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Abstract

Climate change is the most serious environmental, social, and economic problem humanity is currently facing. Education is a fundamental pillar for societies in their efforts to address climate change, as stated in Article 12 of the Paris Agreement. In view of this imperative, the need to develop a Climate Change Education (CCE) plan that would be up to the challenge arose in the field of educational research. The guidelines for such a task are based on the study of four educational factors: the students, the teachers, the teaching and learning strategies and methods, and the goals of education. Research on these factors is abundant; nevertheless, there is a lack of these studies concerning Africa. Here, we present an exploratory study which focuses on students in Pemba (Mozambique) and aims to be the first step in the exploration and development of a basis for CCE in this country. We employed a questionnaire consisting of 38 closed-end items which was administered to 256 Mozambican students (aged 16–18). Findings suggest that students declared a limited knowledge about climate change, erroneous beliefs about the anthropogenic causes of climate change, and low levels of responsibility and risk perception. Further progress in the development of CCE in Mozambique would require future research to explore other educational factors with the aim of building a more accurate image of the educational reality of climate change in this country.

Introduction

The consensus that human activities are causing climate change is shared by 97% of climate scientists (Cook et al., 2016). In contrast, the economic, environmental, and social impacts of climate change do not achieve the same level of consensus, due to the complexity of the climate system and the global society. Some scientists criticize the reports of the Intergovernmental Panel on Climate Change (IPCC) as being too cautious (Waldman, 2018). Even though IPCC reports predict global food shortages, the flooding of coastal cities, and a refugee crisis as the world has never seen before, critics point out that these documents do not consider the economic costs of severe weather events, nor the displacement of people, among other factors that might exacerbate future climate scenarios.

In terms of social impacts, the most vulnerable societies will bear the brunt of the consequences. In this respect, African countries are home to some of the populations that will suffer the most serious impacts (Carvalho, Santos, & Pulqu□erio, 2017) despite being minor carbon emitter countries (Ritchie & Roser, 2017). Thus, the report of the IPCC Working Group II on the impacts, adaptation, and vulnerabilities related to climate change, assesses with high confidence the increase in temperature over land regions

across all Africa and the reduction in precipitation over North Africa and the southwestern parts of South Africa. In addition to the destruction of ecosystems, the stress on water availability, the risks to food production, and the impact on health, among others (IPCC , 2014). Thereby, adaptation strategies should be the main goal. To this end, Artur and Hilhorst (2012) suggest that "the successes and failures of climate change adaptation depend more on societal perceptions and the sensitivity of institutions than on the availability of appropriate policies, technologies or funding, notwithstanding the importance of these last three aspects" (Artur & Hilhorst, 2012, p. 529). This argument emphasizes the importance of social research in the climate crisis beyond its scientific-technical component and, at the same time, reinforces the complaints regarding the insufficient attention that the topic of climate change is given in social science research (Henderson, Long, Berger, Russell, & Drewes, 2017).

Given this situation, Climate Change Education (CCE) is a promising approach for coping with this global problem, but it is not an easy solution considering the strong cultural resistance it has to face, as well as societal and psychological barriers such as identities, worldviews, values, or emotions (González-Gaudiano & Meira-Cartea, 2019). As Wi (2019) stated, to achieve mitigation and adaptation goals successfully "climate change education policy should focus not only on education but encourage the participation of the citizens and the government" (2019, p. 2), for which reason, "there is no "magic bullet" in climate change education and […] the effectiveness of policies differs from country to country" (2019, p. 12).

In the case of Mozambique, in the educational area there is an apparent lack of research on the understanding of climate change. For this reason, this exploratory study aims to present the first results on this population and compare findings with other research carried out in different geographical contexts. In addition, Mozambique is part of the Portuguese-Speaking African Countries' group (in Portuguese, Países Africanos de Lıngua Oficial Portuguesa or PALOP) along with Angola, Cape Verde, Guinea-Bissau, Sao Tome and Príncipe and Equatorial Guinea. This group has established a common collaboration framework that constitutes a favourable context for the consolidation of this type of research and the development of CCE in Africa.

