argent & Boxer, 2013:11). Hanushek and Wößmann (2007) posit that the curriculum should include such content that learners will be equipped with the necessary knowledge and skills to obtain substantial salaries once schooling has been completed. Only when the South African youth are able to develop the necessary products and processes which are required by the manufacturing, research and technological bases will the greening of society and its financial benefits become and remain localised (Borel-Saladin & Turok, 2013; Economic Development Department, 2011). One of the many favourable aspects of green jobs is that they require a wide range of educational backgrounds and skill types within a variety of occupational profiles (Hatting, 2013). Borel-Saladin and Turok, (2013) maintain that most of these jobs are intended to assist matriculants and unemployed graduates who struggle to start their careers, however, the educational background required for employment in these green jobs is lacking in South African schools.

According to the Economic Development Department (2011) the South African Government aims to develop five million new green jobs by 2020. Nearly 80% of these jobs are aimed at employing local youth (Economic Development Department, 2011). Through the Department of Higher Education and Training, the Government plans to develop the skills necessary for

employment in these green occupations in order to ensure that South Africa does not carry all the expenses of greening the economy without reaping the rewards of job creation (Economic Development Department, 2011). The research findings presented in Chapter 5 revealed that the Life Sciences teachers who formed part of this study, in agreement with the researcher, believe it is necessary to start the development of these knowledge and skills areas as early as secondary education, because this is the age at which many learners decide which courses they wish to enrol for at tertiary institutions or at which companies they wish to seek employment after schooling. Many of the interview participants were like-minded that green economy information needs to be included from as early as Grade 8.

To conclude, the findings have revealed that green economy content is incompletely integrated into the Life Sciences curriculum as most areas are addressed as extra content. Through this study, the importance of including green economy content as an integral part of the CAPS LSC has come to the fore. The researcher proposes that curriculum designers completely integrate green economy content into the Life Sciences CAPS document, including not only content for discussion purposes but also investigations and activities which will lead to skills development, compelling learners to modify their behaviour and seek solutions to the urgent problems faced by humanity in terms of environmental degradation and economic collapse. As Ciocoiu (2011) has stated, pursuing a green economy is the only means by which to restore economic growth amidst the current economic crises, while simultaneously addressing environmental threats such as climate change, biome destruction and other unsustainable practices. The researcher further recommends that teachers use a variety of currently published sources when teaching Life Sciences to ensure that present-day issues are fully addressed in the classroom. The recommendations for future researchers will be addressed in the following section.

6.3. Recommendations for Future Research

Researchers who plan to investigate the extent to which green economy content is integrated into curricula may find the theoretical framework of this study useful in leading the data gathering instrument design. Should they wish to investigate specifically the integration of green economy content into the Life Sciences curriculum, they may wish to extend their document analysis beyond that of the Curriculum Assessment Policy Statement to include additional teaching aids such as textbooks. In educational practice, educators seldom work with the CAPS document in isolation but rather rely on a variety of sources to guide their content prescription. Furthermore, the sample may be broadened to include all nine provinces thus sampling

participants throughout South Africa. The larger the group of participants, the more diverse the results, the better the views and understanding of Life Sciences teachers in terms of green economy and the relevance of the LSC for learners' everyday use will be represented. If the sample size and area were increased, the findings could more readily be applied to the broader population. Teachers' understanding of green economy could be then be researched as a study in itself. In addition to this, the predominantly qualitative nature of this study led to the development of a questionnaire which could only be analysed by means of descriptive statistical analysis. Should this study be further investigated using a quantitative approach, the questionnaire could be adapted in such a manner that it lends itself to inferential statistical analysis, allowing for generalisation of the research findings. Finally, it is recommended that this study be extended to include an additional sample of Life Sciences curriculum developers and curriculum specialists. Gaining insight from participants who are directly involved in selecting the content for the CAPS document, could contribute valuable insight to this study.

6.4. Limitations

The ability to generalise the findings of the second and third secondary research questions, which relied on the participation of Life Sciences teachers, was limited by the relatively small sample of teachers who participated in the questionnaire completion and interviews. As this study was an exploratory mixed methods research project, the primary source of data was the Life Sciences CAPS document on which the researcher did content analysis. A larger sample of teachers as secondary source could have contributed a wider range of information on teachers' understanding of green economy and their views on the relevance of the content prescribed in the CAPS document. Moreover, the teachers who participated in this study had difficulty in distinguishing between CAPS, textbooks and personal teaching preferences when it came to answering questions which relate to the various sources from which they draw their content guidelines. Thus, the questionnaire analysis and interview analysis revealed contradictory data, which had to be clarified by the participants at a later stage.

6.5. Conclusion

Global environmental depletion and the near collapse of the economy worldwide has led to certain professions, such as biology and engineering, being in high demand as the world is faced with the challenge of adapting to sustainable practices (Devogelaer, 2013). Curricula and

schooling will therefore have to make adjustments in order to assist in the transition to new industrial and social activities which cater not only for the needs of mankind, but also for that of the environment (Devogelaer, 2013). “By and large, green economy could be the answer to the prophesied climate change and global warming, as it promotes sustainable economic and social development” (Ciocoiu, 2011:41). The Life Sciences curriculum has the foundations in place, to fully integrate green economy content to the extent that it will provide learners with actionable knowledge and skills required for green jobs. The Life Sciences teachers however, will also need to be educated on green economy and its implementation in South Africa if this newly created niche is to be filled by South African youth.

