UncoveringClimate Change Education-enabling Themes in the South African Grade 7 Natural and Social Sciences School Curricula

**Headman Hebe1\***

Department of Science and Technology Education, College of Education, University of South Africa, South Africa

P.O. Box 392, Pretoria 0003

 \* Corresponding author: hebehn@unisa.ac.za

**Abstract**

Environment sustainability is perennially threatened by many challenges like drought, declining biodiversity, pollution, desertification, and etcetera. Global warming, an offshoot of greenhouse effect, is central to most of these issues. Climate change education (CCE) has been touted as the main vehicle for the mitigation of climate change challenges. Accordingly, this study investigated whether the Grade 7 Natural and Social Sciences school curricula in South Africa provide for possible integration of CCE in pedagogy. In this interpretive qualitative study, the researcher used content analysis to tease out some of the themes that could enable CCE from the Curriculum and Assessment Policy Statements (CAPS) which guide pedagogy in the two subjects. Aided by the abductive, deductive and inductive modes of extrapolation, the researcher found that there are several themes that could enable CCE in the selected subjects. However, the findings also suggest that there is, virtually, no guidance in the policy documents on how to infuse CCE in pedagogy. Furthermore, the literature points to the dearth of research in this area. Accordingly, the researcher recommends that the South African school curriculum be reviewed to accommodate the integration of CCE in pedagogy, and that scholars conduct more studies like this one, globally.

**Keywords**:Climate change, natural sciences, social sciences, curriculum, pedagogy

**INTRODUCTION**

The ravaging effects of climate change are fast becoming indelible perennial global and grand scale phenomena. Virtually, hardly a day goes by without news reports detailing catastrophes attributed to climate change in one or the other part of the world. Accordingly, environmental sustainability is threatened by a myriad of challenges such as drought, flooding, widespread vector-borne diseases, loss of biodiversity, pollution and etcetera (Solomon et al., 2022; Reddy, 2011; Steg & Vlek, 2009; Yan & Fengfeng, 2008). Undoubtedly, the clarion calls made by, *inter* *alia*, scholars, politicians, ordinary global citizens and influential international organisations like the United Nations (UN) organisation, that meaningful, impactful and on-going actions be undertaken to circumvent the impact of the scourge called climate change are not misplaced.

Notably, there is sizeable consensus among various stakeholders in education and research as well as other significant role players in society that environment-inclined education must be adopted, refashioned and implemented as a “more proactive, provocative, and purposeful” (Nuangchalerm & El Islami, 2018) vehicle to address environment sustainability challenges including climate change (Annisa, Kaniawati & Eliyawati, 2024; Monroe et al., 2017). For example, in its Sustainable Development Goals (SDGs)-driven 2030 Agenda, among its goals, the UN (2015) has SDG 4 which calls for global citizens to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” (p. 35). Significantly, of relevance to this study. SDG 13 urges humanity to “take urgent action to combat climate change and its impacts” (UN, 2015, p. 35). In the main, researchers acknowledge the role of education in empowering the youth as future leaders who need help to gain awareness, knowledge, skills, attitudes, and values to enable them, to commence now, rather than in the future, to actively participate in pro–environment actions that seek to mitigate climate change (McKenzie, 2021; Monroe et al., 2017; Ojala, 2012). For this reason, various countries, globally, are taking up this challenge by implementing climate change education (CCE) (Vesterinen, et al., 2016; Boakye, 2015).

In the context of South Africa, where this study was conducted, the *National Curriculum Statement Grades R-12*, which is the public-school curriculum, accommodates; albeit exiguously, the possibility of climate change education in pedagogy across various grades and subjects. (e.g., Natural Sciences) and to a very limited extent, the implementation of CCE. This is discernible from one of the aims of the national curriculum stated in respective Curriculum and Assessment Policy Statements (CAPS) used to guide pedagogy in every school subject. These aims include, *inter alia*, “to produce learners that are able to use science and technology effectively and critically showing responsibility towards the environment and the health of others; and demonstrate an understanding of the world as a set of related systems by recognising that problem solving contexts do not exist in isolation” (Department of Basic Education, 2011a, p. 5). The preceding aims amplify the principles of the same curriculum which seek to ensure the realisations of “human rights, inclusivity, environmental and social justice: infusing the principles and practices of social and environmental justice and human rights” (DBE, 2011a, p. 5). However, even though the South African school curriculum underscores the importance of addressing environmental issues including climate change, the curriculum does not state which topics should be used to enable the implementation of CCE.