Thus, the aim of this research is to understand how students in Mozambique address the issue of climate change from three angles: their knowledge, their beliefs, and their perceptions. The project is meant to be the first step towards the integration of CCE into the country's education. The Mozambican population —politicians, stakeholders, and citizenry—need to be aware of the issue in order to learn how to overcome their specific vulnerability and to be able to adapt to it efficiently by taking advantage of its strengths and weaknesses. As Chang and Pascua (2017) pointed out, research on CCE should focus on four main aspects: the knowledge, attitudes and behaviours of the students, as well as those of the teachers; the way the subject is taught; and the broader purpose of education. Thereby, the participants in this study are Mozambican secondary students who are likely to access higher education and therefore to become

an important part of their future society as politicians, stakeholders or/and active citizens.

The case of Mozambique

Africa is one of the most vulnerable regions of the planet to the impacts of climate change, first, due to its dependence on vital sectors such as agriculture or fishing in coastal regions, and second, due to the limited adaptability of its countries to cope with climate change hazards, mainly due to their socio-economic development (Brooks, Adger, & Kelly, 2005; Sokona & Denton, 2001). In the case of Mozambique, many significant events related to climate change have occurred since 1997, mostly droughts and floods (Cabral et al., 2017; Chikoore, Vermeulen, & Jury, 2015; Kienberger, 2012; Zacarias, 2019). In the foreseeable future, these hazards will have an important impact on several vital sectors of the country, such as the agro-alimentary system that will be affected by increasing temperatures, changes in precipitation, and salt-water intrusion (Gliessman, 2017) or the energy sector which is not only related to the population electricity demand, but also to the national development and economy, since Mozambique exports electricity to other African countries (Uamusse, Aljaradin, Nilsson, & Persson, 2017).

As far as education is concerned, Mozambique has a young education system that was introduced after the country declared its independence from Portugal in 1975, in what "was the first guarantee of the democratization of education" (Gerdes, 1981, p. 460). At this time, almost 90% of the population was considered illiterate (Sheldon, Sheldon, 1998), primary education was established, and scientific knowledge was chosen to be the basis of a new society based on unity and equality. This new system of education aimed to be permanent and progressive, meaning that learning should be continuous, but not restricted to the context of the classroom. Students were not expected to have an uninterrupted theoretical education from kindergarten to university, but rather to complete different educational "stages", and at the end of each stage to gain practical experience by working (Gerdes, 1981).

Nowadays, as Adams, Luitel, Afonso, and Taylor (2008) indicated, science education in Mozambique is based on positivist and post-positivist approaches grounded in Western views of science education, which exclude local epistemologies, beliefs and discourses. As the authors reported, this kind of approach hinders developing contextualized curricular materials and connecting knowledge to daily habits and traditions. Furthermore, as many other post-colonial states in Africa, Mozambique adopted the former colonial language as the only official language. Mandatory education practices in foreign languages have become a factor in the assimilation of foreign worldviews, far from what Artur and Hilhorst (2012) suggested Mozambique needed in order for the citizens to be able to participate in the social negotiation necessary to develop and implement adaptation policies based on social equality and local characteristics.

Background

Three studies were found that explored aspects related to the knowledge or perception about climate change among African students: two papers in South Africa (Lekgeu & Davis, 2017; Nkoana, 2020) and one in Nigeria (Eze, 2020). Furthermore, a review of the international available research in related areas would allow us to provide a broader background on the knowledge and perceptions of climate change among adolescent students.

Several shared misconceptions about climate change have been reported among secondary school students from all around the world. Lekgeu and Davis (2017) found some misconceptions among South African students regarding climate change occurrence, ozone layer depletion, or the greenhouse effect. Chang, Pascua, and Ess (2018) also corroborated these misunderstandings in Singapore students. They also explored false associations of climate change with phenomena such as earthquakes, tsunamis, acid rain, and skin cancer, and confirmed the resilience of some of these false beliefs (Chang et al., 2018). Similar findings have been reported by other studies. For instance, Yazdanparast et al. (2013) conducted a study with Iranian students and found a similar prevalence of misconceptions regarding the consequences of climate change, such as the increase in skin cancer (Espejel Rodríguez & Flores Hernández, 2015; Oztas, Tanriverdi, & Oztas, 2014), or a higher frequency of earthquakes. Several misconceptions regarding the causes of climate change were also identified, such as the role of ozone depletion (Boyes, Chuckran, & Stanisstreet, 1993; Lin, 2017), acid rain as a cause or consequence of climate change (Chang & Pascua, 2016; García-Rodeja & Lima de Oliveira, 2012), or false beliefs related to rubbish in the rivers or litter in the streets (Boyes, Stanisstreet, & Yongling, 2008).

