Leal Fihlo, W, Yayeh Ayal, D, Wall, T, Shiel, C, Paco, A, Pace, P, Mifsud, M, Lange Salvia, A, Skouloudis, A, Moggi, S, LeVasseur, T, Vinuesa Antonio, G, M Azeiteiro, U, Ioannis, N and Kovaleva, M

An Assessment of Attitudes and Perceptions of International University Students on Climate Change

An Assessment of Attitudes and Perceptions of International University Students on Climate Change

Author links open overlay panelWalter Leal Filho [a], Desalegn Yayeh Ayal [b], Tony Wall [c], Chris Shiel [d], Arminda Paco [e], Paul Pace [f], Mark Mifsud [g], Amanda Lange Salvia [h], Antonis Skouloudis [i], Sara Moggi [j], Todd LeVasseur [k], Garcia Vinuesa Antonio [l], Ulisses M Azeiteiro [m], Nikolaou Ioannis [n], Marina Kovaleva [o]

[a] Research and Transfer Centre “Sustainable Development and Climate Change Management”, Hamburg University of Applied Sciences, Ulmenliet 20, D-21033 Hamburg, Germany

[b] Center for Food Security Studies, College of Development Studies, Addis Ababa University

[c] Liverpool Business School, Liverpool John Moores University, Liverpool, United Kingdom GB

[d] Department of Life & Environmental Science, Faculty of Science & Technology, Bournemouth University, Poole, UK

[e] Universidade da Beira Interior, NECE-UBI (Research Centre for Business Sciences), Rua Marquês D'Ávila e Bolama 6201-001 Covilhã

[f] Centre for Environmental Education and Research, University of Malta, Msida 2080, MSD, Malta

[g] Centre for Environmental Education and Research, University of Malta, Msida 2080, MSD, Malta

[h] Graduate Program in Civil and Environmental Engineering, University of Passo Fundo, Campus I-BR 285, São José, Passo Fundo, RS 99052-900, Brazil

[i] Department of Environment, University of the Aegean, Mytilini, Greece

[j] University of Verona, Department of Business Administration, via Cantarane 24 - 37129 Verona, Italy

[k] College of Charleston, Sustainability Literacy Institute, Charleston, US

[l] SEPA-interest Research Group in Social Pedagogy and Environmental Education. Universidade de Santiago de Compostela

[m]

Department of Biology and CESAM - Centre for Environmental and Marine Studies, University of Aveiro, Aveiro, Portugal

n

Democritus University of Thrace, Department of Environmental Engineering, Faculty of Engineering, Greece

o

European School of Sustainability Science and Research, Hamburg. University of Applied Sciences, Ulmenliet 20, 21033 Hamburg, Germany

Abstract

Universities have an unrivaled potential to educate students on climate change issues and to actively engage them in climate affairs, both as citizens and influencers of future professions. Despite this potential and the many advantages of university student engagement in climate change, less emphasis has been given to understanding their attitude and perceptions towards climate change, in a way that may guide changes in the curriculum and teaching practices. Based on the need to address the existing literature gap, this article assesses university studentś attitudes and perceptions toward climate change at the international level. This study comprises a survey of a sample of universities across the world and uses statistical analysis to identify the most important trends across geographical locations of the universities. The study revealed that university students are aware of climate change and associated risks. The university students believe that climate change education is a means to shape their attitude and equip them with relevant skills and knowledge so as to influent others. The awareness of university students is inextricably linked to their field of study and participation in various climate change events. Furthermore, the student's knowledge of climate change risks varies across gender, age, and academic education. The study provides recommended universities to include climate change issues in their curricular and extracurricular programs so as to prepare future professionals to cope with the far reaching challenges of a climate change.

Keywords

Attitude

climate change

curriculum

education

perceptions

students

universities

1. Universities and climate change

Climate change undermines the achievement of global sustainable development goals, and hence it requires the engagement of various actors for immediate solutions. The role of universities in contributing generally to sustainable development and in particular to climate change adaptation and mitigation is well documented. Sustainable development has become a significant field of research that describes how universities should contribute and fulfil their responsibilities (Barth and Rieckman, 2013). There is a widespread view that universities have a key role to play in carbon reduction by reducing their own greenhouse gas emissions through campus greening, in partnership with other local actors, (Godwell and Nompe, 2014), and raising community awareness through capacity building interventions (Shiel et al., 2015). The university campus is an entity that consumes a considerable amount of energy which further increases greenhouse gas emissions (Katzy et al., 2021, Cordero et

al., 2020, Leal Filho et al., 2015). Therefore, universities are ideal venues to serve as a living lab for the mitigation and adaptation efforts to the climate. Therefore, sensitizing university students with climate change could develop their confidence and knowledge to make the right choices on energy consumption so that they can contribute to the nurturing of ideal climate in the best interest of the wider community (Cordero et al., 2020, Cotton et al., 2016).

For the purposes of this article, the term "climate change education" is used to refer to curricular contents deployed to increase awareness on climate change. The universities' climate change education programme is vital for equipping students with basic and advanced skills and knowledge and for influencing their behaviour and lifestyle, resulting in actions to adapt and mitigate climate change impacts throughout their lifetime that can also influence future generations (Choi et al., 2017, United Nations Educational, 2010, United Nations, 1992). Climate change education can also create a path for students to initiate climate change activism and work with various actors (Cordero et al., 2020). Despite the importance of climate change education in responding to the impacts of climate change, less attention has been given to systematically assessing the attitude, perceptions, and practices of students and the integration of the climate topic in the higher education institutions' curricula and co-curricular activities in a way that may guide changes in the curriculum and teaching practices. Therefore, there is a clear and pressing need to conduct this research for a better understanding of the perceptions of university students on climate change. The significance of this article lies in filling that literature gap and in highlighting the importance of climate education in higher education institutions.

Despite the increasing importance given to education for sustainable development (ESD), (see, for example, [11 (Vare and Scott, 2007) few researches refer specifically to climate change education. Universities have been identified as having a key role in educating students on the theoretical and practical aspects of the socio-economic and environmental impacts of climate change as well as mitigation and adaptation measures (Molthan-Hill et al., 2019, Leal Filho et al., 2019, Owen et al., 2013, Fussel and Klein, 2006, Füssel, 2005), but previous research reports lack fewer details on the topic. In line with this (Filho, 2010) emphasized, over a decade ago, that education about climate change should be the most significant priority. As he rightly pointed out, while sustainability education operates at the macro level, climate change education should be treated as an equally important matter at micro-level unit as both are interrelated, intertwined, and mutually reinforcing.

Here, it is argued that universities need to extend climate change education beyond the traditional technical subjects, emphasising the importance of opening up ways to foster a deeper understanding of climate change and ensuring that students have a broader and deeper understanding of the challenges.

2. Climate change and student involvement

Organisations such as the United Nations (UN) and United Nations Educational, Scientific and Cultural Organization (UNESCO) have been stressing the need for climate change education, and this is reflected in the ever-growing significance to young people (Körfgen et al., 2017, Kuthe et al., 2020). As argued by Akrofi et al. (Akrofi et al., 2019), increasing student awareness through education is crucial in fostering active participation to promote climate change actions at all levels of the community. Thus, universities need to inspire both students and staff to become involved with the challenges brought by climate change so that they become active agents, promoting research, developing solutions for climate change mitigation/adaptation, and even taking a leading role in the political field (Molthan-Hill et al., 2019). Efforts should be made to develop educational programmes that are designed to increase climate literacy and to empower students to move towards sustainability (Burkholder et al., 2017).

