CHAPTER 7

An Analysis of Environment and Sustainability Content Coverage in the Grade 12 Curriculum

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Introduction

Kyburz-Graber (2013) stated that environmental education (EE) was integrated into the curricula of many countries towards the end of the 1960s as a response to the growing fears about degradation of the environment. This movement is still in process as indicated by the international goal to integrate the principles, values and practices of sustainable development into all aspects of education and learning (Unesco 2019). The South African education sector has experienced several shifts in the curriculum since 1994, thus affecting the coverage, teaching and examination of environmental content in the Further Education and Training (FET) phase (Grades 10–12). Environmental content coverage in the curriculum is important for developing the capacity of South Africa's future leaders to respond to issues such as pollution, climate change, deforestation, desertification and loss of biodiversity in the country. Hence, this chapter investigates the coverage of environmental content in subject policy documents and the Grade 12 examinations written annually between 2012 and 2015. The start of this period coincides with the 2012 implementation of the latest South African curriculum – the Curriculum Assessment Policy Statement (CAPS).

Integrating environment in education systems and curricula

Environmental education has been encouraged through both informal means, geared towards the public, and formal means, such as its integration in curricula from primary up to tertiary level (Hill et al. 2006). Kyburz-Graber (2013) states that EE, as part of a demand for new education systems, was launched in many countries towards the latter part of the 20th century as a response to the growing evidence of human degradation of the environment. Sitarz (1994) notes that the increase in the world's population and unsustainable pathways of development, production and consumption, particularly in the industrialised countries, has stimulated economic growth and worsened negative environmental impacts. The nations of the world now recognise that the industrialisation and over-exploitation of the Earth's resources have degraded the environment and generated unmanageable amounts of waste and pollution. In line with the global scenario, South Africa, too, has experienced environmental degradation (South Africa DEA 2017).

In June 2000 the South African government recognised the importance of EE in the education system, implementing a policy to ensure that EE would become prominent in all learning areas in both the General Education and Training, and Further Education and Training bands (Irwin & Lotz-Sisitka 2014). Environment as a phase organiser became a tool to explore EE issues in the curriculum. In the changeover to a new curriculum – the National Curriculum Statement (NCS) for the FET band – environmental content became an integral part of all learning areas. This was underpinned by a principle of human rights, inclusivity, and environmental and social justice. Thus, there was a change from a cross-curricular phase organiser in Curriculum 2005 to a strong focus on environmental justice integral to all subjects in NCS (South Africa DBE 2011). The ongoing implementation challenges resulted in a review in 2009 (South Africa DBE 2011).

In 2011, the new Curriculum Assessment Policy Statement (CAPS) retained the principle of social and environmental justice and human rights, with the prescribed aim of producing learners that are able to use science and technology effectively and critically, while showing responsibility towards both the environment and the health of others (South Africa DBE 2011). The CAPS presents variability in environment and sustainable development concepts in all subjects. The aim of the study that informed this chapter was to explore the extent and breadth of the coverage of environmental content in the different subjects in the curriculum.

Research design

The study used both qualitative and quantitative descriptors and the method was a content analysis of documents. Content analysis concentrates on **word** and **phrase counts** as well as **numerical** measures of textual expressions (Given 2012b). Documents enter the social field as instructions, obligations, contracts and policies. These documents also have enduring effects in the present and the future, and are thus

helpful in contextualising research within its subject or field (Given 2012a). They are significant as both the curriculum and trends in examination content will affect where teachers focus their teaching. They also influence the acquisition of knowledge and skills regarding environmental challenges with which students will move into their post-schooling professional and academic lives.

The study reviewed environmental content coverage in the syllabi for all eleven core subjects for Grade 12: Economics, Life Sciences, Geography, Agricultural Sciences, Physical Sciences, Business Studies, History, Accounting, Mathematics, Mathematical Literacy and English First Additional Language. The former seven subjects had identifiable environmental content. This content was analysed according to generic environmental content mentioned in the description of the purpose and specific aims of the subject (see Appendix A). The curricula were further analysed in terms of the extent of environmental content in the final year examinations for 2012–2015 (Appendix B).