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Appendices:

Appendix 1: Document Analysis Protocol

Cultural Issues:	CR	PR	IR
The LSC encourages learners to respect differing world views			
The LSC encourages ethical awareness amongst learners			
The LSC prescribes contextual knowledge, skills and values worth learning in South African schools			
The LSC encourages learners to be sensitive to diversity issues, such as disability, race, inequality and poverty			
Case-based Issues:	CR	PR	IR
The LSC prescribes content on alternative fuel sources e.g. biofuels or geothermal energy			
The LSC prescribes content on renewable energy production e.g. solar plants, wind turbines or hydroelectricity			
The LSC prescribes content on improving energy efficiency of buildings/houses			
The LSC prescribes content on energy saving			
The LSC prescribes content on the necessity of recycling items such as glass, paper, metal, textiles, electronics or plastic			
The LSC prescribes content on steps of recycling such as reduce, reuse, repair and recover			
The LSC prescribes content on South African recycling projects such as buy-back centres, collection centres or deposits in sorting bins			
The LSC prescribes content on conservation			
The LSC prescribes content on sustainable economic development			
The LSC prescribes content on environmental management			
The LSC prescribes content on waste management			
The LSC prescribes content on water management			
Nature of Science Issues:	CR	PR	IR
The LSC prescribes content on the nature of science			
The LSC prescribes content on scientific methods/research processes undertaken by scientists			
The LSC prescribes content on the socio cultural embeddedness of science			
The LSC promotes problem solving skills amongst learners			
The LSC encourages innovative and creative thinking amongst learners			
The LSC assists learners in developing decision making skills			
The LSC promotes critical thinking skills amongst learners			
Discourse Issues:	CR	PR	IR
The LSC requires teachers to engage learners in discussions/ debates on ecological issues			
The LSC requires teachers to engage learners in discussions/ debates on economic issues			
The LSC requires teachers to engage learners in discussions and debates on social issues			
LSC requires learners to formulate and defend arguments			

Economic Issues:	CR	PR	IR
The LSC prescribes content on youth unemployment			
The LSC prescribes content on self employment in green economic fields (entrepreneurial jobs aimed at restoring or preserving environmental quality)			
The LSC prescribes content on employment in existing green economic careers (e.g. sustainable agriculture, soil and land management; biodiversity conservation; energy efficiency)			
The LSC creates awareness amongst learners of local entrepreneurs which advance solutions to issues such as food security, energy saving and climate change			
The LSC promotes entrepreneurial skills development amongst learners			

*CR: Completely represented

PR: Partially represented

IR: Insufficiently represented

Appendix 2.1: Green Economy Questionnaire

- The purpose of this questionnaire is to investigate the extent to which Green Economy content has been integrated into the Further Education and Training (FET) Life Sciences curriculum.
- A *Green Economy* includes economic practices related to renewable energy projects; recycling; sustainability; environmental, waste and water management; and citizen employment.
- Please answer all questions as far as possible.
- This questionnaire should take approximately 30 minutes to complete.
- Your answers to this questionnaire will be treated confidentially.
- Thank you for your willingness to complete this questionnaire.

Answer each question by writing an 'X' on the appropriate number provided in the **shaded box**.

Participant number

For office use

V1 1

A. BACKGROUND INFORMATION

1. Age

20-29 years	1
30-39 years	2
40-49 years	3
50-59 years	4
60-69 years	5
Other (Specify):	6

V2 3

2. Highest level of education completed

Degree/Diploma	1
Honours degree	2
Masters degree	3
Doctoral degree	4
Other (Specify):.....	5

V3 4

3. Years of teaching experience

1-5	1
6-10	2
11 or more	3

V4 5

4. School area where you currently teach

Well-resourced area	1
Under-resourced area	2

V5 6

For each of the following statements, fill in the questionnaire by writing an 'X' on the appropriate **box**:

B. THE FET LIFE SCIENCES CURRICULUM (LSC): CONTENT

e.g. *The LSC prescribes content on plants*

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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5. The LSC prescribes content on alternative fuel sources e.g. biofuels or geothermal energy

V6 7

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

6. The LSC prescribes content on renewable energy production e.g. solar plants, wind turbines or hydroelectricity

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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V7 8

7. The LSC prescribes content on improving energy efficiency of buildings/houses

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V8 9

8. The LSC prescribes content on energy saving

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V9 10

9. The LSC prescribes content on the necessity of recycling items such as glass, paper, metal, textiles, electronics or plastic

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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V10 11

10. The LSC prescribes content on steps of recycling such as reduce, reuse, repair and recover

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V11 12

11. The LSC prescribes content on South African recycling projects such as buy-back centres, collection centres or deposits in sorting bins

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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V12 13

12. The LSC prescribes content on conservation

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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V13 14