Another significant element is risk perception, which Mead et al. (2012) defined as "the belief that one is vulnerable to a disease or risk factor [and so, it is] a significant predictor of self-protective behaviour" (Mead et al., 2012, p. 33). Thus, these authors suggested a connection between perceiving risks associated with climate change and modifying behaviours aimed at fostering mitigation and adaptation actions. Likewise, Smith and Mayer (2018) found that "in general, risk perception and trust […] has a positive effect on climate change behaviours and support for climate change policies at the individual-level" (2018, p. 149). They also suggested that individuals who believe in climate change threats are more likely to act or support mitigation and adaptation policies. Similarly, Stevenson, Peterson, Bondell, Moore, and Carrier (2014) examined two interconnected factors that could interfere with climate change risk perception: knowledge about climate change on the one hand, and worldviews on the other hand, specifically hierarchical-individualists vs. egalitarian-communitarians. The authors did not find strong relations between climate change knowledge and risk perception in adolescents. Nor do worldviews, which in teenagers are still forming, seem to have the same impact on risk perception as they do in adults.

Furthermore, Özdem et al. (2014) found in their research that only 41% of the students enrolled considered they were, or would be, personally affected by climate change, close to the proportion of those who declared to be unsure (40%) of its threat and

similar to the results offered by Lekgeu and Davis (2017). The authors also explored the students' perception of who takes responsibility for tackling climate change. Almost 30% of the respondents indicated environmental organizations as the main responsible for taking action, whereas only 8% identified the business/industry areas as having the most responsibility. The authors stated that there is a "students' tendency to understand the impacts of climate change at global rather than local scale" (Özdem et al., 2014, p. 306) which could interfere in the assessment of climate change risk.

Purpose of the research

As stated, our research interest concerned students' knowledge of climate change in Mozambique and the manner in which they perceive the phenomenon. It is an exploratory and descriptive study in which the main objective was to assess the students' climate change knowledge levels and their perceptions of risk and responsibility relating to this phenomenon. Once these factors were assessed, our aim was to understand the relationship between them in order to provide useful information for planning CCE in Mozambique. We also explore the beliefs about the occurrence of climate change and its anthropogenic cause. Specifically, the following research questions were addressed:

1. What do eleventh grade students in Mozambique know about climate change? and,

2. Do higher levels of climate change knowledge predict a better understanding and perception of climate change?

Method

This study used an exploratory research design approach. A survey was employed to investigate eleventh grade students' general knowledge and perceptions of climate change in Pemba city. The absence of studies on this type of population in Mozambique, together with the difficulty of carrying out research on this continent (Carvalho et al., 2017) are the main reasons for proposing an exploratory study.

Sample

Eleventh graders from two public schools from the urban centre in Pemba (North Mozambique) participated in the survey in the spring of 2019. One of the researcher and Mozambican co-author visited the schools and gave similar instructions to all students. 256 Mozambicans students participated, out of which 136 were girls and 116 were boys (N_{lost}=4). Dattalo (2008) indicates that small samples (fewer than 150 cases) are justifiable for exploratory studies, so this sample size is considered large enough to carry out this research.

The authorization to carry out the survey was signed by the pertinent Province Pedagogy Department, and the students were informed of the voluntary nature of their participation and the confidentiality in the treatment of the data[1].

Instrument development

The instrument employed was developed by the Resclima project to assess aspects regarding climate change comprehension and representation among college students (Meira-Cartea, Gutiérrez-Pérez, Arto-Blanco, & Escoz-Roldán, 2018). The knowledge section included items relating concepts presented by the National Oceanic and Atmospheric Administration and the American Association for the Advancement of Science in the document "The essential principles of climate literacy" (NOAA , 2009) as well as instruments developed by Boyes et al. (2008) and Liarakou, Athanasiadis, and Gavrilakis (2011). It also comprised items (11 out of 32) related to alternative conceptions explored in other studies (Chang et al., 2018; Lin, 2017). For the perception section we followed Maibach, Roser-Renouf, and Leiserowitz (2009) instrument. All statements in the questionnaire were translated from Spanish into Portuguese. Our instrument included background variables (gender and age) and was divided into the following three sections:

1. The climate change knowledge section included 32 items related to several areas of climate change: physical-chemical processes, consequences, causes, responses, and misconceptions. The items and the format of the answers encompassed two of the four principles that the United States Global Warming Research Program (NOAA , 2009) established as essential for a climate literate person: "Understands the essential principles of Earth's climate system [and] Knows how to assess scientifically credible information about climate" (NOAA , 2009, p. 4). The items are presented as declarative statements, and participants had to indicate what extent of certainty they attributed to each statement -totally true, likely true, likely false, totally false-. We decided not to include a mid-point option in order to avoid evasive responses (Croasmun & Ostrom, 2011). Following Johari et al. (2011), all items were assigned values of difficulty index higher than 0.3 -except four items that are related to four broad misconceptions- meaning these statements had an acceptable degree of difficulty in terms of the participants' understanding of the questionnaire. Reliability test offered a value of Cronbach's alpha of 0,690.
2. The climate change occurrence section included three items that explore beliefs about the occurrence and anthropogenic causes of climate change.

