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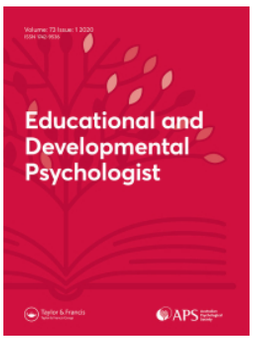

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Youth's knowledge and awareness of human contribution to climate change: the influence of social and cultural contexts within a developing country

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ABSTRACT

Introduction: Climate change is a pressing topic as scientists continue to reveal its links to human activities as contributing factors to its exacerbation. These observations lead global governments to seek initiatives that could mitigate these negative impacts. South Africa's government has attempted to grow knowledge and awareness by incorporating climate change topics into the Grades 10 to 12 high school curriculum.
Objective: The objective is to establish "What are youths" knowledge and awareness of climate change and their impact on their environment?'
Method: Twenty-nine first-year biology students responded to a questionnaire in 2020.
Results: Although environmental education provided by the curriculum is important to the development of students' knowledge and awareness of anthropogenic factors contributing to climate change, social and cultural contexts linked to poverty within a developing country determine the extent to which pro-environmental behaviours are asserted.
Conclusion: As youth are future decision makers, it is vital to understand their perspectives on the human contribution to climate change. This study illustrates that they can be change agents and contribute to pro-environmental behaviours with adequate knowledge and awareness, which can help them make informed decisions in their current contexts and as future leaders.

KEY POINTS

What is already known about this topic:

(1) The consequences of climate change are predicted to become more severe in the future.
(2) Youth will be more acutely impacted by climate change.
(3) Catastrophic occurrences associated with climate change have left communities vulnerable in a number of ways, and developing countries could be severely impacted in the future.

What this topic adds:

(1) The South African curriculum taught in schools can effectively inform youth's knowledge and awareness of issues of climate change.
(2) Curriculum revisions could include knowledge of the local impact of climate change within local communities to encourage proactive behaviours.
(3) Contextual social and cultural factors within a developing country impacts environmental behaviour, youth can be change agents in this context.

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KEYWORDS
School curriculum; climate change; environmental knowledge and awareness; African youth; social and cultural contexts; developing country

Climate change across the social and cultural contexts

The effects of climate change are already noticeable. However, these are predicted to be more severe in the future and will therefore impact younger generations more acutely. The prevailing question is whether youth, our future leaders, are equipped with the required knowledge and are aware of this potential threat. Their level of knowledge and awareness could give an indication of the pro-environmental behaviours they will display and would also illustrate any factors that may impede future mitigation measures.

This study contributes to literature by showing how the South African curriculum taught in schools can effectively inform youth's knowledge and awareness of issues of climate change, and offers that if curriculum revisions include knowledge of the local impact of climate change within local communities this could encourage proactive behaviours. However, one contention within the developing world context is that poverty influences pro-environmental behaviours that are exhibited by communities (Amanchukwu et al., 2015). It is therefore also necessary to understand how contextual social and cultural factors within

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developing countries could impact environmental behaviour, even if environmental knowledge and awareness are established by means of the school curriculum, this study sheds light on this area.

The Intergovernmental Panel on Climate Change (IPCC), the United Nations body for assessing the science related to climate change, in 2007 defined climate change as "any change in climate over time, whether due to natural variability or as a result of human activity" (p. 2). A key concern that has emerged from over three decades of research (Mahl et al., 2020) is that climate change has accelerated over the past thirty years, thus impacting resource allocation. Catastrophic occurrences associated with climate change such as floods, droughts, and hurricanes have been accelerated, which have left communities vulnerable in a number of ways (Ongoro & Ogara, 2012).

Most studies on the impact of climate change have been conducted in the Global North, and far fewer are available on the Global South (Mahl et al., 2020). Yet these changes make developing countries such as South Africa (Ziervogel et al., 2014) more susceptible to a number of issues that will increase poverty and inequality. Akrofi et al. (2019) emphasise Africa's extensive vulnerability to the threats of climate change due to its high dependence on climate-sensitive economic practices such as agriculture and its inadequate resources to react to these threats socially, financially, and technologically. Furthermore, in spite of the rapid changing weather patterns, these authors observed how two-thirds of adults in South Africa and Nigeria had not heard about climate change.

Further still, Wisner (2010) points out that climate change has grave consequences for cultural transmission. This author shows that in rural communities minority language groups were forced to move due to climate change impacts. Some have had to relocate to find work in cities as agricultural practices are widely affected. Relocation of communities by large corporations for the purpose of harvesting natural resources disperses communities, which causes cultural and traditional disruptions. Disruption of livelihoods puts young people in a vulnerable position, and therefore their perceptions are a crucial element in policy formulation and ideas on developing future mitigation. The various international bodies that represent a united effort to bring awareness of climate change, such as the IPCC, fail to take into consideration the voices of young people. Thus their perceptions are indirectly excluded. Studying youth's perceptions aids in including them as key stakeholders and improving social mobilisation for climate change action (Ferragamo et al., 2020), especially in the developing world context.

Schools offer an ideal setting for the promotion of a positive environmental mindset and conduct towards climate change, because the curriculum influences levels of knowledge, skills, and attitudes (Ronald et al., 2017). It is essential to gain insight into how the future leaders of South Africa (youth) understand climate change and see human activities as a contributor to this phenomenon, especially since the curriculum at schools has integrated information on aspects of climate change. In terms of the curriculum Amanchukwu et al. (2015) recognise that young people play a part in educating the citizenry on issues of climate change within local environments, and that this can be done when they disseminate knowledge that they have gained from the school curriculum. Thus the social and cultural environment provides a platform for communication between youth and the community at large. It is in this role that young people could be envisaged as change agents.