Student involvement in climate change adaptation and mitigation is critical [e.g., 23-29]. (Akrofi et al., 2019) found that 'students' involvement in climate change-related workshops and campaigns significantly influenced their knowledge levels. The same study further indicated that students' attitudes and behaviours are dependent on their level of awareness and knowledge about climate change issues. This in turn implies that their cognitive repertoire depend on their level of participation in climate change courses, workshops and campaigns, membership in environmentalist groups, and access to climate information. However, university students' perceptions of climate change are not a settled research agenda (e.g., see 23,25,26]. Their perceptions of climate change vary across disciplines in which they are enrolled (Haq and Ahmed, 2020), personal experiences and exposure to climate-related risks, access to the internet and international media (Ayanlade and Jegede, 2016, Freije et al., 2017, Mugambiwa and Dzomonda, 2018, Ojomo et al., 2015, Agboola and

Emmanuel, 2016, Beck et al., 2013, Myers et al., 2012). In general, studies highlighted that university students' attitudes and perceptions of climate change as well as its causes and its impacts are shaped by formal and informal education.

Therefore, universities need to broaden their educational efforts to ensure that graduates understand the commonly accepted scientific concept of climate change and its causes in order to become part of the solutions (Wachholz et al., 2014). Students' involvement and participation in climate change adaptation and mitigation activities are crucial to address the direct and indirect impacts of climate change. However, since students have not reached the desired level of consciousness, educational curriculums on climate change need to be designed to positively affect students' perceptions about the environment, and their courses should improve university students' scientific skills and knowledge that shape their attitudes and beliefs (Shaman and Knowlton, 2017). The research question which guided the study is: what are the perceptions and attitudes of university students around the world about climate change? The study was designed to identify studentś opinions and attitudes with the intent that new insights gained from the research could be helpful to the design and redesign of curricular contents on climate change education.

In sum, whilst evidence highlights differences in the students' perceptions and understanding of climate change across disciplines, there is a gap in understanding students' perceptions and attitudes towards climate change in a way that would guide changes in the curriculum and teaching practices. This is partly based on the fact that studentś perceptions on climate change are seldom considered in curriculum design, or as part of evaluation frameworks. Table 1 provides an overview of some studies on university students and climate change.

Table 1. Examples of studies on increasing awareness of climate change at universities

Initiative	Country	Literature
Studentś attitudes and perceptions of climate change	Portugal, Mexico, and Mozambique	Morgado et al. (Morgado et al., 2017)
Teaching about climate change to students in health-related disciplines	China	Yang et al. (Yang et al., 2018)Maxwell and Blashki (Maxwell and Blashki, 2016)
Teaching on climate change and health education	Columbia	Shaman and Knowlton (Shaman and Knowlton, 2017)
Teaching about adaptation to climate change; knowledge for action	Montreal Canada	Lapaige and Essiembre (Lapaige and Essiembre, 2010)
Students' knowledge and perceptions about the health impact of climate change	Ethiopia	Nigatu et al. (Nigatu et al., 2014)
Students' attitude toward sustainability issues and climate change	Australia	Eagle et al. (Eagle et al., 2015)
Students' climate change awareness	Taiwan	Di Giusto et al. (Di Giusto et al., 2018)
Students' perceptions of climate change	Turkey	Bakaç (Bakaç, 2018)
Students understanding on climate	Australia	Pfautsch and Gray (Pfautsch and

Initiative	Country	Literature
change and sustainability		Gray, 2017)

These examples illustrate the a variety of works conducted so far leave much to be desired about the need to climate change education.

3. Methodology

The levels of knowledge, attitudes, perceptions, and engagement of university students in climate change were assessed by using an online administered questionnaire survey at the global level. The questionnaire was designed in such a way that the results could offer valuable insight to guide changes in curriculum development and teaching practices, using the existing literature and in consultation with the research team of the Inter-University Sustainable Development Research Programme (IUSDRP). IUSDRP is an academic network of 139 member universities interested in sustainable development research, and they involve over 700,000 students (please visit the website of the universities' sites for the details). Furthermore, the authors reviewed the survey questions to avoid redundancy and to ensure that all relevant issues were considered. The survey questionnaire included 21 questions and was pre-tested and adjusted based on the feedback from 10 experts in the areas of climate change and sustainability at different universities. The full questionnaire was also designed to collect general information and ensure that details were anonymous (Appendix A). According to the German law on the issue at hand, the study is exempted from ethical approval and informed consent from participants as study is based on questionnaire/survey.

The online survey was conducted from 16th September to 30th November 2020 using Survey Monkey (https://www.surveymonkey.com/). The survey was disseminated repeatedly via email, providing a web link with access to the online instrument (in English) to students attending universities within the Inter-University Sustainable Development Research Programme (IUSDRP). Participation was voluntary, and authors had no influence or control over who participated; hence, there was no self-selection bias. A total of 424 questionnaires were received from 41 countries around the world. The most represented region was Europe with 45.3% of the replies, followed by North America (14.9%), Africa (14.6%), Latin America and the Caribbean (12.5%), Asia and Pacific Region (7.8%), and Oceania (5%). Figure 1 shows the countries participating in the study.

1. Download : Download high-res image (215KB)
2. Download : Download full-size image

Figure 1. Countries from which questionnaires were returned. Source: Google maps

To adequately explore and provide an accurate view of the result of the possible differences and relationships between university students' attitudes and perceptions of climate change, the questionnaire survey participants were grouped into six categories according to the UN geoscheme in order to be able to perform the statistical analysis: Africa, Asia, and Pacific region, Europe, Latin America and the Caribbean, North America, and Oceania.

The Variance analysis (ANOVA) test and Bonferroni post-hoc test for multiple comparisons were conducted to explore statistical differences between scale variables whose mean values can be measured (CCCo, CCA,S and current engagement). Regression tests were also performed to further investigate the results. The t-student test was conducted to explore statistical differences by gender.

A Pearson Chi-square test was conducted for categorical variables (CCO and CCC), nevertheless, the results were not reliable because of the distribution of the sample (too many cells have an expected coof unt less than 5) so we decided to perform an ANOVA test. Despite these variables where categorical, the answerś format could fix as a scale from 1 to 5 in CCO and from 1 to 6 in CCC (see table 2). Pearson and Spearmańs correlation coefficients were measured to assess possible relationships between variables. We decided to conduct both tests to reinforce convergent results. Statistical reports are provided in SPSS web report format.

4. Results

This section describes the findings, which were explored in relation to climate change occurrence (CCO), knowledge about its causes (CCC), the concern about the problem (CCCo), climate change awareness through five items that result in the climate change awareness scale (CCA, α=.796) and climate change engagement.

4.1. Descriptive results on knowledge, beliefs, and concern about climate change

As depicted in Table 2, more than 88% of the participants indicated that the climate is definitely changing, while 10.4% felt the climate is probably changing. It seems clear that the majority of university students were certain about the changing climate. However, provided that climate change and its impending dangers are real, those doubtful university students should be convinced.

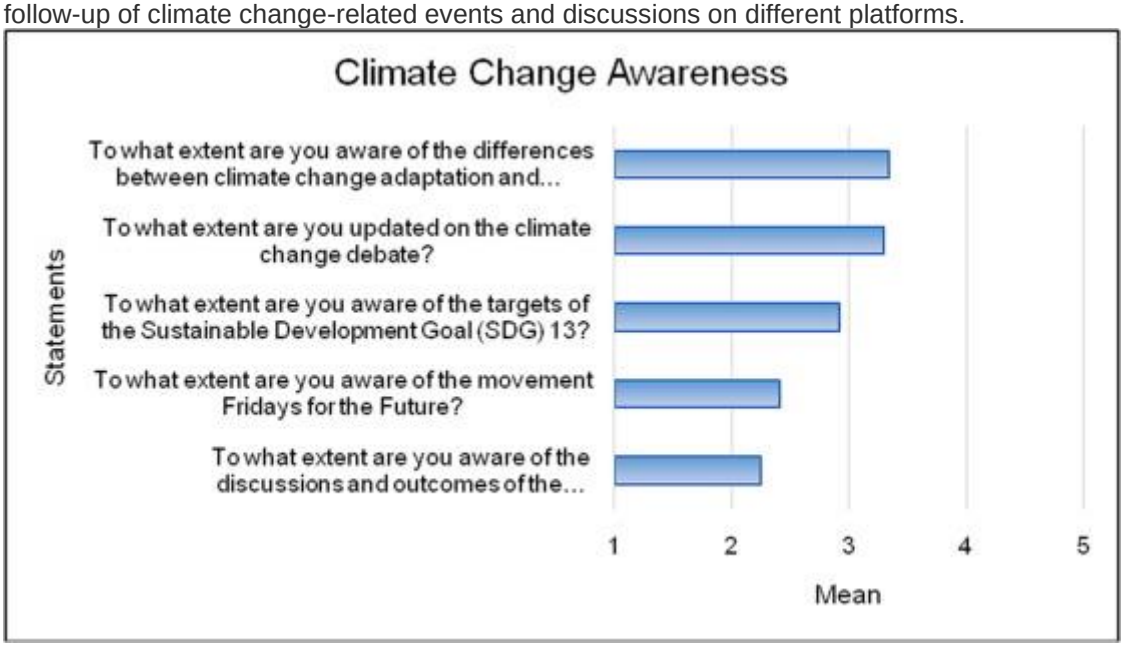
Table 2. General answers about climate change occurrence, causes, and concern