13. The LSC prescribes content on sustainable economic development

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V14 15

14. The LSC prescribes content on sustainable agricultural practices

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V15 16

15. The LSC prescribes content on environmental management

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V16 17

16. The LSC prescribes content on waste management

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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V17 18

17. The LSC prescribes content on water management

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V18 19

18. The LSC prescribes content on minimising pollution

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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V19 20

19. The LSC prescribes content on youth unemployment

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V20 21

20. The LSC prescribes content on self-employment in green economic fields (entrepreneurial jobs aimed at restoring or preserving environmental quality)

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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V21 22

21. The LSC prescribes content on employment in existing green economic careers (e.g. sustainable agriculture, soil and land management; biodiversity conservation; energy efficiency)

V22 23

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

22. The LSC creates awareness amongst learners of local entrepreneurs which advance solutions to issues such as food security, energy saving and climate change

V23 24

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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23. The LSC prescribes content on the nature of science (key principles and ideas of science as a way of knowing*)

V24 25

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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24. The LSC prescribes content on scientific methods/research processes undertaken by scientists

V25 26

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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25. The LSC prescribes content on the socio cultural embeddedness of science

V26 27

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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C. THE FET LIFE SCIENCES CURRICULUM (LSC): SKILLS

26. The LSC promotes problem solving skills amongst learners

V27 28

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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27. The LSC encourages innovative and creative thinking amongst learners

V28 29

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

28. The LSC assists learners in developing decision making skills

V29 30

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

29. The LSC promotes entrepreneurial skills development amongst learners

V30 31

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

30. The LSC promotes critical thinking skills amongst learners

V31 32

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

31. The LSC promotes the transfer of knowledge to everyday life

V32 33

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

32. LSC requires learners to formulate and defend arguments

V33 34

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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*Moore, J.A. (1984). Science as a way of knowing – Evolutionary Biology. *American Zoologist*, 24:467-534.

D. THE FET LIFE SCIENCES CURRICULUM (LSC): CONTEXT

33. The LSC reflects the social context in which learners live

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V34 35

34. The LSC encourages learners to respect differing world views

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V35 36

35. The LSC encourages ethical awareness amongst learners

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V36 37

36. The Constitution of the Republic of South Africa is reflected in the LSC by including social justice, human rights and inclusivity content

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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V37 38

37. The LSC encourages learners to be sensitive to diversity issues, such as disability, race, inequality and poverty

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V38 39

E. GREEN ECONOMY UNDERSTANDING AND IMPLEMENTATION

38. I fully understand what green economy entails

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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V40 41

39. I would feel comfortable teaching learners about green economy

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V41 42

40. The LSC requires teachers to engage learners in discussions and/or debates on ecological issues

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V42 43

41. The LSC requires teachers to engage learners in discussions and/or debates on economic issues

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V43 44

42. The LSC requires teachers to engage learners in discussions and/or debates on social issues

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V44 45

Thank you

Appendix 2.2: Preliminary Green Economy Questionnaire

- The purpose of this questionnaire is to investigate the extent to which Green Economy content has been integrated into the Life Sciences curriculum.
- *A Green Economy includes economic practices related to renewable energy projects; recycling; sustainability; environmental, waste and water management; and citizen employment.*
- Please answer all questions as far as possible.
- This questionnaire should take approximately 30 minutes to complete.
- Your answers to this questionnaire will be treated confidentially.
- Thank you for your willingness to complete this questionnaire.

<i>Answer each question by writing an 'X' on the appropriate number provided in the shaded box.</i>		For office use
Participant number		V1 <input type="text"/> <input type="text"/> 1
C. Background information		
6. Age		
20-29 years	1	V2 <input type="text"/> 3
30-39 years	2	
40-49 years	3	
50-59 years	4	
60-69 years	5	
Other (Specify):	6	
7. Highest level of education completed		
Degree/Diploma	1	V3 <input type="text"/> 4
Honours degree	2	
Masters degree	3	
Doctoral degree	4	
Other (Specify):.....	5	
8. Years of teaching experience		
1-5	1	V4 <input type="text"/> 5
6-10	2	
11 or more	3	
9. School where you currently teach		
Well resourced area	1	V5 <input type="text"/> 6
Under resourced area	2	
<i>For each of the following statements, fill in the questionnaire by writing an 'X' on the appropriate box:</i>		
D. The Life Sciences curriculum (LSC): content		
10. The LSC prescribes content on alternative fuel sources e.g. biofuels or geothermal energy		V6 <input type="text"/> 7
Strongly agree	Agree	Uncertain
Disagree	Strongly disagree	

11. The LSC prescribes content on renewable energy production e.g. solar plants, wind turbines or hydroelectricity

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
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V7 8

12. The LSC prescribes content on improving energy efficiency of buildings/houses

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V8 9

13. The LSC prescribes content on energy saving

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V9 10

14. The LSC prescribes content on the necessity of recycling items such as glass, paper, metal, textiles, electronics or plastic

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V10 11

15. The LSC prescribes content on steps of recycling such as reduce, reuse, repair and recover

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V11 12

16. The LSC prescribes content on South African recycling projects such as buy-back centres, collection centres or deposits in sorting bins