[1] In Mozambique, school principals and their class coordinators have the responsibility to oversee all the interests of underage students, as well as social and pedagogical aspects, as students of the school, and are within the school grounds. In turn, the guardians transmit the information and events to the students' parents, in a meeting called school councils, which usually takes place once a month.

3. The responsibility and risk perception section included four items with response options ranging from one (minimum) to ten (maximum). The items inquired about national perception and self-perception in both topics (α =0.513).

Table 1. Categorization established to analyse climate change knowledge levels according to mean values according to scores obtained by summing all 32 items in a 100 scale. Quartile distribution by total and by gender.

	Mean	Median	SD	Percentiles (Knowledge levels)		
				25 Low	50 Medium	75 High
Female	63.26	64.06	6.88	58.59	64.06	67.96
Male	62.28	63.28	6.81	58.59	63.28	66.40
Total	62.82	63.28	6.94	58.59	63.28	67.18

Note: SD = Standard deviation. Maximum score = 100.

Data analysis

The proportion of missing data points in the 39 variables analysed was slightly greater than 5% (5.38%). We used a scale from one to four in the first 32 items regarding knowledge about climate change. Variables were coded as one for an erroneous response and four for a completely correct response, considering that all statements were either true or false. We established two categories for the assessment of knowledge levels: the first according to mean values by item, and the second according to total scores in the 32 items, based on their quartile's distribution: Q1 as low knowledge level, Q2 as medium and Q3 as high.

To properly conduct the contrast test chi-square comparing the results from the risk and responsibility perception section, we established five categories by adding responses as following: low [1, 2], medium-low [3, 4], medium [5, 6], medium-high [7, 8] and high [9, 10].

Following Luepsen (2018), we also performed a variance analysis test (ANOVA) to explore whether there is a relationship between the total knowledge score, beliefs, and perceptions. In order to contrast some of the categorical variables we also used chisquare analysis.

Results and discussion

Climate change knowledge

General results from mean scores suggest a medium level of climate change knowledge (Tables 1 and 2). ANOVA indicates that there are no statistical differences between females and males regarding their knowledge.

The detailed results by item –attached in the supplemental online materials– show confusions of the type described in the introduction, thus corroborating the persistence of alternative conceptions (Yazdanparast et al., 2013) widespread in different countries and cultures worldwide. These misconceptions are related to:

a. Confusion between the natural greenhouse effect and the enhanced greenhouse effect due to human activities (Chang et al., 2018; Lekgeu & Davis, 2017). Four items explore this misunderstanding: 11,214 and 31. Even though most participants responded correctly to statements 1 and 12, they gave incorrect answers to statements 14 and 31.

b. The erroneous relation between ozone layer depletion and climate change (Boyes et al., 1993; Espejel Rodríguez & Flores Hernández, 2015; Oztas et al., 2014). Four items explore this misconception: 4, 6, 16, and 27. Most of the participants obtained a low level of knowledge in all these items.

c. The relation between any environmental disaster, such as earthquakes or acid rain, and climate change (Chang & Pascua, 2016, García-Rodeja & Lima de Oliveira, 2012). This misconception was explored by items 7 and 15, in which participants obtained low scores. This answer pattern seems to indicate that students identify climate change as an environmental problem, but the lack of knowledge or understanding about it makes them relate it to other environmental problems (Barros & Pinheiro, 2013) such as earthquakes or acid rain, in this study, or rubbish and nuclear waste in others (Boyes et al., 2008).

Table 2. Percentages of Climate Change Knowledge levels related to the total score and by gender.

Climate change knowledge	Total (%)	Female (%)	Male (%)	Sig.
Low	27.40	26.50	28.40	0.610
Medium	44.80	40.40	50.00	0.496
High	27.80	33.10	21.60	0.700

Note: Sig = significance (ANOVA), $\alpha > 0.05$. Chi-square sig. = 0.113.