The analysis of environmental content was conducted according to the following questions:

- How many of the subjects make explicit reference to environmental concerns when they describe the role and rationale of the subject?
- How many of the subjects prescribe explicit environmental topics and what is this topic content (see Appendix A for results of this analysis)?
- What is the total number of environmental topics in each subject?
- How much time is allocated for environmental topics (weeks) in each subject and how does this compare to other topics (percentage)?
- What is the coverage of environmental topics in examinations (measured as marks allocated to environmental content questions in relation to total marks) (see Appendix B for the results of this analysis)?

Discussion of findings

The introduction to this chapter described the generic CAPS principle and aim regarding the expected critical and holistic approach to environmental concerns. Table 1 shows only the subjects that explicitly prescribe content that would provide opportunity for this principle and aim to be exercised. The review of the CAPS syllabi revealed that only seven subjects out of the eleven have environmental content in the programme of teaching and learning. These subjects are Life Sciences, Geography, Agricultural Sciences, Physical Sciences, Business Studies, Economics and History. The policy documents show that Geography has the highest number of environmental content topics relative to the other subjects analysed. Life Sciences has only one topic, but it is an extensive topic, as indicated by the time allocation for this topic. Life Sciences has 9% of total time allocated to environmental content, which is the highest time allocation of all subjects. With time allocations of between 7% and 9%, Life Sciences, Geography, Economics and Physical Sciences appear to demonstrate the greatest commitment to environment and sustainability. Business Studies and Agricultural

Sciences have allocated 4% and 3% respectively. In History there is one small reference to environmental content in one of the topics, but the coverage is minimal and has insufficient time allocation to be counted as significant.

Table 1. Analysis of environmental content in CAPS documents in Grade 12

CAPS POLICY DOCUMENTS							
	Life Sciences	Geography	Agricultural Sciences	Physical Sciences	Business Studies	Economics	History
Total number of topics	12	31	41	52	15	20	6
Total number of environmental topics	1	3	1	2	1	2	1
Tuition time allocation for all the topics in the exams (weeks)	28	27	29	29	25	26	26
Time allocation for environmental topics (weeks)	2.5	2	1	2	1	2	Not specific
Percentage time allocation of environmental topics (%)	9	7	3	7	4	8	N/A

(Source: the author)

As mentioned above, the environmentally focused general principle and aim for all subjects does not specify content but is significant in terms of how to approach environmental concerns, as well as the type of competencies we expect to emerge from environmental learning. Environmental learning could either be guided by environmental content specified as topics in some subjects, or be included in classroom teaching or in textbooks as contextual cases or problem-solving contexts for other subjects. This might be the strategy for introducing environmental content in the four subjects that did not specifically name environmental topics as part of their syllabi (Accounting, Mathematics, Mathematical Literacy and English First Additional Language). However, the scope of the study did not include any analysis of classroom teaching or textbooks, thus we are not able to know the extent to which environmental topics might be included in these subjects. For the seven subjects listed in Table 1 that do explicitly include environmental content, more detail is provided below (see also Appendix A).

In **Physical Sciences**, the subject definition specifies inclusion of environmental content where investigation is based on physical and chemical phenomena. This is done through scientific inquiry, and application of scientific models, theories and laws in order to explain and predict events in the physical environment. The purpose of the subject is given as follows:

The purpose of Physical Sciences is to make learners aware of their environment and to equip learners with investigating skills relating to physical and chemical phenomena, for example, lightning and solubility. (South Africa DBE 2011)

Notable environmental content mentioned in the Physical Sciences policy is the topic of ‘oxidation numbers’ that is applied to the fertiliser industry to evaluate the effect of the use of inorganic fertilisers on humans and the environment.

In **Business Studies**, the definition of the subject included a mention of an environmental focus, in that the subject encompasses business principles, theory and practice that underpins the development of entrepreneurial initiatives, sustainable enterprises and economic growth. Environmental content appeared in the overview of topics to be taught per term and in the annual teaching plan. This environmental focus highlighted issues such as protection and sustainability of the environment, and impacts on human health and the environment by businesses.