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V12 13

17. The LSC prescribes content on conservation

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V13 14

18. The LSC prescribes content on consumption management

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V14 15

19. The LSC prescribes content on sustainable development

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V15 16

20. The LSC prescribes content on sustainable agricultural practices

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V16 17

21. The LSC prescribes content on environmental management

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V17 18

22. The LSC prescribes content on waste management

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V18 19

23. The LSC prescribes content on water management

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V19 20

24. The LSC prescribes content on minimising pollution

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V20 21

25. The LSC prescribes content on youth unemployment

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V21 22

26. The LSC prescribes content on self employment in green economic fields (entrepreneurial jobs aimed at restoring or preserving environmental quality)

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V22 23

27. The LSC prescribes content on employment in existing green economic careers (e.g. sustainable agriculture, soil and land management; biodiversity conservation; energy efficiency)

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V23 24

28. The LSC creates awareness amongst learners of local entrepreneurs which advance solutions to issues such as food security, energy saving and climate change

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V24 25

29. The LSC prescribes content on the empirical nature of science

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V25 26

30. The LSC prescribes content on scientific methods/research processes undertaken by scientists

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V26 27

31. The LSC prescribes content on the socio cultural embeddedness of science

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V27 28

F. The Life Sciences curriculum (LSC): skills

32. The LSC promotes problem solving skills amongst learners

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V28 29

33. The LSC encourages innovative and creative thinking amongst learners

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V29 30

34. The LSC assists learners in developing decision making skills

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V30 31

35. The LSC promotes entrepreneurial skills development amongst learners

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V31 32

36. The LSC promotes critical thinking skills amongst learners

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V32 33

37. The LSC promotes the transfer of knowledge to everyday life

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V33 34

38. LSC requires learners to formulate and defend arguments

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V34 35

G. The Life Sciences curriculum (LSC): context

39. The LSC reflects the social context in which learners live

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V35 36

40. The LSC encourages learners to respect differing world views

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V36 37

41. The LSC encourages ethical awareness amongst learners

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V37 38

42. The LSC prescribes knowledge, skills and values worth learning in South African schools

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V38 39

43. The LSC prescribes content relevant to local contexts

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V39 40

44. The Constitution of the Republic of South Africa is reflected in the LSC by including content on social justice, human rights and inclusivity for example

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V40 41

45. The LSC encourages learners to be sensitive to diversity issues, such as disability, race, inequality and poverty

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V41 46

H. Green economy understanding and implementation

41. I fully understand what green economy entails

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V42 47

42. I would feel comfortable teaching learners about green economy

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V43 48

43. The LSC requires teachers to engage learners in discussions/ debates on ecological issues

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V44 49

44. The LSC requires teachers to engage learners in discussions/ debates on economic issues

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V45 50

45. The LSC requires teachers to engage learners in discussions and debates on social issues

Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
----------------	-------	-----------	----------	-------------------

V46 51

Thank you

Appendix 3.1 Interview Schedule

The integration of green economy content into the Life Sciences curriculum (LSC)

- Thank you for your willingness to participate in the interview.
- The interview should not be longer than 20 minutes.
- May I audiotape the interview?
- The contents of the interview will be treated with confidentiality.

A. Background information

1. Male Female
2. Years of experience:
3. Could you describe the socio economic circumstances of this school? (Is it well resourced, with learners from urban areas, for example?)
4. Would you consider yourself to be well acquainted (up to date) with the CAPS document? Why?
5. How often do you refer to the CAPS document for guidance on prescribed content? (Daily, weekly, monthly, quarterly...)
6. Where do you get most of your content guidelines from? CAPS, teacher's workbook or textbooks? Why?

B. Green Economy understanding and implementation

1. Prior to completing the questionnaire, had you heard of 'green economy' before?
Where did you hear of it?
Can you briefly explain what it was that you heard?
2. Can you describe your understanding of green economy? (Define it in a few sentences?)
3. How do you think a greener economy can be implemented?
4. Is it something everyone can participate in? (or Would you say greening the economy only includes occupations in the financial sector for example?) Why?
5. Have you heard of Green jobs before?
6. Can you briefly explain your understanding of green jobs?
7. Do you think green economy is a concept that learners should be made aware of? Why?
8. Can you give a few examples of green economy content which you feel forms part of the LSC?

C. Green Economy and the Life Sciences Curriculum

(Keeping in mind green economy topics such as renewable energy projects; recycling; sustainable economic practices; waste, water and land management; and unemployment)

1. To what extent do you think green economy content is integrated into the LSC?
(Completely – learners are taught green economic content and skills which can be applied in

daily South African life,
partially – learners are provided with information but few skills are developed which would lead to application in real life,
incompletely – learners will soon forget the information because skills are not developed)

2. Are teachers required to thoroughly discuss/teach these green economy topics? Can you elaborate?
3. Can you provide examples in which of these green economic topics you have taught before?
4. Would you say these topics are prescribed in the CAPS document, in textbooks or both?
5. Does the CAPS document explain to teachers how to develop learners' skills in such practices?
6. Does the curriculum include content which explains to learners how they can participate in a greener economy (green jobs for e.g.)?
7. Once learners have completed the LSC, do you think they will be empowered to seize green economic opportunities within society?
8. How can the integration of green economy into the LSC be improved?
9. In your opinion, should green economy content be in the LSC?