Within the South African context, there are instances of youth acting as agents of change. One of the earliest and best-known examples of this is the Soweto uprising of 1976 when Black youth protested against the enforcement of Afrikaans as their medium of instruction at school. Another more recent example is the #FeesMustFall protests of 2015/16. Both these examples illustrate that when youth are exposed to information they can be instrumental in taking etudialist ideas and using these to influence society. Etudialist student movements are explained by Luescher et al. (2017) as having a tendency to be "inward-oriented, primarily towards higher education and student-related concerns" (p. 232). But, as Lethoko (2014) highlights, when South African youth are not sufficiently formally educated on issues of climate change they cannot act as change agents.

A matter of concern is a study conducted by Akrofi et al. (2019) that surveyed students at various universities across the African continent and revealed that they did not view their decisions as having potentially negative impacts on the environment. This, they deduced, indicated that these young people might not be aware of their contributions to the problem of exacerbated global warming and climate change, and therefore would not be able to educate others on how climate change could influence livelihoods and the quality of life within their local communities and for Africa at large. Within the South African context, where the school curriculum for Geography and Life Sciences has intentionally focused on

aspects of climate change, it is important to determine the extent to which youth who have experienced this schooling system are knowledgeable on climate change and are aware of their contributions towards this phenomenon.

Study rationale

According to Karl and Trenberth (2003), the one thing that all nations have in common is the atmosphere. The atmosphere is affected by many triggers such as emissions and changes in the Earth's surface or beneath it. They make note of how an experiment involving human balloon flights around the world revealed that it takes a week for air to move from a specific location to halfway around the Earth. Thus they concluded that this atmospheric movement is indicative of the potential for emissions to affect the atmosphere globally and ultimately contribute to global climate changes. The youth are our future leaders and with such a large array of possible career paths it is important to assess how the youth perceive climate change and their impact on the environment, this could influence their decisions as future leaders in diverse career fields. At tertiary level climate change education is narrowly focused within the environmental sciences or geography programmes; school provides a platform of introducing this topic early and even though students may opt for other career paths, their awareness from school will enable them to understand or identify climate change potential risk in their day to day experiences and within any of their chosen career paths. Climate change affects us globally and is a topic that requires unity and interdisciplinary efforts in attempting to tackle it; and so this evoked questions of how much understanding there was, surrounding this phenomenon, within the youth in the community.

The curriculum provided during Apartheid was structured differently for white and Black schools. The curriculum for Black schools was devoid of content to develop higher cognitive skills, or place any focus on global and local needs such as the impact of climate change on ecosystems. The syllabus provided at predominantly white schools at the time, in contrast, incorporated global environmental knowledge. Black schools covered mostly material teaching learners to be labourers who maintained local farms. White schools privileged the development of cognitive skills, while the curriculum for Black schools focused mostly on producing menial labourers who were able to take instruction rather than deliberate problems (Leibowitz & Bozalek, 2014). Literature, such as that produced by Braun (2018), recognises that when trying to encourage positive environmental behaviour among learners, environmental education on local and global issues needs to be integrated into lesson planning. When South Africa became a democratic state in 1994 one of the priorities was for the government to provide an equitable education system for the entire population. This meant that, as the curriculum was revised over time, an increasing number of climate change topics was included in the Grade 10 to 12 syllabus. The extent of coverage varies across the grades. The dominant topics are shown in Table 1.

The Curriculum and Assessment Policy Statement (CAPS) is described by Lekgeu and Davis (2017) as a standardised and unified curriculum spanning across the entire country; it has a set of milestones that are meant to be achieved in each grade relating to climate change. As early as grade 5 the learner should be able to distinguish between climate and weather, including all elements that affect them. As learners progress through school they are exposure to subjects such as Geography, Social Science, Natural Sciences and Life Sciences which have some focus on climate change as well (Lekgeu & Davis, 2017). These authors further elucidate how the curriculum continues to highlight these topics between Grades 10–12 where learners are introduced to human impact on the environment, greenhouse gasses, global warming and climate change in the African context. The aim of the current curriculum, according to the Department of Basic Education (2011), is to increase knowledge, engage learners in scientific investigations through practical work and empower them in applying the knowledge

Table 1. Geography and life sciences curricular topics.

GRADE 10	GRADE 11	GRADE 12
Water resources: Water in the world: oceans, flooding, water management	Global air circulation, Africa's weather and climate, Africa's climatic regions	Climate and weather: cyclones, local climate
Impact of greenhouse effect on people and environment	Resources and sustainability: soil, energy	Human impact on the environment: current crisis
Global warming: causes and consequences in Africa	Human impact on environment: current crises	
Impact of climate change on the environment and people of Africa (deserts, droughts, floods, rising sea levels)	Oceans and climate control in Africa	

gained in their everyday lives. Based on this, one could scrutinise the extent to which students understand climate change and their perceptions of their influence on their environment after having experienced this curriculum. Our study sets out to provide access to youths' awareness and knowledge of climate change, and their contributions towards this phenomenon.

Theoretical framework

Individuals' climate knowledge influences their concern for the environment (Patchen, 2006). This is because their knowledge influences their attitudes, and this is expressed through their actions or behaviours. People with pro-environmental behaviours would usually be more concerned about environmental preservation (Braun, 2018). Work done in social psychology, such as that of Patchen (2006), shows how individuals evaluate the outcomes of behaviour, and that this process of judgement comes from personal values held by the individual. This assessment is therefore linked to an emotional response. People react in accordance with their emotional responses, and these shape their attitudes and resulting behaviours. In terms of issues related to climate concerns, Patchen asserts that "Environmental awareness, personal values, emotions, and perceived control combine to determine behaviour" (p. 2).