International literature suggests that these misconceptions seem to be perpetuated by either biased explanations of textbooks (Reinfried, Aeschbacher, & Rottermann, 2012) or information received through the media (Meira-Cartea, 2016), and are reinforced in everyday interactions. We will take theses international findings as a base to our discussion considering the influence of Western views of education in Africa (Adams et al., 2008); the lack of knowledge about these educational aspects in Mozambique; in addition to the public communication on climate change in Mozambique that not address its scientific understanding (Artur & Hilhorst, 2012).

Anthropogenic climate change occurrence

We used three items to explore the beliefs about climate change occurrence: the first item explored the belief in its occurrence (Table 3); the second item sought to establish the participants' certainty about the previous response (Table 4), and the third item questioned about the causes of climate change (Table 5). The outcomes are presented in the following tables.

The results show that 10.2% of the students who participated in the study do not believe in its occurrence (Table 3). Additionally, more than 50% of the students who

declared that they believed in the occurrence of climate change expressed doubts about their beliefs (Table 4). A similar tendency was found regarding the causes of climate change (Table 5), where 63.8% of the students who stated their belief in its occurrence thought it is happening due to natural causes. These outcomes are consistent with the results obtained in item 18, which stated: climate change is the result of natural climatic variability, and which seven out of ten participants declared was true or likely true. These results can be explained by the conclusions of Artur and Hilhorst (2012), who point out that the everyday governmental and religious discourse on climate change in Mozambique bears little relation to its scientific understanding and is mainly directed towards maintaining social order, using manners of communicating the phenomenon that avoid creating awareness of its anthropogenic origin.

Table 3. Outcomes obtained in item 33: Do you believe climate change is happening?.

	Climate change occurrence		
	Yes	No	$\sum$
Students	219	25	244
Percentages	89.75%	10.25%	100%

Note. $N = 256$, $N_{lost} = 12$.

Table 4. Cross-tabulation of climate change occurrence responses and certainty about the response.

		Certainty in the previous response				
		Not sure	Hardly sure	Quite sure	Sure	Total
Climate change is happening	Yes	36	76	41	55	208
	No	7	8	1	8	24
Total		43	84	42	63	232

Note: Item 33. *Do you believe climate change is happening?* Item 34. *To what extent are you sure of your answer to the previous question?* $N = 256$. $N_{lost} = 24$.

Table 5. Cross-tabulation of climate change occurrence and causes of climate change.

		Climate change is caused by				
		Only natural causes	Mainly natural causes	Mainly human causes	Only human causes	Total
Climate change is happening	Yes	66	70	63	14	213
	No	10	8	5	2	25
Total		76	78	68	16	238

Note: Item 33. *Do you believe climate change is happening?* Item 34. *If you believe climate change is happening, do you think it is caused by … ?* $N = 256$, $N_{lost} = 18$.

Additionally, we did not find any relation between the belief in climate change occurrence and knowledge, nor other perceptions explored, in contrast to the findings of Smith and Mayer (2018), who also suggested that the belief in the occurrence of climate change is an important element to address in order to promote effective interventions in CCE. Nevertheless, the purpose of this exploratory study was to provide useful results for the design of educational strategies, in line with other studies that stress the importance of the belief in climate change occurrence, and the fact that,

based on this belief, some communication and educational strategies are more effective than others (Maibach et al., 2009).

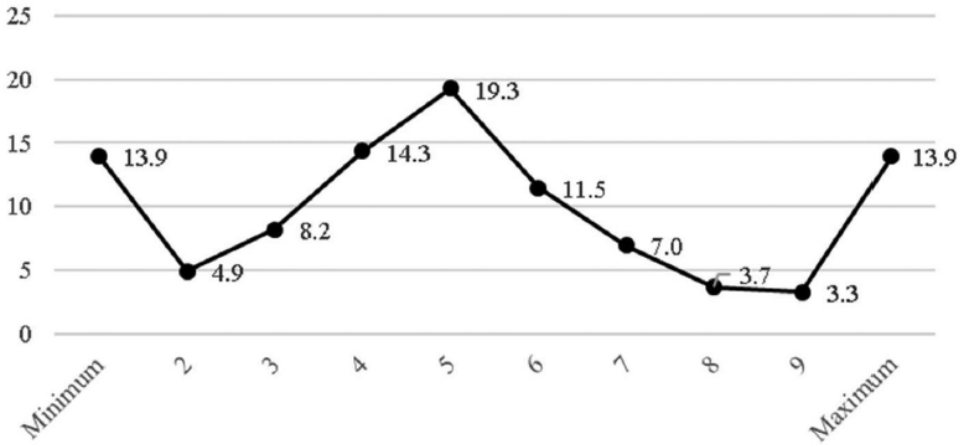

Figure 1. Distribution of percentages in the responses to item 36: *Assess from one (minimum) to ten (maximum) the responsibility of Mozambique in the causes of climate change.*