The climate is... (%)		**Climate change is... (%)**		**How worried are you about climate change? (%)**	
Definitely not changing	**.2%**	**Definitely not happening**	**.2%**	**Not at all worried**	**1%**
Probably not changing	.2%	Caused entirely by natural processes	.5%	Not very worried	4%
I am not sure	.9%	Caused mainly by natural processes	2.4%	Somewhat worried	18%
Probably changing	10.4%	Caused equally by human activity and natural processes	12.6%	Very worried	36%
Definitely changing	88.2%	Caused mainly by human activity	69.4%	Extremely worried	42%
		Caused entirely by human activity	14.9%		

Table 2 shows that 70% of the respondents rightly attributed the cause of climate change mainly to human activity. Nevertheless, about 13% of the respondents wrongly gave equal weight to the naturally induced and human-induced climate change. Likewise, 15% of the respondents believe that climate change is entirely caused by human activity. This is clear evidence that universities should revisit their curriculum and co-curricular activity to shape the attitude and perceptions of students on climate change causal attribution. This is because university students, regardless of their discipline, could play important roles in their university and within the community if they understand the real causes of climate change.

The results related to the respondents' concerns about climate change are shown in Table 2. Around 18%, 36%, and 42% of respondents were somewhat worried, very worried, and extremely worried about climate change-related risks, respectively. However, 4% of respondents were not worried about the adverse impacts of climate change. The variation of the level of concern could be connected with their exposure to climate change-related risk and weather information dissemination platform. However, in general, an extremely high level of worry or ignorance could demotivate university students in taking climate change adaptation and mitigation action. Extremely high levels of concern could undermine their actual capacity to respond to the adverse impacts of climate change, and an equal optimist attitude could hinder students from understanding the reality of climate change and its impact. The student's contributions to the direct climate change adaptations and mitigations within their university - as well as the implementation of measures in their lifetime within the community - depend on their balanced judgment of the causes of climate change.

The university students' awareness of climate change is the result of their direct exposure to climate-related risks, participation in climate change-related events, dialogue and news. As illustrated in Figure 2, more than 50% of the respondents were aware of the Sustainable Development Goal 13 target, are up-to-date in the climate change debate, and understand climate change adaptation and mitigation measures. On the contrary, the majority of the respondents were not aware of the discussions and outcomes of the Conferences of the Parties (COPs). Hence, the students' involvement is low in the follow-up of climate change-related events and discussions on different platforms.



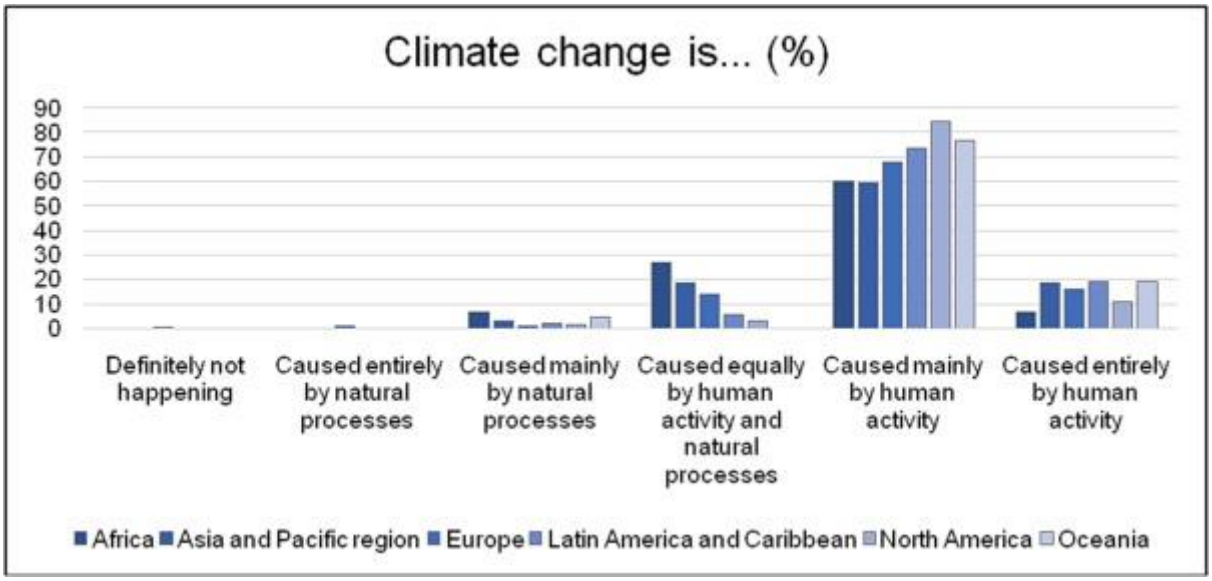
1. Download : Download high-res image (193KB)
2. Download : Download full-size image

Figure 2. Mean values of the five statements of Climate Change Awareness.

Correlation analysis results show that there is a positive relationship between the respondents' concern and their awareness of climate change (Spearman's rho .350*, p=.000; Pearson correlation .344, p = .000). The result suggests that the more concerned the university students are, the more aware they will be about climate change. The result suggests that universities could improve student awareness by organising climate change-related themes in discussion sessions and incorporating into in the curriculum and co-curricular activities.

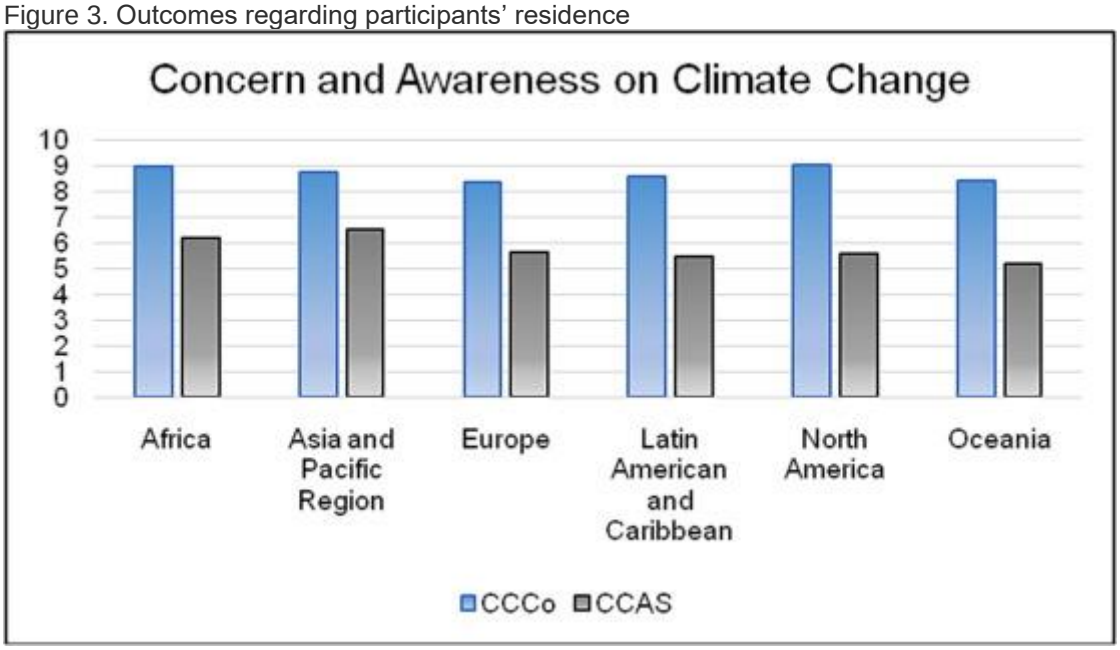
4.1.1. Regions

Figure 3 shows the mean values regarding CCC. Subsequently, CCCo and CCA are shown in Figure 4.