Ajzen (1991) planned behaviour model focuses on evaluating attitudes. This model illustrates that when individuals come across new knowledge their attitudes could change. Similarly, in the context of our study, when Grade 10 to 12 high school learners are taught a curriculum which has an environmental education focus this knowledge and thus awareness could enable them to have a more informed perspective on pro-environmental behaviours. In this way, they could see how climate change issues are relevant to them as individuals, have influence on their society and local context, and have global impacts as well. Young people who are informed could exhibit pro-environmental behaviour within current contexts and as future decision makers in the country.

Masud et al. (2015) emphasise the role of the individual in addressing climate change. This is not the responsibility of only governments or environmental campaign agencies. Patchen (2006) explains that when individuals see the direct and indirect connections that climate change has to their own lives, this could bring about a change in attitude and thus behaviour in relation to the environment. In terms of the environmentally based curriculum that learners are introduced to at school, the new knowledge that they have received can lead to new perspectives and thus reformed behaviours that are pro-environment (Akrofi et al., 2019). The awareness, knowledge and perception of climate change model of Masud et al. (2015) illustrates that people who have a strong awareness and foundation of knowledge of the impact of climate change vulnerability are prone to act more conscientiously to mitigate the effects of climate change.

Considering the abundance of research which shows that knowledge and awareness prompt pro-environmental behaviour (Kollmuss & Agyeman, 2002), and the fact that the South African curriculum has focused on climate change phenomena more acutely in recent years, it is necessary to understand the extent to which knowledge gained at school informs the behaviour of youth. It is also necessary to further probe youth perspectives on which factors may exist that impede their pro-environmental behaviours, especially within a developing world context.

Methods

The South African high school Geography and Life Sciences curriculum details a number of topics that provide a foundation for understanding climate change (Table 1). This curriculum has been revised multiple times over the years. The focus on environmental education at high school is now foregrounded by examining topics related to humanity, and social and environmental justice, the topics are centred on the responsibility humans have towards the environment (Msezane, 2020). As Msezane shows, the South African high school curriculum evolved to increase the number of topics on the environment in recent years, and more focus was placed on factors that influenced biodiversity, global warming, invasive plants, and farming practices. These topics made up 8.8% of the Life Sciences syllabus. The concern, as pointed out by Msezane, is that topics such as deforestation, carbon footprint, droughts and floods, methane emissions and ozone depletion had less focus in more recent years.

The study population comprises first-year students registered at a higher education institution in South Africa. All first-year biology students (n=approximately 700) were invited to participate in the study. The study was conducted at the start of the 2020 academic year, prior to the students' exposure to the first-year academic programme, thus allowing for a true indication of the participants' understanding of climate change before being influenced by the university curriculum. The study utilised a qualitative approach as well as convenience sampling. Etikan et al. (2016) explain that convenience sampling is a method used by

researchers to select a sample of respondents from a larger population and is a non-probability method. The university Human Research Ethics Committee (non-medical) approved this study (protocol number: HA2003).

This research was an adaptation of a study conducted by Bord et al. (1998), where data from the United States and other countries was utilised to assess public knowledge and awareness of climate change and the participants' willingness to change their personal activities to minimise potential impacts. Furthermore this study showed that individuals' awareness and willingness to change was important in developing policies that would be acceptable to the public. The study by Bord et al. thus inspired the formulation of this study in a South African context, looking at perceptions of future leaders and policy developers. The survey by Bord et al. prompted the formulation of open-ended questions as well as Likert-scale type questions for our survey. This survey, adapted for the South African context, is described in more detail below, the establishment of validity and reliability is explained as well.

An online questionnaire was designed to collect data from first-year students who volunteered to participate in this research. Section one of the questionnaire comprised close-ended, short-answer questions covering demographic information to gain an understanding of the participants' backgrounds. Section two probed the students' knowledge and awareness of climate change. This was used to highlight their personal understanding of what climate change entails and how they became aware of it. These questions were open, and students could answer in a paragraph format. There was no restriction on the number of words that could be used in these responses. Section three focused on measuring the participants' ranking of potential climate change threats to society and their ranking of issues perceived to be of importance within their communities. The questions in this section were mostly based on the Likert scale, the focus of these questions were on the students' views on climate change in relation to their impact on the climate, their health and safety, the concerns in the community on teenage pregnancy, poverty, overpopulation, unemployment, gender-based violence, HIV and AIDS, crime, and the economic situation, with the exception of one question that was posed as an open-answer question. The question focused on whom or what participants believed to be contributors to climate change. The questionnaire was provided as a Google form (a survey administration software and web application offered by Google LLC).

Table 2. KMO and Bartlett's test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		585
Bartlett's Test of Sphericity	Approx. Chi-Square	139.595
	df	45
	Sig.	000

The questionnaire was piloted by the first author who distributed it to learners who were in matric at the time; this was to determine if all critical elements to the study were being addressed in the questionnaire and detect if it was understandable and appropriate for their age.

Once the questionnaire was piloted, the authors reviewed the responses and determined that the questionnaire showed reliability and validity. The co-authors discussed the results after independently coding the surveys, it was found that the responses were stable in relation to the questions posed on the pilot study. Thereafter the link to the Google form was sent out to all the first-year biology students. Of the approximately 700 students in the cohort, 29 responded to the survey. Data was interpreted on the Likert scale in relation to the responses to open-response questions on awareness and knowledge of climate change to determine whether there is an observable pattern or trend across these areas.

In determining the validity and reliability of the adapted survey, ten items relating to the students' views on climate change in relation to their impact on the climate, their health and safety, the concerns in the community on teenage pregnancy, poverty, overpopulation, unemployment, gender-based violence, HIV and AIDS, crime, and the economic situation were factor analysed using the principal component analysis with varimax rotation. Prior to performing exploratory factor analysis two statistical diagnostic measures were conducted to assess the factorability of the data. These measures were the Kaiser Meyer-Olkin Measure of Sampling adequacy (KMO and Bartlett's Test of Sphericity) (Table 2).