Accordingly, to contribute towards addressing the shortcomings of the school curriculum as stated in the preceding paragraph, there is an urgent need to undertake studies that seek to guide teachers by teasing out, from various school subjects, themes that could be used by teachers to enable CCE-inclined pedagogy. The literature reviewed for this study suggests that there is a paucity of literature that seeks to contribute towards empowering teachers by outlining some of the topics, in various subjects, that could aid the integration of CCE in pedagogy. For this reason, the purpose of this study is to contribute towards sealing this paucity in the research space, considering the urgency of empowering the global citizenry, especially the youth, regarding the challenges of climate change. This study seeks to answer the question: Which themes in the South African Grade 7 Natural Sciences and Social Sciences Curriculum and Assessment Policy Statements could be used to enable the integration of climate change in pedagogy?

**Theoretical Framework**

In this study Bernstein’s (2003) concept of curriculum recontextualisation was deemed relevant as it empowered the researcher to determine the criteria for the adaptation of the curriculum content and its refashioning for implementation to fit a specific context. Hence, writing on the concept of curriculum recontextualisation, Nsubuga (2008) asserts that an expert in a specific curriculum can use their knowledge to decide on the criteria for adapting the curriculum content for implementation in another context. Accordingly, in the context of this study, the researcher as ‘the knower’ in the space of environment and sustainability education (ESE), of which climate change is part, has the power to determine the topics from those set down in the curriculum documents, the ones he deems pertinent to climate change education. Likewise, the discussion of various environmental literacy frameworks by McBride et al. (2013) also assisted the researcher to determine the themes that have the potential to enable the infusion of climate change in pedagogy. McBride et al. (2013) highlight various concepts of relevance in the advancement of environment-inclined pedagogy, including climate change education. Additionally, since the researcher conceives climate change as an aspect of ESE, Lucas’s (1972) seminal work on the triadic approach to the environment-inclined pedagogy, i.e.., education, *about*, *in* and *for* the environment was found also useful in enabling the attainment of the purpose of this study. This work by Lucas (1972) has been used for decades and to date scholars in ESE still use it as the basis to guide environment-inclined pedagogy (Reddy, 2021; Kopelke, 2012).

In a nutshell the triadic approach entails education *about* the environment and the focus here is on sharing information *about* the nature of the environment, the challenges faced by the environment, possible solutions to environmental challenges and etcetera. Education *in* the environment focuses mainly on interacting directly with the environment and is undertaken outdoors to enable learners to experience, firsthand, the real holistic environment and some of the challenges inflicted by humans on the environment. The third aspect, i.e., education *for* the environment is action-oriented and empowers the learners to participate in pro-environment actions aimed at addressing environmental challenges. Undoubtedly, the three pedagogical practices entailed in the triadic approach can be employed simultaneously for meaningful solution to environmental challenges.

**METHOD**

In this study the researcher used an exploratory qualitative research approach with interpretivism as the undergirding paradigm. This strategy was deemed pertinent because the phenomenon under investigation is under-researched (Cresswell, 1994) and this approach allows the researcher some room for flexibility and opportunity to “explore diverse dimensions of a phenomenon” (Khan, et al., 2023, p. 96) under investigation. Furthermore, the interpretivist paradigm empowers the researcher as ‘the knower’ in the field of ESE the latitude to subjectively use personal and socially acquired experience interspersed with the fusion of intuition and cognition (Swanwick, 1994) to cognise, make sense of and determine the potential application of themes for infusion in climate change-inclined education. In this text, owing to the intertwined interconnectedness of the steps used in data collection and data analysis in document content analysis (Zhang & Wildemuth, 2009). these aspects are discussed in the same subsection.

**Data collection and analysis**

The researcher commenced by conducting a scoping review of various CAPS documents with focus on Grade 7. The focus on Grade 7 was deemed relevant because this is the exit grade at primary school level in the South African schooling system. It needs to be noted that the South African schooling system is divide into two bands, namely, the General Education and Training (GET) and the Further Education and Training (FET) bands. The former band is further divided into the following phases, Foundation Phase (Grade R to 3), and the Intermediate Phase (Grade 4 to 6) and the Senior Phase (Grade 7 to 9) while the latter band covers Grades 10 to 12. Most primary schools commence with Grade R and the exit phase is Grade 7. Therefore, the researcher was interested in finding out the extent to which the exit grade at primary school covers climate change education. This is significant in the view of the researcher as it would indicate the extent to which primary school learners, at exit level, are exposed to CCE.