1. Download : Download high-res image (200KB)
2. Download : Download full-size image

Figure 3. Outcomes regarding participants' residence



1. Download : Download high-res image (182KB)
2. Download : Download full-size image

Figure 4. Outcomes regarding participants' residence. CCCo (Climate Change Concern) and CCAS (Climate Change Awareness Scale) averages. The results are presented on a scale of 10.

Fig. 3 illustrates that the majority of participants in all regions mainly attributed climate change to human activities. The university students' climate change causal attribution is in agreement with the literature (Ojomo et al., 2015, IPCC, 2021). However, a regional variation of climate change causal attributions was observed amongst the university students. For instance, the great majority (85%) of participants in North America, followed by Oceania (78%), attributed climate change mainly to human activity. Likewise, about 28% of participant university students in the African region associated climate change equally with human activity and natural processes. In the Asia and Pacific region, the proportion of university students stating that climate change is caused by human and natural factors was equal to those who attributed its cause entirely to human activity. There were no participants in

Oceania who linked climate change equally with human activity and natural processes. The university students' causal attribution variation to climate change could be due to variations in exposure to climate change education, climate risks, participation in co-curricular activities, media, dialogue and differing socio-cultural backgrounds (Ayanlade and Jegede, 2016, Agboola and Emmanuel, 2016). Climate change education could shape university students' causal attribution and perceptions. Consistent with our argument, Ochieng and Koske (Ochieng and Koske, 2013) reported that awareness is a means of strengthening individuals and the wider community.
The results suggest that there are no differences regarding climate change concerns and awareness. All participants declared similar levels of concern and awareness. Although ANOVA test offered differences regarding climate change concern (sig. = .013, F = 2.911, df = 5) Bonferroni post-hoc test only offered significance differences between Europe and North America (sig. = .034).

4.1.2. Socio-demographic and academic characteristics: gender, age, the current study, and area of study

Table 3 presents the regression model summary for the variables CCO, CCC, CCCo, and CCA regarding gender, age, current studies, and area of study as predictors. Table 4 shows the descriptive analysis of the socio-demographic and educational status of respondents about their awareness and concern about climate change.

Table 3. Regression model summary

Empty Cell	Empty Cell	**MODEL SUMMARY**				**ANOVA**				
Var	**Predictor**	**R**	**R Square**	**Adjusted R square**	**Std Error**	**Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**
CCO	**Gender**	.084	.007	.005	.403	.489	1	.489	3.005	.084
CCO	**Age**	.024	.001	-.002	.426	.044	1	.044	.242	.623
CCO	**Current Studies**	.086	.007	.005	.426	.573	1	.573	3.161	.076
CCO	**Study Area**	.108	.012	.009	.446	.753	1	.753	3.788	.053
CCC	**Gender**	**.114**	**.013**	**.011**	**.661**	**2.406**	**1**	**2.406**	**5.507**	**.019**
CCC	**Age**	**.139**	**.019**	**.017**	**.664**	**3.644**	**1**	**3.644**	**8.254**	**.004**
CCC	**Current Studies**	.014	.000	-.002	.670	.037	1	.037	.081	.776
CCC	**Study Area**	.095	.009	.006	.654	1.230	1	1.230	2.874	.091
CCCo	**Gender**	.066	.004	.002	.869	1.370	1	1.370	1.814	.179
CCCo	**Age**	.004	.000	-.002	.877	.005	1	.005	.006	.937
CCCo	**Current Studies**	**.096**	**.009**	**.007**	**.874**	**2.974**	**1**	**2.974**	**3.895**	**.049**

Empty Cell	Empty Cell	**MODEL SUMMARY**				**ANOVA**				
Var	**Predictor**	**R**	**R Square**	**Adjusted R square**	**Std Error**	**Sum of squares**	**df**	**Mean Square**	**F**	**Sig.**
CCCo	**Study Area**	**.113**	**.013**	**.010**	**.912**	**3.448**	**1**	**3.448**	**4.148**	**.043**
CCA	**Gender**	.089	.008	.006	4.790	75.822	1	75.822	3.305	.07
CCA	**Age**	**.196**	**.039**	**.036**	**4.721**	**370.505**	**1**	**370.505**	**16.625**	**.000**
CCA	**Current Studies**	**.314**	**.099**	**.097**	**4.569**	**946.704**	**1**	**946.704**	**45.356**	**.000**
CCA	**Study Area**	.027	.001	-.002	4.617	4.810	1	4.810	.226	.635

Note: CCCo (climate change concern); CCA (climate change awareness)

Table 4. Respondents' climate change concern and climate change awareness based on social-demographic and academic variables

Social-demographic and academic variables		**Climate change concern**		**Climate change awareness**	
Empty Cell	Empty Cell	**Mean**	**Sig,**	**Mean**	**Sig.**
Gender	Female	**8.67**	-	**5.54**	-
	Male	**8.48**		**5.90**	
Age Group	AG1 = 18 – 25	**8.60**	-	**5.39**	.009(AG1-AG2)
	AG2 = 26 – 35	**8.57**		**6.08**	
	AG3 = 36 – 50	**8.48**		**6.20**	
	AG4 = 51+	**9.16**		**7.08**	
Current studies level	L1 = Undergraduate	**8.51**	-	**5.17**	.000(L1-L2 & L1-L3)
	L2 = Postgraduate	**8.56**		**6.15**	
	L3 = Doctoral	**9.06**		**6.84**	
Area of study	A1 = Education	**9.06**	-	**6.95**	.000(A1-A4).038(A3-A4).000(A5-A4)
	A2 = Arts & Humanities	**8.80**		**5.66**	

Social-demographic and academic variables		Climate change concern		Climate change awareness	
Empty Cell	Empty Cell	**Mean**	**Sig,**	**Mean**	**Sig.**
	A3 = Social Sciences, Journalism & Information	**8.87**		**6.05**	
	A4 = Business, Administration & Law	**8.33**		**5.00**	
	A5 = Natural Sciences, Mathematics & Statistics	**8.64**		**6.17**	
	A6 = Engineering, Manufacturing &Construction	**8.26**		**6.10**	
	A7 = Agriculture, Veterinary & Wildlife Management	**8.47**		**5.07**	
	A8 = Health &Welfare	**9.33**		**6.28**	
	A9 = Biology &Environmental	**8.90**		**7.07**	

Note: ANOVA values: CC Concern: (Age) df = 3, F = .497, sig. = .684; (Current Studies) df = 2, F = 2.851, sig. = .059; (Area of study) df = 7, F = 2.354, sig. = .023; t-student values: CC Concern (Gender) t = -1.347, df = 418, sig = .179ANOVA values: CC Awareness: (Age) df = 3, F = 6.017, sig. = .001; (Current Studies) df = 2, F = 22.867, sig. = .000; (Area of study) df = 7, F = 5.586, sig. = .000; t-student values: CC Awareness (Gender) t = 1.818, df = 411, sig = .70

Results suggest that socio-demographic and academic characteristics could influence the variables analysed. Women tend to declare in greater percentages than men that human activity is the main cause of climate change. Women are more aware and concerned about climate change than their men counterparts (Chowdhury et al., 2021, McCright, 2010, Elke, 2010). This could be due to the fact that climate change affects women and men differently. For instance, women are 14 times more likely to die than men due to climate change related risks (Brody et al., 2008). Gender inequality is a major factor contributing to the increased vulnerability of women and girls in disaster situations, such as Hurricanes Mitch and Katrina and flooding in South and East Asia, that are being increasing linked to climate change. According to a recent report from the World Conservation Union/ Women's Environment and Development Organization (IUCN/WEDO), women and children are more likely to die than men during disasters (xxxx). Age also seems to influence climate change causes valuation, main differences appear between the aged group 18-25 and 36-50, where the latter tend to assess a higher percentage of activities as the mean causes of climate change.