The **Economics** subject definition and specific purpose mentioned issues of sustainable development but made no mention of the ecological dimensions of environment, such as abiotic and biotic factors. In this subject, the environmental topics of environmental sustainability, basic economic problems in tourism, and economic redress can be found. Approached from an economic perspective, this subject content highlights the importance of critically reviewing the promotion and violation of human rights and environmental rights, the state of the environment, measures to ensure sustainability, and adherence to major international agreements.

In **History**, an environmental focus is mentioned in the purpose of the subject as described in the introductory History chapter. This chapter explains that History encourages civic responsibility and responsible leadership, including addressing current, social and environmental concerns. There is one topic in the curriculum, ‘a new world order’, in which ‘environmental movements’ are listed as part of the content; however, this content is minimal and has insufficient time allocation to be counted as significant.

The definition of **Life Sciences** is given as the scientific study of living things from molecular level to their interactions with one another and their environments. By studying Life Sciences, learners are expected to develop an understanding of the ways in which humans have impacted negatively on the environment and organisms. Further, learners are expected to develop an awareness of what it means to be a responsible citizen in terms of their impacts on the environment and the lifestyle choices that they make. The CAPS elaborated that **environmental studies** should be studied as a discipline or specialisation. The subject is organised into four knowledge strands, and Environmental Studies is one of these. This shows that environmental studies in this subject has significant coverage. The content described in Environmental Studies that covers Human Impacts (Current Crises), is dealt with in Grade 11, but this topic is only examined in the National Senior Certificate examination at the end of Grade 12. This content in Life Sciences helps learners to understand the contribution of Science to social justice and societal development, as well as the need for using scientific knowledge responsibly in the interest of society, the environment and ourselves.

In **Geography**, the main aim is making and justifying informed decisions and judgements about social and environmental issues. The subject is defined as the study of human and physical environments. The curriculum states that Geography can be explored by applying a conceptual framework that embraces one of the four big ideas, which is 'Human and Environment Interaction'. Environmental topics in this subject are environmental impact, human-environment interaction, and environment quality. These topics include content such as climate and weather, drainage systems, rural and urban settlements.

In **Agricultural Sciences**, the environmental content topics are based on sustainable natural resource utilisation, ecology and agro-ecology. Learners are expected to develop an awareness of the management and care of the environment, natural resources and the humane treatment of animals through the application of science and related technology. Learners are also expected to become informed and responsible citizens in the production of agricultural commodities, caring for the environment, and addressing social justice issues such as equal protection from environmental harm. Agricultural Sciences content also covers better cultivation methods to sustain natural resources; impact of organic and inorganic fertilisers on the environment; environmental factors to be considered when selecting the general locality for greenhouses; and water quality and sustainable use of water in agriculture.

In summary: all of the above subjects stipulate the general principle of taking cognisance of human rights, inclusivity where **environment** provides both opportunities for and challenges to **inclusion**, and environmental and social justice. All subjects also aim for learners to be able to use science and technology effectively and critically while showing responsibility towards the environment and the health of others. The content analysis findings showed that subjects such as Physical Sciences, Business Studies, Agricultural Sciences and Economics have a specific aim and purpose that mentions the importance of environmental awareness in the subjects. However, some subjects such as Life Sciences and Geography have no subject-specific aim or purpose that highlights the importance of environmental content in their policies. Despite this lack, these subjects still include some reference to environmental content in their definitions and descriptions. For instance, Life Sciences has environmental studies integrated as a discipline or specialisation, while Physical Sciences, Economics and Geography have specific definitions formulated around environmental themes.