In the context of this study and owing to the broad and fluid meanings attached to the concept and process (Wilson, 2014; Levac, Colquhoun & O’ Brien, 2010), scoping entails a rapid, systematic and iterative scanning of curriculum documents to “map the breadth of evidence available on a particular” (Munn et al., 2022, p. 951) set of themes that could be used to enable CCE. It was essential for the researcher to conduct this review to determine whether there are any subjects that provide ‘sizeable’ and pertinent themes that could be used to expose primary school learners to climate change related knowledge. The scoping review suggested that relative to the other Grade 7 subjects, Social Sciences and Natural Sciences subjects, respectively, contain more themes that could be used as (a) vehicle(s) for the implementation of CCE. It is also worth mentioning that the Social Sciences subject covers the aspects of History Education and Geography Education, of which the latter contains more themes that could be used to implement CCE.

Upon the completion of the scoping review process, the research commenced with content analysis. In the process of data collection and analysis, the researcher began by reading the CAPS documents of the two subjects (DBE, 2011a; DBE, 2011b) consecutively, more than once, while highlighting the themes that could be used for CCE. The initial reading, which was cursory, was followed by a meticulous and focused reading to help the researcher conduct a deeper content analysis of the respective subjects. The researcher focussed on all the themes, which are supposed to be covered in a single academic year over the four terms that constitute the academic year.

The process was aided by the theoretical frameworks stated earlier and the three methods of inference pertinent to document content analysis and other qualitative research methods, namely, the deductive, abductive and inductive reasoning. The three modes of inference were used in a complementary manner.

Deductive reasoning was useful in that it empowered the researcher to analyse “qualitative data in the context of existing theory” (Barrett & Younas, 2024, p. 6). In this case, deductive reasoning enabled the researcher to use the three theoretical frameworks selected for this study to make an analysis and apply inference to determine whether a specific theme could be used to implement CCE. Abduction was used because it “recognises the role of the researcher through embracing their prior experience…. without undermining the integrity of the research” (Conaty, 2021, p. 2). Accordingly, this approach enabled the researcher to use personal experience, insight, creativity and reflection to determine the themes considered relevant in advancing CCE. In this case the current researcher’s knowledge and experience in the space of ESE and education, in general, were accommodated through this mode of reasoning. The inductive approach was used because it enabled the researcher to identify relevant themes from the raw document data flexibly without hindrances that are typical of structured methods (Thomas, 2003) such as those used in positivism. For example, in the selection of the topic on “Volcanoes, earthquakes, and floods” (DBE, 2011a, p 22) as one of the themes to enable CCE in Grade 7, the researcher used his extensive experience in Geography Education, the Environmental Literacy framework (McBride et al., 2013), intuition and inference to conclude that since active volcanoes emit pollutant gases which contribute to global warming, then this topic can be used to integrate CCE in the teaching of Social Sciences.

Therefore, as stated earlier, the researcher collected and analysed data by reading each document meticulously while reflecting and drawing inferences on whether a specific topic in each of the curriculum documents selected for this study could be used to teach climate change education. Upon identifying the relevant topics, the researcher used the curriculum documents of the respective selected subjects to glean pertinent information while also using his experience to draw conclusion on how CCE could be implemented using the triadic approach of learning *about*, *in* and *for* the environment. The topics thus identified are indicated in Table 1 and 2, under the heading on results and discussion in this text.

**Trustworthiness**

To ensure validity and reliability of the process of selecting themes that could be used to enable climate change education, the researcher relied on personal expert knowledge, and adhered to the frameworks selected to guide the conceptualisation of pertinent ESE concepts in this study (Grant & Osanloo, 2014). Furthermore, a colleague with expert knowledge (Stahl & King, 2020) on both ESE and the process of coding and thematising in data collection and analysis was consulted to comment and critique the selection of themes for CCE in the subjects which form focus of this study.

**RESULTS AND DISCUSSION**

This section focuses on the presentation and discussion of empirical results. Two tables are used to expedite this process. The respective tables highlight some of the topics gleaned from CAPS documents analysed in this study and the researcher conceived as potential enablers of CCE. Table 1 presents some of the topics sourced from the Grade 7 Natural Sciences document while Table 2 focuses on selected topics that could be used in Social Sciences. In each table there is a second column which provides suggestions, informed by the inferences of the researcher and the information gleaned from the CAPS documents, on how the triadic approach, i.e., education *about*, *in* and *for* the environment, postulated by Lucas (1972) to ESE could be used to facilitate the implementation of CCE.