D. Relevance of Life Science curriculum for everyday use

1. What is your opinion on the relevance of the current LSC's content to learners' everyday lives?
2. Do you believe the prescribed activities assists learners in seeing a relationship between the science they learn in school and the science problems they encounter in everyday life? Can you provide examples?
3. Does the curriculum enhance learners' ability to apply the knowledge and skills learnt in the classroom in their daily practices?
4. Do you think the content prescribed in the LSC is of use to learners once they have completed school? (Will it prepare learners for 'real life' issues?)
5. In your opinion, can the knowledge and skills learnt in Life Sciences be used to earn an income once learners have completed schooling?
(Teachers may be asked if this can be accomplished without attending university/tertiary institutions.)
6. Does the curriculum provide learners with such knowledge that it could lead to self-empowerment? (In other words actionable knowledge?)
7. Does the LSC create opportunities for learners to showcase innovative ideas?
8. In your opinion, is the content prescribed in the LSC of such a nature that it can address some of the socio-economic challenges (poverty, unemployment) faced in South Africa? Explain?
9. Does the LSC prescribe teachers to teach learners how to develop solutions to our current environmental crises?
10. Does the content require learners to make behavior modifications to their daily practices? Can you elaborate?
11. Do you feel that there are any shortcomings in terms of the value which Life Sciences may have for learners once they have completed schooling?

- Is there any additional information you would like to share on the topic of 'green economy' or the LSC?
- Thank you for the time you took to participate in this interview.

Appendix 3.2: Preliminary Interview Schedule

The integration of green economy content into the Life Sciences curriculum

- The participant will be thanked for his/her willingness to participate in the interview.
- It will also be stated that the interview should not be longer than 20 minutes.
- The participants' permission will be requested to audiotape the interview.
- The participant will be informed that the contents of the interview will be treated with confidentiality.

A. Background information

1. How long have you been a Life Sciences teacher?
2. Could you describe the socio economic circumstances of this school? (Is it well-resourced, with learners from urban areas, for example?)

B. Green Economy understanding and implementation

1. Prior to completing the questionnaire, had you heard of 'green economy' before? (Depending on the answer, questions such as 'Where did you hear of it?' and 'What was it that you heard?' could be asked.)
2. Can you describe your understanding of green economy? (Depending on the answer, teachers could be asked to elaborate on certain concepts mentioned.)
3. Do you think it is a concept that learners should be made aware of? (A number of potential questions could arise from this question, depending on the information revealed by the participants.)

C. Green Economy and the Life Sciences curriculum

1. How well do you think green economy content is integrated into the Life Sciences curriculum? (As this is thoroughly covered in the questionnaire, teachers will only be further probed if new information comes to the fore.)

D. Relevance of Life Science curriculum for everyday use

1. What would you say is the purpose of education? (Depending on the answer the teacher could be asked whether they think the Life Sciences curriculum fulfils this purpose.)
2. Do you think the content prescribed in the Life Sciences curriculum is of use to learners once they have completed school? (Explanation and elaboration will be encouraged.)
3. In your opinion, can the knowledge and skills learnt in Life Sciences be used to earn an income once learners have completed schooling? (Teachers may be asked if this can be accomplished without attending university/tertiary institutions.)

- Is there any additional information you would like to share on the topic of 'green economy' or the Life Sciences curriculum?
- Thank you for the time you took to participate in this interview.

Appendix 4: Consent letters



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

FACULTY OF EDUCATION
DEPARTMENT OF SCIENCE, MATHEMATICS AND TECHNOLOGY EDUCATION
Groenkloof Campus
Pretoria 0002
Republic of South Africa
Tel: +27 12 420 -5572
Fax: +27 12 420-5621
[http:// www.up.ac.za](http://www.up.ac.za)

Dear Teacher,

I am a Masters of Education (MEd) student studying through the University of Pretoria, and would like to invite you to participate in a research project titled —*The integration of green economy content into the Life Sciences curriculum*. Accompanying this letter is a questionnaire that asks a variety of questions about the presence of green economy content in the Life Sciences curriculum as well as your understanding of what green economy education entails.

If you agree to participate in this study, you will be required to complete the questionnaire, which should take approximately 30 minutes to complete. You do not have to participate in this study and may withdraw your participation at any time should you wish to do so.

Teachers that agree to participate in the completion of the questionnaire *may* be asked to participate in a 20 minute interview. You do not have to participate in the interview and may withdraw your participation at any time should you wish to do so. If you agree to participate in the interview, the researcher will meet you at a time and venue that suits you. The interview will be audio taped and transcribed for analysis purposes.

The results of this research project will be submitted in a report for my masters and may be published in a scientific journal or presented at conferences.