The KMO Index ranges from 0 to 1, with .5 suggested as the minimum value for a good factor analysis (Tabachnick & Fidell, 2013). The Bartlett's test of sphericity was statistically significant ($p = .000$). Bartlett's test of sphericity should be significant ($p < .05$) for the factor analysis to be appropriate (Bartlett, 1954). Using both the Scree Plot and the Kaiser-Eigenvalue Criterion, eight underlying factors were obtained. The plot and summary table explaining the factor loadings will be presented in a forthcoming paper which focuses on validating the survey for the South African context.

According to Braun and Clarke (2006) thematic analysis is used to examine the realities of people, and

acknowledges the way in which individuals construct meaning. Thematic analysis was used in our study to analyse the patterns between the background demographic data (i.e. type of high school attended, subject choice for Geography and/or Life Sciences, career choice and career interest) in relation to the students' awareness and knowledge of climate change, and reflections of personal and youth impact on the climate. The first author coded the responses to the open-ended questions, and then analysed them to determine the patterns and themes which emerged from our data. Comparisons were then made to the coding and themes based on the analysis by the second and third authors. Discussions took place to determine whether the coded data and the trends that emerged were consistent across the data analysed by all authors. There was 95% agreement.

Study sample

Ninety-seven per cent of respondents were aged between 18 and 25 years. Fifty-two per cent of respondents were female and 48% were male. Data from our study reflected that very few respondents were from rural villages, with the majority being from urban areas (see Table 3 below). Regardless of the student composition across these different school backgrounds, the school curriculum that they would have been taught is the same throughout South Africa. Representation from the different provinces in South Africa is shown in Table 4.

Students' perception of the role of the curriculum on their knowledge, awareness, and pro-environmental behaviour

School curriculum and climate change knowledge and awareness

Forty-one per cent of respondents in our study indicated having studied Geography at high school, while 86% studied Life Sciences, it is unsurprising that 93% of the respondents noted that they were aware of climate change. Seventy-nine per cent of the students in our study made connections between the topics that they learnt within the school curriculum and their interest in understanding links between how different organisms impact their environment.

> I was first introduced to climate change in Grade 6, when we had to do a project on environmental responsibility. This is where I first realised the seriousness of climate change.

> Life Sciences and [learning] how the human body and other organisms operate in conjunction with their environments intrigued me … and [I] realise that I love it [through] learning about it in my school curriculum.

Responses such as these quotes confirm that the school curriculum is instrumental in raising awareness and contributing towards an increased knowledge base among learners. Ors (2012) explains that environmental education develops individual perception and evokes pro-environmental behaviours and active participation. Nkoana (2020) adds the importance of climate change education as a tool for raising awareness, since this knowledge and awareness could in turn result in decision-making processes towards mitigation and adaptation measures.

Responses showed that the content in the syllabus (Table 1) also linked to the students' awareness of global impacts of climate change (Figure 1):

> There has been an increase in average temperatures leading to glaciers and icebergs melt[ing], more forest fires, more droughts, increased natural phenomena such as tsunamis, floods, cyclones, etc.

> … we have constant drought in many places around the world [with] people not having access to water […] [e]xcruciating heat in the places near the equator. Some people are dying due to climate change. Some habitats are destroyed, like icebergs, leading to animals losing their home. Plants are dying.

The respondents in our study defined climate change by indicating mostly that it was brought about by the outcomes of human activities such as pollution, and 24% mentioned emissions of methane gases and ozone depletion. Only 3% mentioned naturally induced changes. 31% brought up the element of time, describing climate change as taking place gradually over years and indicating that human impacts have increased this gradual rate. While the school curriculum caters for climate change topics in the prescribed syllabus (Table 1), and respondents acknowledged being introduced to these topics at school, it seems

Table 3. Respondents' area of residence.

Area of Residence	Percentage (n = 29)
Urban	83
Rural	17

Table 4. Respondents' province representation.

Province	Percentage
Gauteng	69
KwaZulu-Natal	14
Eastern Cape	7
Free State	4
Western Cape	3
Mpumalanga	3

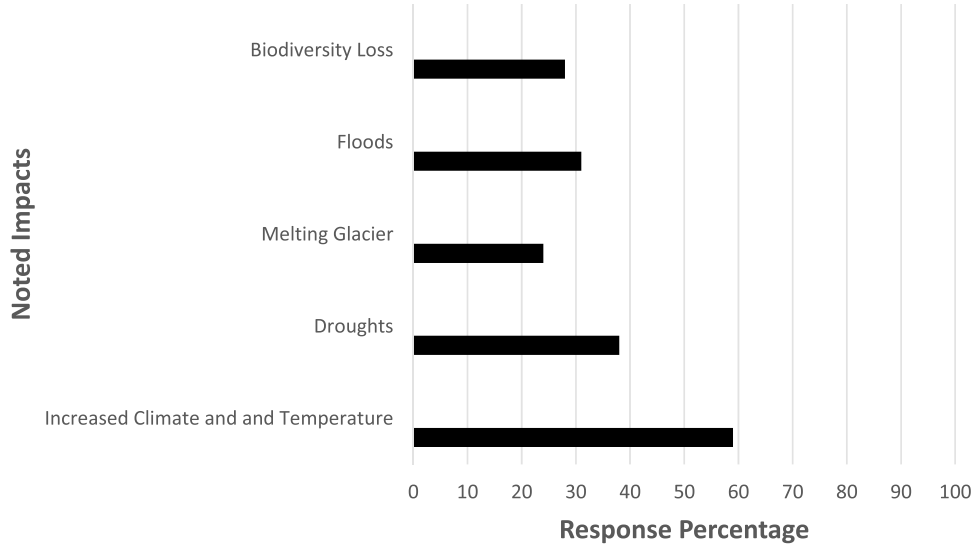

Figure 1. Global impact of climate change as perceived by youth.

that the depth of information they have on climate change could require attention. A large percentage of the sample does not seem to perceive climate change as a natural phenomenon and one that humans contribute to as well. This is alarming, especially in terms of Masud et al. (2015) and Patchen (2006) findings. The questions that these results prompt in relation to the studies by these authors is whether students are aware of the impact of humans on the environment but may not necessarily reflect on how they, as individuals, also contribute towards this impact.