Coverage of environmental content in examinations

There was a further narrowing in the range of the subjects eligible for analysis in this part of the research because only **four** subjects examined environmental content in the Grade 12 final examinations. The environmental content coverage in the curriculum versus the examination content of these four subjects is shown in Appendix B. In **Business Studies** and **History**, there was no coverage of environmental content in the summative assessments. Thus, the minimal environmental coverage in the syllabi for these two subjects (4% of the curriculum in Business Studies and only one topic on 'a

new world order' in History) was further undermined by the lack of environmental reference in the examination content of these subjects.

Another subject eliminated for further analysis was **Physical Sciences** which, as stated above, was identified as one of the four subjects with the highest environmental coverage in the curriculum. With 7% of content in the curriculum of this subject dedicated to environmental content, it is particularly puzzling that there was no coverage of this topic at all in the examinations. The other notable inconsistency, for the opposite reason, was in regard to **Agricultural Sciences**. This subject had less time allocated to environmental content in the curriculum than Physical Sciences, yet allocated 2.5% of the marks to testing environmental content knowledge in the examination (see Appendix B).

In **Economics**, none of the environmental content in the examinations required learners to write on recent international environmental agreements as stipulated in the subject policy. In terms of percentage topic coverage between policy (8%) and examination (10.8%), there was greater emphasis on environmental content in the latter, thus indicating that examiners take the environmental content of the policy document seriously. Similarly, in **Geography**, the percentage of topic coverage in policy (7%) and examination (12%) indicated the importance with which examiners view environmental content in the curriculum. The study found that the significant difference between policy and examination in Geography is the result of some Grade 10 and 11 environmental content being included in the Grade 12 exit level examinations. This included Grade 10 content such as water resources and population distribution and identity, and Grade 11 topics of resources and sustainability, development issues and challenges, and drought and desertification. In **Life Sciences**, there was a closer alignment of the policy (9%) and examination (8.8%) content as seen in Appendix B. The alignment in Life Sciences can be attributed to the specific description of environmental content to be taught in the classroom that is stipulated in the CAPS policy, as well as the actual marks to be allocated for environmental content in the examinations. Lastly, in **Agricultural Sciences**, there was close alignment between CAPS policy projections (3%) and content coverage of environmental content in the examinations (2.5%).

Conclusion

Teachers are likely to be influenced by the extent of environmental topic coverage in documents such as the curriculum and examinations. If the policy implementers and examiners do not align what is in the policy with practice, it is likely that teachers will tend to concentrate on teaching and revising topics that have a wider coverage in the final-year exit level examinations; this is due to the agential/operational effects of the documents.

The findings show that English First Additional Language, Mathematics, Mathematical Literacy, and Accounting do not explicitly define environmental content in their syllabi. Environmental content coverage in these subjects would depend on the

chosen texts and examples introduced by textbooks and teachers in classrooms. The findings further show that Geography, Life Sciences and Economics have significant environmental content coverage ranging from 7% to 12% with up to 5% difference between curriculum and examination. The chapter suggests that this significant coverage should require teachers to concentrate on teaching and revising environmental content in these subjects. Agricultural Sciences has 3% environmental content coverage and slightly less in the examination. Physical Science, Business Studies and History do have prescribed environmental content but this is not tested in the examination. In addition one can note that environmental focus in some subject definitions and purpose is evident, while in other subjects, while it is not specifically outlined, the general aims of the curriculum and purpose include an emphasis on environment.

The chapter recommends that during the next curriculum review, policymakers for all subjects replicate what Life Sciences has done in terms of stipulating the exact percentage of environmental content to be taught. This must then be written into the policy documents both for curriculum and practice (examinations). The chapter further suggests that all subjects are worth revisiting in the next national curriculum review to assess whether environment and sustainability is given the coherent and sufficient coverage it requires, in view of the important foundational role of this knowledge in guiding the young scholars, citizens and professionals who will be influencing human-environment relationships in the present and future.