With your help, I hope to determine:

- To what extent the Life Sciences curriculum integrates green economy content
- To what extent Life Sciences teachers understand green economy and its implementation; and
- What Life Sciences teachers' opinions are regarding the relevance of the current Life Sciences curriculum's content, for everyday use

Should you agree to take part in this study, **the following terms will apply:**

1. You should not write your name on the questionnaire.
2. Only the researcher (Ms Eugenie Wolff) will know your real identity if you agree to participate in the interview.
3. Your responses will be treated confidentially. Only you (the participant), the researcher (Ms Eugenie Wolff) and the supervisor (Dr Lindelani E Mnguni) will access your responses.
4. Pseudonyms will be used in all spoken and written reports.
5. The information you provide will be used for academic purposes only.
6. Participation in this project is entirely voluntary. You have the right to withdraw at any time, and without any prejudice, and the information collected will be discarded.
7. You will not be exposed to acts of deception throughout the research study.
8. You will not be placed at risk of any kind.

Should you agree to participate in the study under the above stated terms, please fill in the details below and return separately, NOT with the questionnaire.

If you have any questions or concerns, please contact me at the contact number or e-mail address given below.

I, _____ (your name only), agree to take part in the research project titled, *The integration of green economy content into the Life Sciences curriculum.*

.....
Signature

.....
Date

Any questions regarding this consent letter and the research can be directed to me at the following address:

Ms Eugenie Wolff
Department of SMTE
University of Pretoria
Groenkloof Campus
Pretoria

Tel: 072 948 3764
Email address: genierudi@gmail.com

Yours truly,
Eugenie Wolff

Supervisor: Dr. L.E. Mnguni

.....
Signature

.....
Signature

.....
Date

.....
Date

100
1908 - 2008



**UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA**

**FACULTY OF EDUCATION
DEPARTMENT OF SCIENCE, MATHEMATICS AND TECHNOLOGY EDUCATION**

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Pretoria 0002
Republic of South Africa
Tel: +27 12 420 -5572
Fax: +27 12 420-5621
[http:// www.up.ac.za](http://www.up.ac.za)**

Dear Sir/Madam,

I am a Masters of Education (MEd) student studying through the University of Pretoria, and would like to collect data at your school, for a research project titled —*The integration of green economy content into the Life Sciences curriculum*. Teachers who are willing to participate in this study, will be asked to respond to a questionnaire and *may* be asked to participate in a follow-up interview. The questionnaire and interview will consist of a variety of questions about the presence of green economy content in the Life Sciences curriculum as well as the teacher's understanding of what green economy education entails.

I am hoping to work with two Grade 10 Life Sciences teachers. The teachers who are willing to participate in the study, will be asked to complete a questionnaire of approximately 30 minutes and *may* be asked to participate in an interview of approximately 20 minutes, at a time and place which suites the teacher and does not intervene with school activities.

Through the teachers' participation, I hope to determine:

- To what extent the Life Sciences curriculum integrates green economy content
- To what extent Life Sciences teachers understand green economy and its implementation; and
- What Life Sciences teachers' opinions are regarding the relevance of the current Life Sciences curriculum's content, for everyday use

It is my hope that the results of this study will lead to the incorporation of Socioscientific issues content, such as green economy, into the Life Sciences curriculum, in order to enhance its relevance for South African learners. The results of this study may be presented at conferences or published in scientific journals.

Teacher participation will be governed by the following terms:

1. The names of schools, from which participating teachers enroll, will be treated confidentially.
2. Teachers need not write their real names on the questionnaire.

3. Only the researcher (Ms Eugenie Wolff) will know the real identity of teachers willing to participate in the interview.
4. Teacher responses will be treated confidentially. Only the participating teacher (the participant), the researcher (Ms Eugenie Wolff) and the supervisor (Dr Lindelani E Mnguni) will access the responses.
5. Pseudonyms for schools and teachers will be used in all spoken and written reports.
6. The information provided by teachers will be used for academic purposes only.
7. Participation in this project is entirely voluntary. Teachers have the right to withdraw at any time, and without any prejudice, and the information collected will be discarded.
8. Teachers will not be exposed to acts of deception throughout the research study.
9. Teachers will not be placed at risk of any kind.

The Faculty of Education at the University of Pretoria and the Gauteng Department of Basic Education has approved this study.

If you have any questions or concerns, please contact me at the contact number or e-mail address given below.

Should you agree to allow teachers to participate in the study under the above stated terms, please fill in the details below and return separately, NOT with the questionnaire.

I, _____ (your name),
the Headmaster/Deputy Principal of this secondary school agree to allow Eugenie Wolff to conduct research in this school, on the project titled,
The integration of green economy content into the Life Sciences curriculum.

.....
Signature

.....
Date

Yours truly,
Eugenie Wolff

Supervisor: Dr. L.E. Mnguni

.....
Signature

.....
Signature

.....
Date

.....
Date

Ms Eugenie Wolff
Department of SMTE
University of Pretoria
Groenkloof Campus
Pretoria

Tel: 072 948 3764
Email address: genierudi@gmail.com

Appendix 5: GDE Research Request Form



GAUTENG PROVINCE

Department: Education
 REPUBLIC OF SOUTH AFRICA

For admin. use

GDE RESEARCH REQUEST FORM

REQUEST TO CONDUCT RESEARCH IN INSTITUTIONS AND/OR OFFICES OF THE GAUTENG DEPARTMENT OF EDUCATION

PARTICULARS OF THE RESEARCHER

1.1	Details of the Researcher	
	Surname and Initials:	Rudolph E
	First Name/s:	Eugenie
	Title (Prof / Dr / Mr / Mrs / Ms):	Ms
	Student Number (if relevant):	27011454
	ID Number:	8807080214083