Concern about climate change seems to be influenced by current studies and study areas (Table 3) nevertheless Bonferroni post hoc test does not support regression model results (Table 4). Regarding current studies, data suggest differences in levels of awareness and concerns about climate issues. Climate change awareness is the only variable that offered differences in both analyses (Table 3, Table 4). Age offered again differences between age group 18-25 and 36-50, where the latter indicated higher values on the CCA scale. The current study's level also seems to influence over awareness: undergraduate students tend to evaluate CCA lesser than post-graduate or PhD students. Finally, in relation to the areas of study, this is not an ordinal variable so we have focused on ANOVA test results (Table 4). It seems that the main differences are regarding Business, Administration & Law students that assessed in a minor grade their climate change awareness than Education, Social Sciences, Journalism & Information, and Natural Sciences, Mathematics & Statistics students.

Table 5 shows correlation results (Spearmańs rank correlation coefficient (rho) and Pearson coefficient). There are statistical differences when comparing the youngest participants (18 – 25 aged) with the others. Participants declared a greater awareness as their age increased. This conclusion is also supported by the Spearman correlation results, which indicate that there is a positive correlation (0.198) between age and awareness levels. Regarding study level, similar results were obtained as was expected, since a higher level of study is related to an older age. The correlation coefficient suggests a stronger relation when reaching a higher level of studies (0.311).

Table 5. Climate change awareness scale averages regarding age and current study level: Bonferroni post-hoc test results and correlations coefficients.

Age	**CCAS (X)**	**18 - 25**	**26 - 35**	**36 - 50**	**>51**
18 - 25	5.39	-	.009	-	-
26 - 35	6.08	.009	-	-	-
36 - 50	6.20	-	-	-	-
>51	7.08	-	-	-	-
	Correlation coefficient		**Significance**		
Spearmańs rho	.198*		.000		
Pearson	.196*		.000		
Study level	**CCAS (X)**	**Undergraduate**		**Post-graduate**	**Doctoral**
Undergraduate	**5.17**	-		.000	.000
Post-graduate	**6.15**	.000		-	-
Doctoral	**6.84**	.000		-	-
	Correlation coefficient			**Significance**	
Spearmańs rho	.311*			.000	
Pearson	.314*			.000	

* Correlation is significant at the 0.01 level (2-tailed). Correlation results details are provided in supplementary material.

4.1.3. Current and future engagement

Current and future climate change engagement was explored through two items. Current engagement was assessed by the statement ‘To what extent are you involved in the climate change movement?’. To explore possible relations, the Spearmańs rank correlation coefficient (rho) and Pearson coefficient were utilised. The results are shown in Table 5. Future engagement was assessed through the statement, ‘Would you like to participate in (more) activities related to climate change?’. Regarding current engagement in climate change, all variables (except age) (Table 6) achieved significant positive results. The strongest relations included those on climate change concern and climate change awareness, which suggests that a greater concern and awareness is related to a

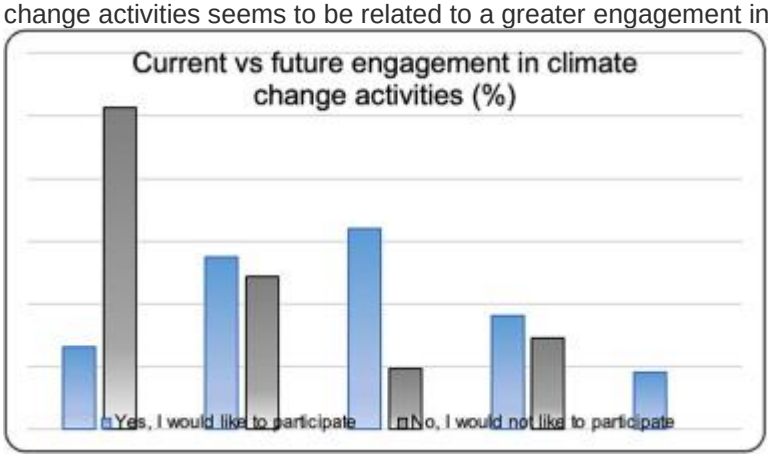
greater current engagement. The same results, but with lower correlation values, were obtained regarding current study level; as the participants reach higher academic levels, they are more likely to participate in climate change activities.

Table 6. Correlation values. Current engagement

Empty Cell	**Correlation coefficient**	**Age**	**Current study level**	**Climate Change Concern**	**Climate Change Awareness**
Current engagement	Spearman	-	.108*	.379*	.624*
	Pearson		.127*	.382*	.631*

* Correlation is significance at the 0.01 level (2-tailed). Correlation results details are provided in supplementary material.

Concerning future engagement (Figure 5), most of the participants (90.1%) declared that they would like to participate in activities related to climate change. In this case, to be currently involved in climate change activities seems to be related to a greater engagement in participating in future activities.



1. Download : Download high-res image (98KB)
2. Download : Download full-size image

Figure 5. T-Student test offered significance differences (t = -5.040, df = 413, sig. = .000)

5. Discussion

Climate change is a serious global developmental challenge that requires the integrated and coordinated action of all sectors and actors. However, society's awareness and concerns for climate change and its impacts vary according to differences in economy, demography, culture, educational level and background, and the degree of exposure to climate risks (Islam and Winkel, 2017, Kabir et al., 2016, Shahid et al., 2016). University students form a vital segment of the community and can play a crucial role in the climate change adaptation and mitigation efforts within their university. Their education and involvement in the reality of changing climate and its impending risks is a means to equip these students with relevant skills and knowledge so that they would positively influence the wider community to implement climate change adaptation and mitigation measures. Therefore, assessing the attitudes and perceptions of students can help universities understand their students' knowledge about climate change and its adverse impacts in order to adequately incorporate climate issues in the co-curricular activities and formal curriculum. Accordingly, this article examined the perceptions of university students about the occurrences, causes and concerns of climate change and their future engagement in climate change adaptation and mitigation interventions.

This study indicates that the majority of respondents are aware of the climate change issue, and most expressed concerns about the impending risks associated with climate change. In line with (Akrofi et al., 2019) study, there was a small percentage of students who expressed some doubt about the existence of climate change and therefore did not express concern about its effects. In contrast to previous studies, this study highlighted that students were seemingly more aware about broader

climate change debates and the differences among change, adaptation and mitigation than about the specific initiatives, such as Conferences of the Parties or Fridays for the Future. This perhaps reflects the scale of awareness of broad debates, but also the possible challenge of more specific initiatives operated on a global basis. As such, this highlights the critical role of the promotion of engagement opportunities.

The proportion of students attributing climate change to human activity was larger than other studies (Ojomo et al., 2015), but lower than published studies on climate scientists (Cook et al., 2016). Females were significantly more likely than males to suggest that human activity is the main cause of climate change. Climate change awareness was highest in the Asia and Pacific Region, and climate change concern was highest in North America. This may reflect the proportion of the wider population and the recent increase in counter-narratives about climate change in the public media, particularly in terms of US policy and related protests. However, the differences between regions were not found to be statistically significant. As there were statistically insignificant differences between reported awareness and concern across continents, the study found general support for the logical and intuitive positive relation between awareness and concern. The wide support for understanding the causes of climate change also highlights the importance of social norms in attempting to prompt climate change adaptive behaviour (van Valkengoed and Steg, 2019). As such, activities would benefit from promoting positive norms and addressing problematic norms in universities.