Kuo (2010) stresses the importance of assessing young people's perceptions that may have the power to positively inspire their choices for climate-protective actions and support for pro-climate policies. Thus exposure to climate change education may bring about increased interest, pro-environmental behaviour and increased environmental lobbying on the part of young people. However, when they are not fully informed on what climate change means and which factors play a part in it, it could impede their considerations for pro-environmental behaviours, and might influence their stance on how they as individuals, and their communities, could influence the effect of anthropogenic impacts on climate change.

Climate change causes according to youth

The causes of climate change noted by respondents in our study included those caused by human actions, like deforestation, carbon gas emissions from non-renewable power stations, increasing human population, the use of non-renewable energy, unsafe food practices (e.g. how cattle are farmed), water wastage, oil spills, and the contributions of fuel and gas companies as well as the meat industry, global warming, increased emissions of greenhouse gases, and use of fossil fuels (Figure 2). Furthermore students noted daily personal activities which they felt had negative and positive impacts on the environment. For example 76% noted that they believed they contributed directly by using electricity, forgetting to switch off lights, and taking long showers, not recycling and supporting the use of non-recyclable items for convenience, using a fridge that contains chlorofluorocarbons (CFCs), and vehicle transportation. The remaining 24% felt that their actions had very little to not any negative impact at all, and that these were insignificant when compared to the actions of large industries. Thus this self-awareness of personal impact indicates the presence of some level of awareness of climate change causes. These results contrasts to the study reported on by Akrofi et al. (2019), our study shows that students are aware of what climate change means and the impact this phenomenon has at a local and global level, they also had considered the influence of human activities, and to an extent their own individual activities, in relation to the environment. Again these findings support Patchen's assertions (2006) and Ajzen's model (Ajzen, 1991) which illustrates that when individuals are more informed on issues related to the environment this can positively influence attitudinal and behavioural changes.

Some of the students' responses spoke to topics taught in the South African school syllabus (Table 1) regarding the enhanced greenhouse effect in relation

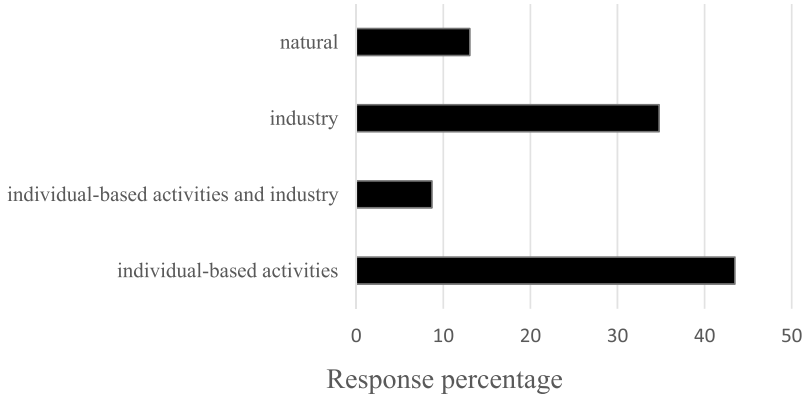

Figure 2. Climate change causes according to youth.

to climate change. The response showing that the meat industry is a contributor to climate change is one such example. There were also misconceptions that emerged from their responses. For instance, while carbon dioxide and CFCs are greenhouse gases, and CFCs do contribute to the hole in the ozone layer, these gases make only a slight contribution to climate change. It is possible that the students conflated their understanding of CFCs as a greenhouse gas with the greenhouse effect and the depletion of the ozone layer. This means that as much as the curriculum provides students with knowledge of factors that contribute to climate change, there needs to be a deeper understanding by youth of how different factors impact on the climate over long periods.

Simpson et al. (2021) state that people who have experienced the effects of climate change and are aware of human-linked negative impacts on the climate are more likely to exhibit pro-environmental behaviour. This study extends on this view by offering that a proactive approach could include the use of the curriculum to inform learners on how their lives are impacted at a local level in terms of social and cultural norms due to their individual impact on the environment, and suggests a more critical curriculum so that they can be more informed on how different factors, such as individuals and industry, affect the climate as well.

When questioned in our study about who they felt were contributors to climate change, participants were split between a generalisation about individuals and large industries, due to emissions. Fifty-nine per cent of respondents in our study felt that climate change perpetrators were the human race, with the remaining 41% specifically pointing to industry emissions, and predominantly those in developed countries. Within the context of a developing country it seems particularly important for youth to understand the powered nature of human decisions that have contributed to the climate crisis. While some factors, such as industry, have a greater impact on the climate, other factors like the use of CFCs have a far lesser effect. Additionally, in 2017 The Guardian newspaper carried the Carbon Majors Report, which reported that 100 companies are responsible for 71% of global greenhouse gas emissions. Misconceptions about or limited knowledge of these areas could prevent effective pro-environmental behaviours and policy decisions. For youth to make informed decisions about their behaviour towards the environment, act as change agents in communities, and take on leadership roles in the future, it is necessary for them to have a depth of knowledge and awareness of how different factors impact on the environment and climate change.

In our study respondents were asked if they had been impacted by climate change directly or indirectly. One of the responses received was as follows:

> The droughts and floods that have been caused [by] climate change have resulted in food insecurity, causing the prices of food to fluctuate, making life more financially difficult. This is a way in which climate change has affected our life indirectly.

This response and the one below reflects an indication of climate change impacts and experiences that are varied across geographic contexts. One of the participants noted drought affecting food production at the family farm:

> Our parents are farmers, so changes in rain cycles can cause issues for us such as ruining crops.