Perceptions of responsibility about climate change

Regarding the perception of responsibility concerning the global problem, the results from the national and individual assessments are shown in Figures 1 and 2 respectively. Following the figures, a cross-tabulation shows the percentages related to the cross-data of knowledge and responsibility perception (Tables 6 and 7). There is no statistical significance between these two aspects, neither on a national nor on an individual level. These results could be explained by the fact that the social actors in Mozambique do not employ the emergency discourse prevailing internationally around climate change (Artur & Hilhorst, 2012), which could produce a non-reflective answer.

Mozambican students are distributed in three areas across the responses range: more than 40% identified a low or medium-low responsibility at the national level; over 30% a medium and medium-high responsibility, and another 30% declared a high responsibility level (Figure 1). Interestingly, these results do not seem to be coherent with the reality of the country, considering than Mozambique is one of the minor carbon-emitter countries (Ritchie & Roser, 2017). Similar results are also described when the students are questioned about their self-responsibility in the phenomenon; although most assessed a lower self-responsibility, over 20% declared a high responsibility level (Figure 2). These answer patterns that are not coherent with reality may be due to a social desirability bias effect, that is, answering questions in a way that will be viewed favourably by the interviewer or others.

Perceptions of climate change risk

As in the previous section, the results from the national and personal assessment of risk perception are shown in Figures 3 and 4 respectively. Following each figure, the cross-tabulation offers the percentages related to the cross-data of knowledge and risk perception (table 8 and 9). There is no statistical significance between knowledge and risk perception levels, on a national nor on an individual level. As we have stated, there

is a lack of emergency of the institutional discourse around the consequences of climate change (Artur & Hilhorst, 2012), which could influence the assessment of risk, as well as some behaviours factors that could influence risk perceptions through psychological bias (Patt & Schröter, 2008), which might need a deeper research.

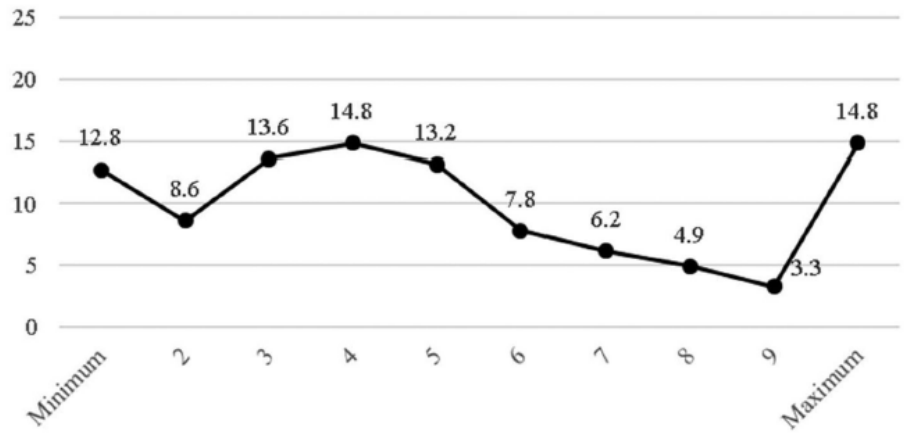

Figure 2. Distribution of percentages in the responses to item 37: *Assess from one (minimum) to ten (maximum) your responsibility in climate change causes.*

Table 6. Cross-tabulation of responsibility levels of Mozambique in climate change occurrence and climate change knowledge levels.

Responsibility perception		Climate Change Knowledge			
	Total (%)	High (%)	Medium (%)	Low (%)	Sig.
High	17.20	18.30	18.20	14.30	0.980
Medium-High	10.70	9.90	10.00	12.70	
Medium	33.70	33.80	29.10	30.20	
Medium-Low	22.50	22.50	23.60	20.60	
Low	18.90	15.50	19.10	22.20	

Note: sig. = significance Chi-square contrast analysis, $\alpha > 0.05$.