Although data suggest that females are reportedly less aware than males of climate change and are more concerned about the effects of climate change than males, there were no statistically significant differences. Similarly, whereas data suggested that people aged 51+ were more aware and concerned about climate change, the most significant difference was found in the youngest age group (18-25 years old). A similar pattern existed for the educational level, where climate change awareness and concern broadly increased from undergraduate to postgraduate levels. These findings contrast with some studies that suggest similar levels of awareness across levels (AbuQamar et al., 2015), but support others that indicate differences in experience over time (Ayanlade and Jegede, 2016). This study suggests that there are increasingly strong relationships between age and climate change awareness, perhaps where age and education might act as a proxy for personal experience and the ability to emotionally receive and make sense of the complexity of climate change issues.

This study reflected the findings of other studies that indicated different levels of awareness across disciplines but also provided comparative data in relation to concern for climate change. In this study, climate change awareness and concern varied between disciplines, from the lowest relative awareness in business, administration and law (similar to (Akrofi et al., 2019), in terms of awareness) and the lowest relative concern in engineering, manufacturing and construction. In contrast, the highest level of awareness was in the disciplines of biology and the environmental sciences similar to (Mugambiwa and Dzomonda, 2018), and the highest level of climate change concern was in health and welfare. These findings were statistically significant and as such provide a new global analysis of disciplines in relation to each other in terms of climate change awareness and concern. This suggests the different ways that climate change is positioned and understood in relation to other disciplinary concepts, which filter through to levels of awareness and concern (Wachholz et al., 2014). Institutional or country level approaches may promote more consistency in addressing such diversity.

In terms of current engagement in climate change initiatives, all variables (apart from age) demonstrated significant positive relationships, and the strongest relationships were identified in climate change awareness and concern and current study level. At the same time, those currently not involved in these initiatives were the most likely to express a continuation of non-involvement. This suggests an association between student concern and their intentional behaviour to change an underlying dissonance related to that concern (van Valkengoed and Steg, 2019, Grothmann and Patt, 2005). This indicates that special efforts might be required to reach this particular group, but that clarity will be needed on what the climate change issues are and why they are significant to the person and discipline; it might take some time for universities to change the perceptions and attitudes towards climate change.

However, (Akrofi et al., 2019) argue, both the causes and effects would need to be key aspects for prompting engagement and thereby changing perceptions and attitudes. Considering the differences between the ages and study levels, this suggests that there may be benefits in creating initiatives that promote vicarious learning across multi-generational cohorts of students. This could potentially enhance the sharing of diverse personal experiences across geographic and cultural locations (Ayanlade and Jegede, 2016). Nonetheless, involvement in environmental curricula or initiatives may not guarantee a change in climate change awareness or concern; as (Mobley et al., 2010) found over a decade ago, involvement in environmental organisations does not automatically mean that students

will perceive that climate change is caused by human activity, and it may indeed promote other narratives that might undermine the possibility of human intervention (such as supernatural causes). This study focuses on a better understanding of factors that shape perceptions of climate change, as well as the resulting levels of engagement in climate-positive actions. The study aimed to shed light on the underlying misconceptions that affect viewpoints about the plausibility of the phenomenon and (may) act as barriers to learning fundamental principles currently supported by scientific evidence and predictions. The factors examined in the study that shape students' perceptions and awareness levels should stimulate discussions among key stakeholders in the higher education institutions regarding the contents of and approaches to climate literacy pedagogy. Climate change education could adopt a variety of approaches in order to engage students about the nexus of climate risks and work towards a climate-literate society that is able to deal with the complexity of the defining issue of our time and to shape practical solutions (both in terms of mitigation and adaptation-resilience). As universities are in a unique position to be part of the solution, and drawing from student perceptions-engagement assessments, curriculum changes have to be considered in national contexts where the increase of students' knowledge and cognitive skills of the climate change awareness-engagement nexus is deemed imperative. Follow-up studies, drawing from larger international samples, could reveal whether curricular changes are required to ensure that all university graduates and postgraduates understand the scientific consensus about climate change. Given the ongoing debate on the specific context of global governance, key findings from international student surveys will continue to offer meaningful insights and encapsulate implications for national and international climate change education policies in order to foster desirable behavioural patterns in the next generation of decision-makers over decarbonisation and climate-proofing.

6. Conclusions

Climate change is a serious global challenge, which requires the continuous, integrated and coordinated action of all sectors and societal actors. Knowledge about climate change, as well as perceptions and understanding about it, form the foundation that can avoid and or reduce its impacts. In this regard, universities are known to occupy a central position as centres for learning, innovation, and research to not only investigate and model climate change, but to also demonstrate climate change adaptation and mitigation measures. University graduates, if properly educated, could become change agents to influence the wider community. This is because awareness, which may be improved through training and information exposure, is a prerequisite for implementing wise adaptation and mitigation actions.

Climate change education in higher education is important, as it provides the knowledge and skills that bring about pro-environmental behavioural changes, leading to responsible, sustainable production and consumption patterns that will positively impact society at large, and may reduce the pressures caused by large CO2 emissions. The integration of climate issues in university education, co-curricular activities and research programmes should be emphasised so as to ensure that the next generation of professionals is duly aware of this global challenge and its many ramifications.

Universities can also, at the institutional level, better respond to climate change by applying environmentally-friendly and sustainable solutions in daily operational activities with the aim of reducing their direct impacts. HEI's climate commitments are mainly set as targets or goals to reduce their carbon emissions, which can occur through operational management, sustainability plans or climate action plans, or through a combination of these approaches.

This article has identified very interesting evidence by examining the level of university students' awareness on climate change. Indeed, the findings of this study shed light on three significant research areas. Firstly, many of the university students seem to be aware of climate change risks. They acknowledge that climate change is mostly an outcome of human activity and not exclusively a regular natural process. It also appears that they trust universities to educate citizens regarding climate change risks. This implies a significant contribution to the discussion on social capital in relation to environmental problems, since there is a perceived need to mobilise higher education institutions towards global environmental problem-solving. Another important point highlighted by this study is the degree of students' concern about climate change risks. As expected, the awareness of university students is inextricably linked to their degree of familiarity with the topic, part of which is their participation in various climate change events.

Secondly, the findings show various views of university students from different regions concerning climate change risks. The findings suggest that university students from the Asia and Pacific region are more aware than those from other regions on climate change issues. This difference is probably associated with the variety of exposure of various regions to climate risks and, of course, the different levels of awareness of climate change risks among the university students in these regions.

Third, a variation in the knowledge of climate change risks is identified across gender, age and academic education. More female respondents shared the opinion that climate risks are an outcome of human activities than their male counterparts. Regarding the age of the respondents, it seems that the older university students have a better knowledge and higher awareness of climate risks. Furthermore, as it could be expected, university students within the field of environmental studies are more aware of climate change risks than students attending other courses.

As any other study, there are some limitations to this study. Although a significant number of questionnaires were collected in this survey from different countries, a larger number would be required to provide more robust trends in finer subcategories. In addition, the study did not entail interviews, a trend associated with the COVID-19 pandemic, which makes social contact more difficult. The fact that a non-probabilistic survey sample was used, and the fact that students who did not have internet access were unable to take part in the research, are a further limitation of the study. A further matter which poses a limitation is related to the self-selection of participants. It is believed that only those motivated enough made a decision to take part in the study. This is not unusual and as the literature shows [e.g. 56], it need to be taken into account. But despite these constraints, the study offers very useful insights into how university students perceive climate change.

Future studies should focus on further exploring the awareness of university students about particular themes, such as climate change risks, and comparing the views of the academic community in contrast with other sectors (e.g. industry).

It is hoped that this study will encourage more research that could strengthen the emphasis academic institutions give to climate change and help to catalyse more efforts into models of environmental behavior and psychology, which may in turn bring about a greater participation of university students in the handling of the many challenges posed by a changing climate.