**Table 1: Some of the topics that could enable climate change education in Grade 7: Natural Sciences**

|  |  |
| --- | --- |
| TOPIC | PEDAGOGICAL APPROACH (as guided by the triadic approach: pedagogy *about*, *in* and *for* the environment) |
| The biosphere | The focus here is the planetary spaces “where life exists and includes the lithosphere (soil and rocks), hydrosphere (water), and atmosphere (gases)” (DBE, 2011a, p. 17. Furthermore, attention is given to the needs (e.g., water, soil, energy and gases) of living things.Here, teaching *about*, *in* and *for* the environment is possible with CCE as the focal point, e.g. focus can be on how human actions pertaining the generate electricity contribute to the emission of greenhouse gases that cause global warming and climate change. Outdoor activities where the impact of acid rain could be observed and how electric power station pollute the atmosphere, culminating in global warming, can be undertaken. |
| Biodiversity | Pedagogy could focus on the various species on earth (and why there is a need to sustain biodiversity), and how human actions such as emission of greenhouse gases lead to global warming, the rising temperature and pollution of water culminating in the death and even extinction of some organisms (plants and animals).Furthermore, teachers can also engage learners in discussions on and undertaking of actions to promote biodiversity. Local case studies could be effective in this respect.  |
| Properties of materials | This topic focuses on, *inter alia*, the production of metals and plastics. Therefore, this topic could be used to enable CCE by focusing on the impact of the process of producing materials such as metals and plastic when fire generated through fossil fuels emits greenhouse gases to the environment.  |
| Sources of energy | The focus here is on “non-renewable sources of energy such as fossil fuels (coal, oil, natural gas) and nuclear fuels (such as uranium) ... and renewable sources of energy such as hydro power, wind, sunlight, biofuel (wood)” (DBE, 2011a, p. 26)The focus can be on discussions on the process of energy generation and its impact on the environment, especially how it contributes to climate change. Furthermore, discussion on the impact of fossil fuels *vis-à-vis* the use of wind to generate energy on climate change. Field trips to power stations could be undertaken and learners could also be engaged in discussions potential participation in activism advocating for green energy.  |
| Heat transfer | The section caters for discussion of heat transfer through “conduction, convection and radiation” (DBE, 2011a, p. 27).The teacher could discuss how heat, which warms our surroundings, is trapped by gases around us and how too much concentration of these gases in the air can lead to global warming and climate change |

**Table 2: Some of the topics that could enable climate change education in Grade 7: Social Sciences**

|  |  |
| --- | --- |
| TOPIC | PEDAGOGICAL APPROACH (as guided by the triadic approach, i.e., pedagogy *about*, *in* and *for* the environment) |
| Volcanoes, earthquakes, and floods | This topic focuses on aspects such as what a volcano entails and why it occurs (DBE, 2011b). Furthermore, it caters for discussions on the “effects of earthquakes – including injury and loss of life, disease, displacement of people, damage to infrastructure, fires and tsunamis” (DBE, 2011b, p. 22). The emission of gases when volcanoes occur and how these gases contribute to climate change could form the point of discussion in pedagogy. Also, case studies of real global events can also be the point of focus. |
| Population growth and change (Focus: World) | This topic accommodates, *inter alia*, learning about disease (DBE, 2011b, p. 23). This could be used to discuss the impact of climate change on the spreading of diseases. Also, the issue on the clearing of land for housing and how this contributes to climate change can also form part of pedagogy.  |
| World population growth | The topic accommodates pedagogy that focuses on the need for more food production as a corollary of population growth and limited land, which leads to the clearing of vegetation and climate change being an ultimate outcome emanating from an increase in carbon dioxide (CO2) due to a reduction in (green) vegetation. |
| Natural resources and conservationin South Africa  | This theme focuses on and provides for pedagogical opportunities that relate to “natural resources on earth – including water, air, forests, soil, animal and marine life…. use and abuse of selected examples” (DBE, 2011b, p. 24). This topic also zooms into water conservation with focus on “disappearing wetlands and why conservation is necessary” (DBE, 2011b, p. 24). CCE could focus on case studies pertaining to climate change induced disappearance of wetland and the need for action to avert this scourge.  |

As indicated in tables 1 and 2, above, the findings of this study suggest that there are numerous topics that could be used to enable CCE in Grade 7 Natural Sciences and Socials Sciences subjects in South African schools. In recent times, the interface between some of these topics and climate change have receive tangible attention both in the scholarly terrain and the media. For example, the connection between climate change and issues like “biodiversity” and “sources of energy”, which are covered in the Grade 7 Natural Sciences, and the topic on “population growth” covered in the Grade 7 Social Sciences finds extensive expression both in media and scholarly spaces. Additionally, albeit to a very limited extent, the curriculum documents do provide some pointers on the aspects that could form the focal point of pedagogy in certain topics.