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Appendix A: Environmental topics and content in CAPS

SUBJECTS	GENERIC ENVIRONMENTAL CONTENT	ENVIRONMENTAL IMPACT TOPICS	CONTENT
PHYSICAL SCIENCES	Definition, specific aims and purpose of physical sciences is only concentrated on understanding how the physical environment works	- Oxidation numbers and application of oxidation numbers - The fertiliser industry (Nitrogen, Phosphorus, Potassium)	- Evaluate the use of inorganic fertilisers on humans and the environment - Search for and present information on environmental issues related to the use of plastics - Describe, using half equations and the equation for the overall cell reaction, the layout of the particular cell using a schematic diagram, and potential risks to the environment such as electrolytic processes used in industries - Evaluate the impact of inorganic fertilisers on humans and the environment
BUSINESS STUDIES	No mention of environmental content in the purpose of the policy	Human rights, inclusivity and environmental issues	- Create business opportunities, creatively solve problems and take risks, respecting the rights of others and environmental sustainability - Environmental issues (protection of the environment and human health by business)
ECONOMICS	The definition and purpose of the study unpacks issues of sustainable development that includes societal, economic, environmental and political	- Tourism & Economic redress (environmental sustainability) - Basic economic problem: environmental sustainability	- Promotion or violation of human rights and the environment (human rights and the environment) - Analysis of environmental sustainability, investigation of recent international agreements in this regard, for example, the Rio de Janeiro and Johannesburg summits - The state of the environment - Measures to ensure sustainability - Major international agreements (Rio de Janeiro and Johannesburg summits)
HISTORY	Only one reference to environment can be found in the topic of 'A new world order' – and that is the focus on environmental movements	A new world order	Responses to globalisation, heralding an age of economic insecurity and environmental movements

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SUBJECTS	GENERIC ENVIRONMENTAL CONTENT	ENVIRONMENTAL IMPACT TOPICS	CONTENT
LIFE SCIENCES	• Environmental studies is studied as a discipline or specialisation of the subject • The subject is organised in strands, with Environmental Studies as Knowledge Strand No. 3 of the curriculum • Includes a deep appreciation of the unique diversity of past and present biomes in Southern Africa and the importance of conservation • Gives an awareness of what it means to be a responsible citizen in terms of the environment and of lifestyle choices that are made	• Human impact on environment. Revision of current crises learned in Grade 11 • In Grade 12, three of the four Knowledge Strands are addressed and serve to ensure progression. The content described in Environmental Studies: Human Impacts (Current Crises), dealt with in Grade 11 in order to lessen the pressure in Grade 12, but this Knowledge Strand will only be examined in the National Senior Certificate examination at the end of Grade 12	• The development of scientific knowledge, understanding scientific knowledge and how it can be used to answer questions about the nature of the living world around us. It can prepare learners for economic activity and self-expression and lay the basis for further studies in science. Prepares learners for active participation in a democratic society that values human rights and promotes acting responsibly towards the environment • It also helps learners to understand the contribution of science to social justice and societal development as well as the need for using scientific knowledge responsibly in the interest of ourselves, society and the environment • Biosphere to ecosystems, biodiversity, population ecology, current crises for human survival
GEOGRAPHY	• Definition mentions that the subject is the study of human and physical environments • Specific aim of the subject is that learners should be guided in making informed decisions and judgements about social and environmental issues • Geography can be explored by applying a conceptual framework that embraces one of the big four ideas, that is, human and environment interaction	• Impact of tropical cyclones on human activities and the environment • Strategies that help to prepare for and manage the effects of tropical cyclones • Case studies that show how selected urban areas in South Africa are managing urban challenges and handling environmental, economic and social justice concerns • Physical, economic, social, political and cultural environments	• Water in the world, the world's oceans, water management in South Africa, floods, drainage systems in South Africa, fluvial processes, catchment and river management • Environmental impact, social impact, interdependence • Human-environment interaction, • Environmental quality

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SUBJECTS	GENERIC ENVIRONMENTAL CONTENT	ENVIRONMENTAL IMPACT TOPICS	CONTENT
AGRICULTURAL SCIENCES	The purpose of the subject is to teach learners to develop an awareness of the management and care of the environment, natural resources and the humane treatment of animals through application of science and related technology	Sustainable natural resource utilisation, ecology and agro-ecology	- Better cultivation methods to sustain natural resources - Impact of organic and inorganic fertilisers on the environment - Environmental factors to be considered when selecting the general locality of greenhouses - Water-use quality and sustainable use of water in agriculture