Uncited references

Sterling et al., 2013, Bethlehem, 2010.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A.

Climate Change: Attitudes and Perceptions of University Students
Section 1 – Background
1. Country:

2. Sex:

() F

() M

() Other

3. Age group:

() 18-25

() 26-35

() 36-50

() 51+

4. Study area:

() Education

() Arts and humanities

() Social sciences, journalism and information

() Business, administration and law

() Natural sciences, mathematics and statistics

() Information and communication technologies

() Engineering, manufacturing and construction

() Agriculture, forestry, fisheries and veterinary

() Health and welfare

() Services

() Other: _____

5. Current study level:

() Undergraduate

() Graduate

() Doctoral

6. Climate is…

() definitely changing

() probably changing

() I am not sure

() probably not changing

() definitely not changing

7. Climate change is…

() Caused entirely by human activity

() Caused mainly by human activity

() Caused equally by human activity and natural processes

() Caused mainly by natural processes

() Caused entirely by natural processes

() Definitely not happening

8. How worried are you about climate change?

() Extremely worried

() Very worried

() Somewhat worried

() Not very worried

() Not at all worried

() Climate change is not happening

9. Where do you obtain information on climate change? (multiple answers possible)

() TV

() Radio

() Newspapers

() Social Media

() University

() Family

() Student Clubs/Associations

() NGOs

() Scientific database, like Scopus

() International Symposiums or events

() Other: _____

10. Perception and information on climate change: on the scale below mark your level of perception and information about climate change. (1 = not at all; 5 = to a great extent).

Empty Cell	1	2	3	4	5
To what extent are you aware of the differences between climate change adaptation and mitigation?					
To what extent are you update on the climate change debate?					
To what extent are you aware of the discussions and outcomes of the					

Empty Cell	1	2	3	4	5
Conferences of the Parties (COPs)?					
To what extent are you aware of the targets of the Sustainable Development Goal (SDG) 13?					
To what extent are you aware of the movement Fridays for the Future?					
To what extent are you involved in the climate change movement?					

11. Is climate change present as a topic/subject in your course/teaching programme?

() Yes

() No

12. Level of emphasis to matters related to climate change in your course:

() The topic is very well covered with plenty of information

() The topic is covered with enough information

() The topic is not as well covered as we would like it to be

() The topic is poorly covered

() The topic is not covered at all

() I do not know/am not sure

13. More information about climate change in your university should come from: (multiple answers possible)

() Mandatory courses

() Optional courses

() Students' projects

() Publications

() Placements in companies

() Student clubs/associations

() University strategic plan

() Carrer centers

() Other: _____

14. In your opinion, which are the 3 main impacts caused by climate change (multiple choices possible):

() Damage to biodiversity

() Increase in the number of non-native species

() Increase in poverty

() Increase in conflict

() Sea-level rises

() Increase in number and severity of storms

() Increase in number and severity of droughts

() Melting of glaciers

() Flooding

() Increase in water-borne disease

() Increase in the displacement of communities

() Damage to infrastructure and superstructure

() Other (please specify)

15. Those most responsible for causing climate change are:

() Those in the Global North

() Those in the Global South

() The world's wealthiest people, regardless of geographic location

() Other (please specify)

16. The global increase of temperature as a result of the greenhouse effect will affect the life of…

Empty Cell	**Positively**	**Neutrally**	**Negatively**
Your generation			
The next generation			
Generations far into the future			

17. Which of the following problems hinder communication on climate change? (multiple choices possible)

() No problem at all

() The issue is too scientific

() The issue is too abstract

() The issue is too complex

() The issue has no connection with reality

() The issue does not affect me

() Impacts are too long term

() Other:

18. Would you like to participate in (more) activities related to climate change?

() Yes

() No

19. If so, in which ones?

() Students movements/protests for climate change awareness

() Training/capacity-building workshops

() Volunteerism/community activities

() Research on climate change

() More content about it in my course/teaching programme

() Other: _____

20. On which themes do you need further information? (multiple choices possible)

() Approaches to climate change mitigation

() Approaches to climate change adaptation

() Climate change causes and impacts

() Technologies that reduce climate change

() Sustainable Development Goal 13

() Other: _____

21. Greta Thunberg is a Swedish 17 year old student who has initiated School Strikes for Climate all around the world in an effort to raise awareness of the public and politicians about the climate change crisis.

How do you feel about her efforts (choose the best three options):

() I am not aware of her actions

() I fully support her actions

() I have attended / organised School Strikes for Climate

() I wish I had the courage to do the same

() I feel that her actions have been successful

() I feel that her actions have not been successful

() I feel that she's doing all this to gain popularity

() I feel that she is being manipulated to serve the interests of others

() I feel that she is poorly informed about the complex nature of climate change

() Other (please specify)

Data availability

Data will be made available on request.

References

Barth and Rieckman, 2013

Barth, M. & Rieckman, M. A Review on Research in Higher Education for Sustainable Development. Paper presented at the 7th World Environmental Education Congress, 9-14th June 2013, Marrakech, Morocco (2013).

Google Scholar

Godwell and Nompe, 2014

N. Godwell, N. Nompe

Higher education institutions and carbon management: Cases from the UK and South Africa

Problems and Perspectives in Management, 12 (1) (2014), pp. 218-227

Google Scholar

Shiel et al., 2015

C. Shiel, W.L. Filho, A. Paço, L. Brandlii

Evaluating the engagement of universities in capacity building for sustainable development in local communities

Evaluation and Programme Planning, 54 (2015), pp. 123-134

Google Scholar

Katzy et al., 2021

Katzy, B.R., Pawar, K.S & Thoben, K.D. Editorial: A Living Lab Research Agenda. Int. J. Product Development, 17, ½, 1-8 (2021).

Google Scholar

Cordero et al., 2020

E.C. Cordero, D. Centeno, A.M. Todd

The role of climate change education on individual lifetime carbon emissions

PLoS ONE, 15 (2) (2020), p. e0206266

View PDF

CrossRefView in ScopusGoogle Scholar

Leal Filho et al., 2015

W. Leal Filho, C. Shiel, A. Paço

Integrative approaches to environmental sustainability at universities: an overview of challenges and priorities

Journal of Integrative Environmental Sciences, 12 (1) (2015), pp. 1-14

View article

CrossRefGoogle Scholar

Cotton et al., 2016

D. Cotton, C. Shiel, A. Paço

Energy Saving on Campus: A comparison of students' attitudes and reported behaviours in the UK and Portugal

Journal of Cleaner Production, 129 (2016), pp. 586-595

View PDFView articleView in ScopusGoogle Scholar

Choi et al., 2017

Y.J. Choi, M. Oh, J. Kang, L. Lutzenhiser

Plans and Living Practices for the Green Campus of Portland State University“

Sustainability, 9, 2 (2017), p. 252, 10.3390/su9020252

View PDF

View in ScopusGoogle Scholar

United Nations Educational, 2010

United Nations Educational

Scientific and Cultural Organization (UNESCO). UNESCO strategy for the second half of the United Nations Decade of Education for Sustainable Development

UNESCO, Paris (2010)

Google Scholar

United Nations, 1992

United Nations (1992). United Nations Framework Convention on Climate Change. New York: United Nations, General Assembly (2015).

Google Scholar

Sterling et al., 2013

S. Sterling, L. Maxey, H. Luna (Eds.), The Sustainable University: Progress and prospects, Routledge, Abingdon, Oxon (2013)

Google Scholar

Vare and Scott, 2007

P. Vare, W. Scott

Learning for a change: Exploring the relationship between education and sustainable development

Journal of Education for Sustainable Development, 1 (2) (2007), pp. 191-198

View article

CrossRefView in ScopusGoogle Scholar

Molthan-Hill et al., 2019

P. Molthan-Hill, N. Worsfold, G.J. Nagy, W. Leal Filho, M. Mifsud

Climate change education for universities: A conceptual framework from an international study

Journal of Cleaner Production, 226 (2019), pp. 1092-1101

View PDFView articleView in ScopusGoogle Scholar

Leal Filho et al., 2019

Leal Filho, W., Salvia, A. L., do Paço, A., Anholon, R., Gonçalves Quelhas, O. L., Rampasso, I. S., Ng, A., Balogun, A.-L., Kondev, B .& Brandli, L. L. A comparative study of approaches towards energy efficiency and renewable energy use at higher education institutions. Journal of Cleaner Production, 237, 117728. doi: 10.1016/j.jclepro.2019.117728 (2019a).