For example, the Grade 7 Natural Sciences CAPS document provides for the coverage of issues related to “non-renewable sources of energy such as fossil fuels (coal, oil, natural gas) and nuclear fuels (such as uranium) ... and renewable sources of energy such as hydro power, wind, sunlight, biofuel (wood)” (DBE, 2011a, p. 26) when presenting the topic on “sources of energy”. Likewise, the Grade 7 Social Sciences CAPS document suggests that when addressing the topic on “Volcanoes, earthquakes, and floods”, teachers should, *inter alia*, focus on the “effects of earthquakes – including injury and loss of life, disease, displacement of people, damage to infrastructure, fires and tsunamis” (DBE, 2011b, p. 22). Nevertheless, the curriculum statements do not provide guidance on how CCE could be integrated in the teaching of these topics. Accordingly, this researcher provides some suggestions in the respective tables on how CCE could be integrated in some of the topics.

Regarding the contemporaneity of some of the topics identified as potential enablers of CCE in this study, a few points are worth mentioning. This is essential to amplify the need to integrate these and other relevant topics in CCE-inclined pedagogy at school level. For example, there is some evidence to suggest that, over the years, volcanic eruptions have contributed to an increase in greenhouse gas emissions thereby enabling global warming and climate change (Sadler & Grattan, 1999). Accordingly, Robock (2000, p.161) writes that “volcanism has long been implicated as a possible cause of weather and climate variations”. This point is accentuated by Aubry et al., (2022) who state that “volcanic eruptions shape Earth’s landscapes, have built up Earth’s atmosphere and are powerful drivers of environmental and climate change” (p. 2). Undoubtedly, within the context of the South African Grade 7 Social Sciences curriculum, the topic on “Volcanoes, earthquakes, and floods” can be used to enable CCE.

Likewise, empirical evidence suggests that population growth contributes to climate change (Dodson et al., 2020). For example, an increasing global population necessitates provision of basics such as accommodation, food, water, energy, economic development and numerous other requirements. Invariably, practices like the clearing of vegetation and an increase in industrialisation, to meet the demands of the growing population, contribute to an increase in global warming because industries emit greenhouse gases and the clearing of vegetation decreases natural users (i.e., plants) of carbon dioxide (Martine, 2009). Furthermore, an increase in population is linked to a reduction in biodiversity because the removal of vegetation for meeting accommodation needs leads to the reduction in certain species which use(d) the cleared vegetation as their habitat and niche. Additionally, population growth is associated with spreading of diseases. Significantly, apart from population growth as a contributor to the spreading of diseases, scientists have found that climate change, which is partly a product of population growth, leads to an increase in vector-borne diseases like malaria (Obame-Nkoghe, 2024; Ojwang, 2024). Undoubtedly, topics like biodiversity, population growth and change and all the others highlighted in Tables 1 and 2, respectively, could be used to enable CCE. Certainly, this study did not intend to exhaust the list of topics that could be used to enable CCE in the selected subjects. Therefore, there might be more themes that could enable CCE in the respective subjects selected for examination and analysis in this study

**CONCLUSION**

The aim of this study was to investigate whether there are any topics that could be used to enable climate change education in the Grade 7 Natural Sciences and Social Sciences subjects in South Africa. The findings suggest that there are numerous topics in both subjects that could be used to advance CCE using the ***triadic approach***, i.e., education *about*, *in* and *for* the environment, espoused by Lucas (1972), that has been undisputed as a vehicle for advancing environment-inclined pedagogy over the years. Certainly, there are various other approaches than could also be used to advance CCE. However, the worrying factor is that although there are scanty pointers in the South African *National Curriculum Statement Grades R-12* that could be used by teachers to enable CCE in the two subjects, it is worth noting that, generally, the curriculum documents do not provide guidance on how CCE should be integrated. Accordingly, it behoves the South African Ministry of Education to revise the curriculum to empower teachers on how the topics contained in respective curriculum statements could be used to enable CCE. Furthermore, owing to the paucity of research like the one entailed in this text, scholars, globally, especially in countries whose school curricula lack clear indicators on how CCE should be integrated in pedagogy, have a responsibility to conduct numerous studies such as the current one to contribute towards empowering curriculum developers and implementers with ideas on how CCE could be enabled and advanced in pedagogy.

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