This quote highlights the climate change impact on vulnerable communities that are dependent on agricultural activities and the different ways that climate

change is experienced by youth across the country in their varied geographical contexts.

Mitigation measures and behavioural changes

The main finding that emerges from the data is that, although learners are introduced to the topics of climate change and the influence of human actions on the climate, their knowledge and awareness of the anthropogenic influence on climate change is sometimes erroneous. However, there is agreement among students that human-caused climate change is very rapid compared to natural, geological/atmospheric cycles. The concern which emerges from the data, as shown in the quotes that follow below, is that although students are aware of anthropogenic influences on the climate they do not refer to their own behavioural responses which they could curb to reduce their anthropogenic influence. The recommendation is that learners need to be made aware of how climate change will affect them at individual levels, and in terms of their future social and cultural contexts, in order for a behavioural change to occur. This level of knowledge, awareness and action could also lead to them making more informed decisions as future leaders. Amanchukwu et al. (2015) signifies the role that young people have as change agents within their communities on issues of climate change, therefore if students are to play an active part in citizenry, they need to be well informed on how human behaviours and other factors such as industry impact on the climate and their local environment.

Respondents were in agreement that there are ways to mitigate climate change, and 24% listed reducing and monitoring carbon emission levels, 17% noted reducing consumption patterns, 21% mentioned investing in the use of renewable energy sources and reducing pollution levels, and 17% noted the importance of raising climate change awareness as a part of the solution. The study participants listed mitigation measures that were anthropocentric and there were no suggested measures to mitigate natural climate change.

Semenza et al. (2008) support this notion when highlighting the ways in which society can respond to the climate change threat as being through adaptation and mitigation. This is ultimately brought about by awareness and knowledge of climate change. Semenza et al. describe adaptation as encompassing precautionary measures to avoid, prepare for, or react to probable climate change impacts and point out that it is often a short-term initiative driven by behavioural change. This would include personal levels of activism, while mitigation is described as finding ways to minimise sources of emissions through legislation and increasing areas that are natural greenhouse gas sinks. Respondents in our study indicated the following measures:

> Regulate companies that pollute, or are large contributors to climate change.
>
> Invest in sustainability programs and entities doing research [on] climate change mitigation and monitoring.
>
> If the government can implement new laws that limit the amount of pollution from industries, and laws to fine people who pollute the environment, climate change can be SLOWED DOWN.

This understanding of mitigation measures suggests that the transfer of knowledge through the school curriculum could be more effective and that youth could put these learnings to use in their future endeavours. It is worth noting, however, that student misconceptions have become clear, as their responses show that at times they conflate an increase in greenhouse gases with climate change (Lombardi & Sinatra, 2012). However, considering that human behaviours contribute towards negative human impact on the environment (Braun, 2018), the participants' responses in our study show that they understand the negative impacts on the environment.

As much as the participants in this study did see how industry, and "others" in general, could change their behaviour to mitigate the anthropogenic effects on climate change, the students did not mention the changes they could make to their individual behaviours in an attempt to mitigating these effects. The next section explores the reasons for the lack of behavioural changes at the level of individuals in this study.

Climate change significance and social concerns

Braun (2018) concluded in her study that the country of residence and its political climate were the strongest factors which influenced education. Our study expands on this understanding to show that socio-economic conditions can impact on environmental behaviour and the protection of the environment. South Africa as a developing country is faced with a number of pressing issues to attend to in its aim to provide a better life for its citizens. This incorporates political stability, economic growth, and social development. An assessment of South African attitudes towards climate change conducted by Mahl et al. (2020) revealed that citizens acknowledged climate change as a pertinent issue, but also revealed that many regarded

social problems as more pressing and displayed less concern about climate change.

This observation was also noted by Nkoana (2020); his study revealed that environmental awareness does link to how current and future climate change is perceived, however when short-term risks such as the daily living struggles were considered of more importance than long-term potential threats such as climate change then this could impact on environmental behaviour. However, being familiar with the term climate change is not the same as having climate change literacy. As Mahl et al. iterate, climate change is a complex phenomenon to understand and even more difficult for individuals to relate to their daily lives. Key sectors in South Africa will be affected by climate change, and this includes "water, agriculture, forestry, biodiversity and ecosystems, human health, urban environment, and rural livelihoods" (Babugura, 2010, p. 17). The IPCC report in 2007 elaborates that those who are socially vulnerable are predicted to be most adversely affected. This is because they have limited access to resources, such as financial, technical, human and institutional support, to adapt to the changes. It is particularly necessary for citizens in Africa to understand the anticipated impact of climate change on them since the warming trend for this continent is one and a half times more than trends reported for the globe (Solomon et al., 2007).

For South Africa this means that there will be an increase in temperature of between 1 and 3 degrees Celcius (Babugura, 2010). The IPCC reports that increased droughts are predicted to occur throughout the country. The overriding concern is the effect this will have on agricultural productivity, since there will be implications for food security. This will have a knock-on effect on the quality of life for individuals in this context. Rural populations are more likely to feel the impact of drought since they rely on rain for agricultural activities, and usually rely on home gardens for food. Therefore more is required to build resilience to climate change in these areas so that people do not become more vulnerable (Babugura, 2010).

To get an indication of the level of concern about climate change, respondents in our study were asked to rate their concern levels across a number of social issues prevalent in the South African context in comparison to concerns about climate change. The findings follow below.