Appendix B: Environmental content coverage in the curriculum (policy) in relation to environmental content in examinations

SUBJECTS	ENVIRONMENTAL TOPICS AND CONTENT/ CONCEPT IN CURRICULUM	ENVIRONMENTAL CONTENT IN THE CAPS EXAMINATIONS (2012–2015)
ECONOMICS Tourism & Economic Redress: (Environmental sustainability) Basic economic problem: (Environmental sustainability)	- Promotion or violation of human rights and the environment (human rights and the environment) - Analysis of environmental sustainability, investigation of recent international agreements in this regard, for example, Rio de Janeiro and Johannesburg summits - The state of the environment - Measures to ensure sustainability AVERAGE COVERAGE: 8%	2012: Gas emissions and climate change (global warming), biodiversity loss, conservation of natural resources, pollution and environmental sustainability 2013: Mineral resources depletion, depletion of ozone layer, recycling, green tax, acid water, water pollution, environmental sustainability, climate change, air pollution 2014: Environmental sustainability, conservation, depletion of natural resources (coal, oil, gas), non-renewable resources, land and water pollution 2015: Climate change, depletion of natural resources, green tax, carbon emission, water pollution, sustainability, land degradation AVERAGE % COVERAGE: 10.8%

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SUBJECTS	ENVIRONMENTAL TOPICS AND CONTENT/ CONCEPT IN CURRICULUM	ENVIRONMENTAL CONTENT IN THE CAPS EXAMINATIONS (2012–2015)
LIFE SCIENCES Human impact on environment: current crises	• The development of scientific knowledge and understanding how scientific knowledge can be used to answer questions about the nature of the living world around us. It can prepare learners for economic activity and self-expression. It lays the basis for further studies in science and prepares learners for active participation in a democratic society that values human rights and promotes acting responsibly towards the environment • It also helps learners to understand the contribution of science to social justice and societal development as well as the need for using scientific knowledge responsibly in the interests of ourselves, society and the environment • Biosphere to ecosystems, biodiversity, population ecology, current crises for human survival AVERAGE % COVERAGE: 9%	2012: Threats to biodiversity, culling of elephants that are damaging the Kruger National Park and current crises for human survival 2013: Carbon monoxide emissions, spillage of toxic minerals such as copper and invasion of alien plants in the environment 2014: Global warming, negative effects on crops 2015: Illegal killing of wildlife, excessive fertilisation of soil and food wastage AVERAGE % COVERAGE: 8.8%
GEOGRAPHY Environmental impact on development and energy management Human-environmental interaction and social impact Environmental quality and quality of life	• Water in the world, the world's oceans, floods, drainage systems in South Africa, fluvial processes, catchment and river management AVERAGE % COVERAGE: 7%	2012: Impact of climate change, loss of biodiversity, land degradation, drought, river pollution and air pollution 2013: Health hazards caused by mines, poverty, the negative impact of human activities on wildlife, food security 2014: Effects of Berg winds on veld fires, negative effects of overpopulation in urban areas 2015: Water pollution in the Vaal River, environmental impact of cyclones, high levels of pollution on the outskirts of towns, soil erosion, overstocking AVERAGE % COVERAGE: 12%
AGRICULTURAL SCIENCES Sustainable natural resource utilisation, plant studies, ecology and agro-ecology	• Better cultivation methods to sustain natural resources • Impact of organic and inorganic fertilisers on the environment • Environmental factors to be considered when selecting the general locality of greenhouses • Water-use quality and sustainable use of water in agriculture AVERAGE % COVERAGE: 3%	2012: Threats of climate change (heat stress in pigs), adverse environmental conditions 2013: Effects of high temperatures on animals 2014: Farm management 2015: Greenhouse effect, risk to environment of genetically modified plants AVERAGE % COVERAGE: 2.5%