Table 7. Cross-tabulation of personal responsibility levels in climate change occurrence and climate change knowledge levels.

Self-responsibility perception		Climate Change Knowledge Levels			
	Total (%)	High (%)	Medium (%)	Low (%)	Sig.
High	18.10	24.30	14.00	18.20	0.545
Medium-High	11.10	5.70	14.00	12.10	
Medium	21.00	18.60	24.30	18.20	
Medium-Low	28.40	27.10	29.00	28.80	
Low	21.40	24.30	18.70	22.70	

Note: sig. = significance. Chi-square contrast analysis, $\alpha > 0.05$

The ability to properly perceive climate change risk is a necessary skill for people to engage in mitigation and adaptation strategies and policies. It also allows them to realize their vulnerability in the face of extreme weather events and their consequences (Smith & Mayer, 2018). Thus, accurate perception of climate change risk is an important predictor of self-protective behaviour (Mead et al., 2012). As we have already explained, Mozambique is one of the most threatened countries in Africa and in the world (Cabral et al., 2017). Nonetheless, almost 30% of the Mozambican students interviewed declared a low or a medium-low risk in their country, and another 30% indicated a medium or medium-high risk, meaning than just over 30% answered correctly by stating that Mozambique has a high risk in the face of climate change

(Figure 3). On a personal level (Figure 4), the results are similar. High and medium-high risk perception percentages maintain their respective values, whereas low and medium-low risk perception increases by around 5%. Our analysis did not offer any relation between knowledge levels and risk perception levels (Tables 8 and 9); therefore, contrary to what Stevenson et al. (2014) suggested, we could not support that better (scientific) knowledge about climate change results in a more accurate perception of its risks.

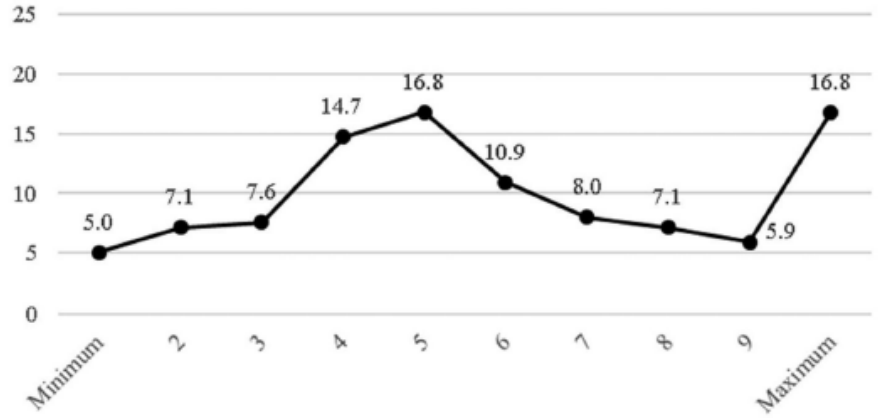

Figure 3. Percentage responses distribution to item 38: *Indicate from one (minimum) to ten (maximum) how do you think climate change could affect to Mozambique.*

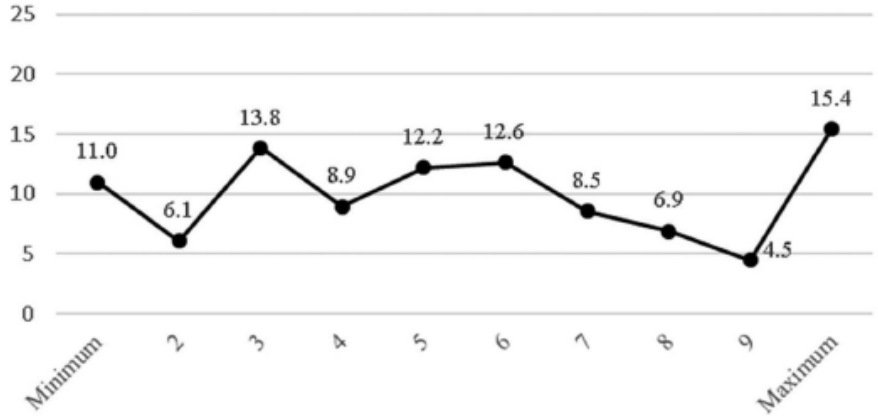

Figure 4. Distribution of percentages in the responses to item 39: *Indicate from one (minimum) to ten (maximum) how do you think climate change could affect you.*

Table 8 . Cross-tabulation of climate change risk levels perception in Mozambique and climate change knowledge levels.