Poverty and climate change concerns

The majority of the respondents rated poverty as a great concern in their community (Figure 3). The scale on Figure 3 is a continuum from 1 to 5, where 1 represents least concerned and 5 most concerned. The responses which rank poverty over climate change concerns raise the question of the immediate desire to meet daily needs versus concern over climate change. When considering that, Khavul and Bruton (2013) allude to the notion that people living in poverty are unlikely to be prioritising thinking of ways to save the environment over finding means to survive. For example their needs might require that they cut

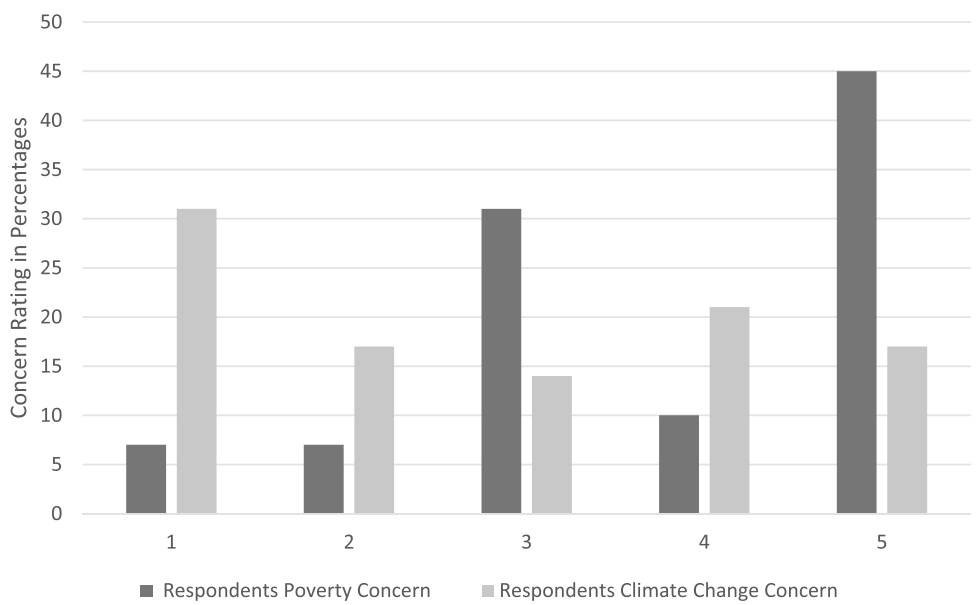

Figure 3. Poverty concerns compared to climate change concerns.

down trees and burn the wood to make their homes warm and prepare meals. Thus, even though Kollmuss and Agyeman (2002) stress that there is a gap between knowing and acting, or knowledge and behaviour, and Braun (2018) emphasises the use of knowledge to create awareness to bridge this gap, our study shows that socio-economic conditions would predominate and persist over the need to protect the environment, and thus be agents of change.

Considering that literature such as Wisner (2010) and Babugura (2010) show that rural communities are vulnerable due to their reliance on the environment for their livelihoods, and that they usually have less formal education than people from urban contexts, research alludes to limited pro-environmental behaviours due to lack of knowledge and awareness of climate change in these contexts. Based on our study, 5 out of the 29 students were from rural contexts (Table 3), and they all reported knowledge and awareness of climate change. However, neither urban nor rural groups reported any individual behaviours to mitigate the effect of climate change, or reported any pro-environmental behaviours that they engaged in as individuals.

Our finding that issues regarding poverty predominate over concerns over climate change were also observed as an outcome of a study conducted by the Human Sciences Research Council of South Africa (HSRC) looking into South African attitudes towards climate change. The council attributed this observation to climate change impacts being perceived as distant threats and thus given a low priority when compared to more immediate threats such as unemployment, HIV/AIDS, poverty, service delivery, and racism (Seager, 2011).

Economic, crime and unemployment in relation to climate change concerns

The respondents in this study were asked to rank their concerns regarding the economy, crime, unemployment and climate change within the South African context. For this question, students selected a response based on a continuum where 1 represented least concerned and 5 most concerned. The economic concern stems from economic instability and unemployment being the predictor of citizens', including youth's, ability to meet needs and have a better future. With the sharp increase of youth seeking entry into institutions of higher learning and employment opportunities and the economy being the driver of these, it is unsurprising that this is of concern to youth. Crime threatens our safety and that of people's assets. Therefore it poses an immediate threat or concern, which accounts for the high ratings shown for this factor (Figure 4).

It is argued that climate change will increase strain, reduce social control, weaken social support, foster beliefs favourable to crime, contribute to traits conducive to crime, increase certain opportunities for crime, and create social conflict (Agnew and Livingstone, 2011). According to Pease and Farrell (2011) crime statistics are directly linked to direct carbon costs, and it would be impossible to foresee a society with high crime rates being a low-carbon society. Unemployment speaks to direct and personal means of securing provisions and meeting needs. Therefore

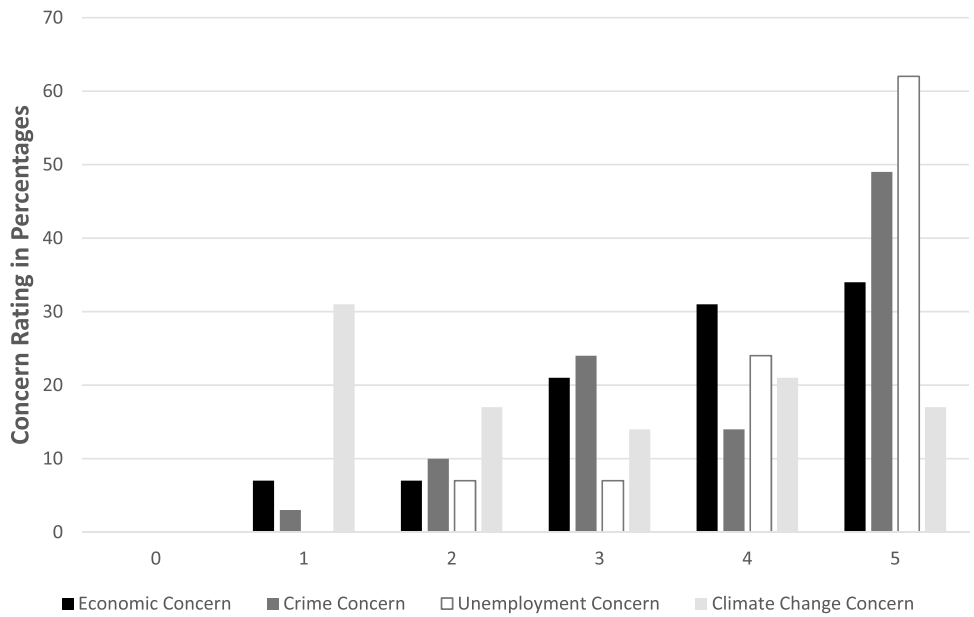

Figure 4. Economic, crime and unemployment concerns compared to climate change concerns.

a large percentage of young people within communities would consider unemployment as a pressing issue that is of great concern.