1.2	Private Contact Details	
	Home Address	Postal Address (if different)
	465 Durr Street	P.O. Box 1611
	Waterkloof Glen	Louis Trichardt
	Pretoria	
	Postal Code: 0010	Postal Code: 0920
	Tel:	
	Cell: 072 948 3764	
	Fax:	
	E-mail: genierudi@gmail.com	

PURPOSE & DETAILS OF THE PROPOSED RESEARCH

2.1	Purpose of the Research (Place cross where appropriate)	
	<i>Undergraduate Study - Self</i>	
	<i>Postgraduate Study - Self</i>	X
	<i>Private Company/Agency – Commissioned by Provincial Government or Department</i>	
	<i>Private Research by Independent Researcher</i>	
	<i>Non-Governmental Organisation</i>	
	<i>National Department of Education</i>	
	<i>Commissions and Committees</i>	
	<i>Independent Research Agencies</i>	
	<i>Statutory Research Agencies</i>	
	<i>Higher Education Institutions</i>	

2.2	Full title of Thesis / Dissertation / Research Project
	The integration of green economy content into the Life Sciences curriculum

2.3	Value of the Research to Education (Attach Research Proposal)
	It is hoped this research can be used to enhance the Life Sciences curriculum's relevance through the inclusion of Socioscientific issues content, specifically green economy content, in order to better prepare learners for everyday life issues such as employment and environmentally sustainable practices.

2.4	Proposed date of completion of study / project and submission of research findings to GDE	
	<i>Completion date:</i>	November 2013
	<i>Submission to GDE date:</i>	July 2014

2.5	Student and Postgraduate Enrolment Particulars (if applicable)	
Name of institution where enrolled:		University of Pretoria
Degree / Qualification:		Med (General)
Faculty and Discipline / Area of Study:		Faculty of Education, Science Education
Name of Supervisor / Promoter:		Dr. Lindelani E Mnguni

2.6	Employer (where applicable)	
Name of Organisation:		University of Pretoria
Position in Organisation:		Junior Lecturer
Head of Organisation:		Prof Eloff (Dean of Faculty of Education) Prof Braun (HOD Dept Science, Mathematics and Technology education)
Street Address:		Leyds Street, Groenkloof Pretoria
Postal Code:		0002
Telephone Number (Code + Ext):		(012) 420 5659 (Prof Braun)
Fax Number:		(012) 420 5621
E-mail:		max.braun@up.ac.za

2.7	PERSAL Number (where applicable)	
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2	7	0	1	1	4	5	4
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PROPOSED RESEARCH METHOD/S

(Please indicate by placing a cross in the appropriate block whether the following modes would be adopted)

Questionnaire/s (If Yes, supply copies of each to be used)

YES	x	NO	
-----	---	----	--

Interview/s (If Yes, provide copies of each schedule)

YES	x	NO	
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Use of official documents

YES	x	NO	
<i>If Yes, please specify the document/s:</i>			
Curriculum and Assessment Policy Statement Grade 10-12 Life Sciences			

Workshop/s / Group Discussions (If Yes, Supply details)

YES		NO	x

Standardised Tests (e.g. Psychometric Tests)

YES		NO	x
<i>If Yes, please specify the test/s to be used and provide a copy/ies</i>			

INSTITUTIONS TO BE INVOLVED IN THE RESEARCH

Type of Institutions (Please indicate by placing a cross alongside all types of institutions to be researched)

<i>INSTITUTIONS</i>	Mark with X here
Primary Schools	
Secondary Schools	X
ABET Centres	
ECD Sites	
LSEN Schools	
Further Education & Training Institutions	
Other	

Number of institution/s involved in the study (Kindly place a sum and the total in the spaces provided)

<i>Type of Institution</i>	Total
Primary Schools	
Secondary Schools	15
ABET Centres	
ECD Sites	
LSEN Schools	
Further Education & Training Institutions	
Other	
GRAND TOTAL	15

District/s where the study is to be conducted. (Please indicate by placing a cross alongside the relevant district/s)

District	
Ekhuruleni North	
Ekhuruleni South	
Gauteng East	
Gauteng North	
<i>Gauteng West</i>	
<i>Johannesburg Central</i>	
<i>Johannesburg East</i>	
<i>Johannesburg North</i>	
<i>Johannesburg South</i>	
<i>Johannesburg West</i>	
<i>Sedibeng East</i>	
<i>Sedibeng West</i>	
<i>Tshwane North</i>	x
<i>Tshwane South</i>	
<i>Tshwane West</i>	

If Head Office/s (Please indicate Directorate/s)

Number of learners to be involved per school (Please indicate the number by gender)

Grade	1		2		3		4		5		6	
Gender	B	G	B	G	B	G	B	G	B	G	B	G
Number												

Grade	7		8		9		10		11		12	
Gender	B	G	B	G	B	G	B	G	B	G	B	G
Number												

Number of educators/officials involved in the study (Please indicate the number in the relevant column)

Type of staff	Educators	HODs	Deputy Principals	Principal	Lecturers	Office Based Officials
Number	30					

Are the participants to be involved in groups or individually?