Risk perception		Climate Change Knowledge			
	Total (%)	High (%)	Medium (%)	Low (%)	Sig.
High	22.70	24.30	10.40	25.00	0.686
Medium-High	15.10	11.40	16.70	16.70	
Medium	27.70	24.30	33.30	21.70	
Medium-Low	22.30	25.70	20.40	21.70	
Low	12.20	14.30	9.30	15.00	

Note: sig. = significance. Chi-square contrast analysis, $\alpha > 0.05$.

Table 9. Cross-tabulation of personal climate change risk levels perception and climate change knowledge.

Self-risk perception		Climate Change Knowledge			
	Total (%)	High (%)	Medium (%)	Low (%)	Sig.
High	19.90	24.60	16.10	21.50	0.631
Medium-High	15.40	13.00	19.60	10.80	
Medium	24.80	21.70	27.70	23.10	
Medium-Low	22.80	23.20	22.30	23.10	
Low	17.10	17.40	14.30	21.50	

Note: sig. = significance. Chi-square contrast analysis, $\alpha > 0.05$.

Limitations, implications and recommendations

This study was exploratory and descriptive in nature, so the findings did not intent to be confirmatory. The socio-economic complexity of Mozambique and its high vulnerability to climate change hazards demand more studies in education and social research in this country in order to get a better understanding of these, and future, findings. This dialogue among different actors of the social sciences research arena is already being a demand of social and educational researchers (Henderson et al., 2017) in order to design policies and educational proposals related to CCE that give consideration to the social, cultural, economic, and demographic particularities of each country. In this sense, studies such as Eze (2020), Lekgeu and Davis (2017) and Nkoana (2020), where gender, information access, sociodemographic characteristics or risk perceptions, among other variables are taken into account, suggest an adequate way of researching, despite the fact of the limited scientific production in Africa. In this sense, universities collaborations are a demand in order to contextualized futures studies in African countries and reduce Western bias.

Furthermore, our findings suggest the need to pay special attention to the need for reinforcing education and communication on climate change by promoting scientific consensus about climate change occurrence and its human causes, linking local extreme events with the global phenomenon and supporting adaptative strategies in order to face future events (more extremes and frequent). Students from Pemba declared a low risk and responsibility perception which could inhibit necessary changes to cope with climate change hazards (Patt & Schröter, 2008). It seems that promoting scientific knowledge is not a key factor to deal with, at least from positivist Western views of education, that have had limited success in Western countries and even worse outcomes in other latitudes by excluding local epistemologies, beliefs and discourses from local communities (Adams et al., 2008) and hindering citizen participation in social negotiations (Artur & Hilhorst, 2012).

Conclusion

Our findings follow the trend suggested by the literature. Regarding the research questions, most of our participants stated that they had limited knowledge about climate change. Their representation about climate change consists of some accurate knowledge coexisting with common misconceptions, but this knowledge seems not to have a relevant influence on the perception of risk and responsibility in the global problem. At the same time, the perception of risk and responsibility seems to be

inconsistent with the reality of what climate change studies have recorded and predicted for Mozambique. This conclusion does not mean that science education is not necessary but rather that, as a core educational topic by itself, climate change has already exceeded its conceptual scientific dimension. Its emergence requires a holistic and humanistic vision that encompasses the multiple interrelations between this phenomenon and the many expressions of human development, culture, and progress.

It seems that the positivist paradigm that prevails in the Mozambican education system (Adams et al., 2008) is having limited success as an educational response to climate change. These same conclusions were defended, at an international level, by other authors (Busch, Henderson, & Stevenson, 2019; González-Gaudiano & Meira-Cartea, 2019) who called for a contextualized and critical education in the face of the climate crisis considering that "socio-economic context […] shapes the awareness and perception of learners to long-term environmental risks" (Nkoana, 2020, p. 12). Likewise, Adams et al. (2008) pointed out the inappropriateness of assimilating Westernised worldviews in other educational contexts, which exclude local epistemologies, beliefs and discourses, and at the same time perpetuate and exacerbate the planet's North-South inequalities.

This exploratory study aims to be an initial step in developing the basis for CCE in the Mozambican context. The results cannot be generalized, but the findings allow us to approach the reality of Mozambican students in relation to CCE. Future research in the direction indicated by Chang and Pascua (2017), with Mozambican teachers, concerning the way climate issues are taught, and curriculum goals would allow us to develop a more accurate vision of this educational reality.

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