Final words and recommendations

Literature is abundant with models (eg. Ajzen, 1991; Masud et al., 2015), which provide valuable insights into how knowledge and awareness (Kollmuss & Agyeman, 2002; Patchen, 2006) can prompt pro-environmental behaviours (Kuo, 2010), and also reports on the influence of societal issues like poverty on decisions to act in conscientious ways towards the environment (Amanchukwu et al., 2015). There is also substantial evidence shown anecdotally within the South African context (described above) and by means of research (e.g. Luescher et al., 2017), however as Lethoko (2014) submits, youth can be agents of change in an effective and informed way only if they have developed a sound understanding of issues that impact their local contexts, communities, and environments. This current study contributes to the existing literature by showing that the focus of environmental education within the school curriculum could include the influence of climate change within local contexts and communities so that the learners can tangibly relate to their local environments. This could in turn make visible to learners the need for pro-environmental behaviours. This study extends on views by e.g. Simpson et al. (2021) which offer that a proactive approach is needed, our study reflects that the curriculum can be used to better inform learners on the factors that impact climate change and how these changes influence them at an individual, societal, and community level. This could then enable students to act as agents of change within the context of South Africa.

Findings show that students recognise that they have covered aspects of climate change in their school curriculum, and most participants specifically remembered covering the human impact on the environment in relation to climate change. However, when students related their understanding in terms of their views on curbing the anthropogenic effects of climate change, some misconceptions began to emerge, such as the effect of CFCs on the ozone layer in relation to climate change. Additionally, even though students were able to voice how industry is responsible for many of the effects of climate change and were able to offer suggestions on how this effect could be mitigated, none of them offered any suggestions on how they could, at an individual level, change their behaviour to assist in mitigating the effects of climate change.

Moreover, students' responses reflected that they were unaware of the extent to which different areas or factors influenced climate change. For instance they seemed to view the effect from industry in the same light as the effect of CFCs on the ozone layer. In light of the curriculum that is offered at schools, it appears that more could be done at a number of levels to assist learners to better understand climate change and the effect of various factors on it. The curriculum could also integrate topics such as the ways in which individuals within local environments are already experiencing climate change, and how climate change will affect the future of local communities that rely on the environment for their livelihoods.

Poverty is perceived by youth as one of the main constraints in effecting behaviours that would be pro-environment. In relation to this finding it is recommended that the curriculum undergo revisions to include a focus on why it is necessary to foresee what the future of the South African contexts would be if climate change mitigation strategies are not implemented at local level, including at the level of individuals and members of communities. Understanding climate change within the context of a developing country is particularly important considering that the African continent is more vulnerable to climate change, and that due to poverty Africans are at higher risk.

Therefore it is necessary for the development of coping and adaptation strategies to develop resilience in communities in developing countries. Young people have been identified as change agents within the South African context. If the curriculum is able to adequately upskill learners in terms of their comprehension of climate change and the anthropogenic factors that lead to climate change, youth would be in a better position to make bold changes to their own behaviour and be more informed as future leaders of the country.

Study limitations

Covid 19 restrictions meant that teaching had to be conducted remotely and students thus did not attend lectures on campus; this meant that there was an increase in information through emails and online platforms. For new students who were still trying to familiarise themselves with being at a tertiary institution and the online teaching methods could have introduced an element of information overload. Respondents were invited to be part of the study via email; with increased volume of information being sent to them via email this too could add to their flooded inbox thus there was difficulty in meeting desired number or sample of respondents. In addition, only the curriculum was analysed for this study, going forward it would be valuable to interview teachers in high school settings to gain a deeper understanding of how content on climate change is addressed

within teaching and learning. Teachers who bring in examples from the local environment or community contexts could provide for a more enriched learning experience in their classrooms.

Conclusion

In agreement with prior research, this study finds significant student understanding regarding the causes of climate change. They were able to connect climate change with visible direct pollution, such as exhaust from either a car or factory, and indirect emissions such as from electricity use and through product or food consumption. Climate change was observed to be considered less of an immediate threat when compared to other social impacts and thus received a low concern percentage rating.

This article recommends that pedagogical responsiveness of the curriculum, by integrating the latest findings on climate change, could influence youth behaviour, especially if the curriculum highlights how the local environment of the community would be influenced by pro-environmental behaviours which mitigate the influence of climate change on local populations and areas. The climate change literacy that learners can attain by means of a more rigorous curriculum is different from young people having knowledge and an awareness of what climate change means.

Therefore, future research needs to explore the changes that can be implemented in the curriculum to ensure that learners are more self-aware of the different impacts that various factors have on the climate, in order for their current behaviours and future decisions as leaders of policy changes are more critically informed. Considering that climate change literacy levels in Africa are low, and that the Global South is likely to be more severely affected by climate change in the future, the continent's citizenry needs to become better informed on ways to mitigate environmental impacts, and thus climate change.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

The anonymised data can be made available on request. This is due to the ethical protocol at the university where the approval is provided. The survey has been provided as supplementary material.

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