Participation	
Groups	
Individually	x

Average period of time each participant will be involved in the test or other research activities (Please indicate time in minutes)

Participant/s	Activity	Time
Teacher	Questionnaire	± 40 minutes

Teacher	Interview	± 20 minutes
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Time of day that you propose to conduct your research.

<i>Before school hours</i>	<i>During Break</i>	<i>After School Hours</i>
		x

School term/s during which the research would be undertaken

<i>First Term</i>	<i>Second Term</i>	<i>Third Term</i>
x	x	

CONDITIONS FOR CONDUCTING RESEARCH IN GDE

Permission may be granted to proceed with the above study subject to the conditions listed below being met and may be withdrawn should any of these conditions be flouted:

The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.

The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.

A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.

A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the

principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.

The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.

Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.

Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.

Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.

It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.

The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.

The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.

On completion of the study the researcher must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.

The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.

Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

<i>DECLARATION BY THE RESEARCHER</i>	
I declare that all statements made by myself in this application are true and accurate.	
I accept the conditions associated with the granting of approval to conduct research and undertake to abide by them.	
<i>Signature:</i>	
<i>Date:</i>	

NB. If a group of Students / Researchers will be conducting the same research in the same / different GDE Institutions, Annexure A (attached) must be completed and signed by each researcher.

<i>DECLARATION BY SUPERVISOR / PROMOTER / LECTURER</i>	
I declare that: (Name of Researcher).....	
is enrolled at the institution / <u>employed by the organisation to which the undersigned is attached.</u>	
The questionnaires / structured interviews / tests meet the criteria of: Educational Accountability Proper Research Design Sensitivity towards Participants Correct Content and Terminology Acceptable Grammar Absence of Non-essential / Superfluous items	
<i>Surname:</i>	<i>Mnguni</i>
<i>First Name/s:</i>	<i>Lindelani</i>
<i>Institution / Organisation:</i>	<i>University of Pretoria</i>
<i>Faculty / Department (where relevant):</i>	<i>Faculty of Education; Science, Mathematics and Technology Education Department</i>
<i>Telephone:</i>	<i>012 420 5572</i>
<i>Fax:</i>	<i>012 420 5621</i>
<i>E-mail:</i>	<i>lindelani@up.ac.za</i>
<i>Signature:</i>	
<i>Date:</i>	

N.B. This form (and all other relevant documentation where available) may be completed and forwarded electronically to Diane.Buntting@gauteng.gov.za The last 2 pages of this document must however have the original signatures of both the researcher and his/her supervisor or promoter. (For Group Research Annexure A, must also have original signatures.) These pages may be faxed to (086 594 1781) or hand delivered (in a sealed envelope) to Diane Buntting, Room 509, 111 Commissioner Street, Johannesburg. All enquiries pertaining to the status of research requests can be directed to Diane Buntting on tel. no. 011 843 6503.

ANNEXURE A:

ADDITIONAL INFORMATION FOR GROUP RESEARCH

This information must be completed by **every** researcher/ student who will be visiting GDE Institutions for research purposes.

By signing this declaration, the researcher / students accepts the conditions associated with the granting of approval to conduct research in GDE Institutions and undertakes to abide by them.

Supervisor/ Promoter / Lecturer's Surname and Name.....

DECLARATION BY RESEARCHERS / STUDENTS:

Surname & Initials	Name	Tel	Cell	Email address	Signature
Rudolph E	Eugenie		0729483764	genierudi@gmail.com	
Mnguni L	Lindelani	0124205570	0792573616	Lindelani@up.ac.za	

Appendix 6: GDE Research Approval Letter



GAUTENG PROVINCE

Department: Education
REPUBLIC OF SOUTH AFRICA

For administrative use:
Reference no. D2013/276

GDE RESEARCH APPROVAL LETTER

Date:	29 January 2013
Validity of Research Approval:	4 February 2013 to 27 September 2013
Name of Researcher:	Rudolph E.
Address of Researcher:	P.O. Box 1611
	Louis Trichardt
	0920
Telephone Number:	072 948 3764
Email address:	genierudi@gmail.com
Research Topic:	The integration of Green Economy content into Life Science curriculum
Number and type of schools:	FIFTEEN Secondary schools
District/s/HO	Tshwane North

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

Making education a societal priority

Office of the Director: Knowledge Management and Research

9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

David Makhado
2013/01/30

1. The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.
2. The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.
3. A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.
4. A letter / document that outlines the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.
5. The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.
6. Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.
7. Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.
8. Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
9. It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.
10. The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.
11. The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.
12. On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.
13. The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.
14. Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

David Makhado

Dr David Makhado

Director: Knowledge Management and Research

DATE: 2013/01/30

Making education a societal priority

Office of the Director: Knowledge Management and Research

9th Floor, 111 Commissioner Street, Johannesburg, 2001
P.O. Box 7710, Johannesburg, 2000 Tel: (011) 355 0506
Email: David.Makhado@gauteng.gov.za
Website: www.education.gpg.gov.za