Google Scholar

Ow

R. Owen, E. Fisher, K. McKenzie

beyond reduction: Climate change adaptation planning for universities and colleges

International Journal of Sustainability in Higher Education, 14 (2) (2013), pp. 46-160

View in ScopusGoogle Scholar

H.M. Fussel, R.J.T. Klein

Climate change vulnerability assessments: an evolution of conceptual thinking

Climatic Change, 75 (2006), pp. 301-329

View article

CrossRefView in ScopusGoogle Scholar

H. Füssel

Vulnerability in Climate Change Research: A Comprehensive Conceptual Framework. UC

University of California International and Area Studies, Berkeley (2005)

Retrieved 03–05-2021

Google Scholar

Filho, W.L. Climate Change at Universities: Results of a World Survey. In: Universities and Climate Change: Introducing climate Change to University Programmes. Filho, W. L. (Ed). Springer-Verlag Berlin Heidelberg: Berlin. pp 1-19 (2010).

Google Scholar

A. Körfgen, L. Keller, A. Kuthe, A. Oberrauch, H. Stötter

(Climate) Change in young people's minds - From categories towards interconnections between the anthroposphere and natural sphere

Science of the Total Environment, 580 (2017), pp. 178-187

View PDFView articleView in ScopusGoogle Scholar

A. Kuthe, A. Körfgen, J. Stötter, L. Lars

Strengthening their climate change literacy: A case study addressing the weaknesses in young people’s climate change awareness

Applied Environmental Education & Communication, 19 (4) (2020), pp. 375-388, 10.1080/1533015X.2019.1597661
View PDF

This article is free to access.
View in ScopusGoogle Scholar

M.M. Akrofi, S.H. Antwi, J.R. Gumbo

Students in climate action: a study of some influential factors and implications of knowledge gaps in Africa

Environments, 6 (12) (2019), pp. 1-15, 10.3390/environments6020012
View PDF
Google Scholar

K.C. Burkholder, J. Devereaux, C. Grady, M. Solitro, S.M. Mooney

Longitudinal study of the impacts of a climate change curriculum on undergraduate student learning: initial results

Sustainability, 9 (913) (2017), pp. 1-28, 10.3390/su9060913
View PDF
Google Scholar

S. AbuQamar, Q. Alshannag, A. Sartawi, R. Iratni

Educational awareness of biotechnology issues among undergraduate students at the United Arab Emirates University

Biochemistry and Molecular Biology Education, 43 (4) (2015), pp. 283-293, 10.1002/bmb.20863
View PDF

This article is free to access.
View in ScopusGoogle Scholar

S. Ayanlade, M.O. Jegede

Climate change education and knowledge among Nigerian university graduates

Weather, Climate, and Society (2016), pp. 465-473, 10.1175/WCAS-D-15-0071.17
View article

View in ScopusGoogle Scholar

A.M. Freije, T. Hussain, E.A. Salman

Global warming awareness among the University of Bahrain science students

Journal of the Association of Arab Universities for Basic and Applied Sciences, 22 (2017), pp. 9-16

View PDFView articleView in ScopusGoogle Scholar

S. Haq, K. Ahmed

Perceptions about climate change among university students in Bangladesh

Natural Hazards, 103 (2020), pp. 3683-3713, 10.1007/s11069-020-04151-0
View article

View in ScopusGoogle Scholar

C. Mobley, W. Vagias, S. DeWard

Exploring additional determinants of environmentally responsible behaviour: The infuence of environmental literature and environmental attitudes

Environment and Behavior, 42 (4) (2010), pp. 420-447

View article

CrossRefView in ScopusGoogle Scholar

S.S. Mugambiwa, O. Dzomonda

Climate change and vulnerability discourse by students at a South African university

Jàmbá: Journal of Disaster Risk Studies, 10 (1) (2018), Article a476, 10.4102/jamba.v10i1.476
View PDF

View in ScopusGoogle Scholar

E. Ojomo, M. Elliott, U. Amjad, J. Bartram

Climate change preparedness: a knowledge and attitudes study in Southern Nigeria

Environments, 2 (2015), pp. 435-448, 10.3390/environments2040435
View PDF

Google Scholar

O.S. Agboola, M. Emmanuel

Awareness of Climate Change and Sustainable Development among Undergraduates from Two Selected Universities in Oyo State

Nigeria. World Journal of Education, 6 (3) (2016), pp. 70-81

View in ScopusGoogle Scholar

Beck, A., Sinatra, G.M. & Lombardi, D. Leveraging higher-education instructors in the climate literacy effort factors related to university faculty's propensity to teach climate change. International Journal of Climate Change: Impacts and Responses, 4, 1-27. doi: 10.18848 /1835-7156/CGP/v04i0 4/37181. (2013).

Google Scholar

T.A. Myers, E.W. Maibach, C. Roser-Renouf, K. Akerlof, A.A. Leiserowitz

The relationship between personal experience and belief in the reality of global warming

Nature Climate Change, 3 (2012), pp. 343-347

Google Scholar

Wachholz, S., Artz, N. & Chene, D. Warming to the idea: university students' knowledge and attitudes about climate change. International Journal of Sustainability in Higher Education, 15(2), 128-141. doi: 10.1108/IJSHE-03-2012-0025 (2014).

Google Scholar

J. Shaman, K. Knowlton

The Need for Climate and Health Education

American Journal of Public Health, 108 (2017), pp. S66-S67, 10.2105/AJPH.2017.304045
View article

Google Scholar

F. Morgado, P. Bacelar-Nicolau, J. Rendon von Osten, P. Santos, L. Bacelar-Nicolau, H. Farooq, F. Alves, A.M.V.M. Soares, U.M. Azeiteiro

Assessing university student perceptions and comprehension of climate change (Portugal, Mexico and Mozambique)

International Journal of Climate Change Strategies and Management, 9 (3) (2017), pp. 316-336

View in ScopusGoogle Scholar

L. Yang, W. Liao, C. Liu, N. Zhang, S. Zhong, C. Huang

Associations between Knowledge of the Causes and Perceived Impacts of Climate Change: A Cross-Sectional Survey of Medical, Public Health and Nursing Students in Universities in China

International Journal of Environmental Research and Public Health, 15 (12) (2018), p. 2650, 10.3390/ijerph15122650
View PDF

View in ScopusGoogle Scholar

J. Maxwell, G. Blashki

Teaching about climate change in medical education: an opportunity

Journal of Public Health Research, 5 (1) (2016), p. 673

View in ScopusGoogle Scholar

V. Lapaige, H. Essiembre

Innoversity in knowledge-for-action and adaptation to climate change: the first steps of an 'evidence-based climatic health' transfrontier training program

Advances in Medical Education and Practice, 1 (2010), pp. 89-105, 10.2147/AMEP.S14027
View PDF

View in ScopusGoogle Scholar

A.S. Nigatu, B.O. Asamoah, H. Kloos

Knowledge and perceptions about the health impact of climate change among health sciences students in Ethiopia: a cross-sectional study

BMC Public Health, 14 (2014), p. 587, 10.1186/1471-2458-14-587
View PDF

This article is free to access.
View in ScopusGoogle Scholar

L. Eagle, D. Low, P. Case, L. Vandommele

Attitudes of undergraduate business students toward sustainability issues

International Journal of Sustainability in Higher Education, 16 (5) (2015), pp. 650-668, 10.1108/IJSHE-04-2014-0054
View article

View in ScopusGoogle Scholar

B. Di Giusto, J.P. Lavallee, T. Yu

Y Towards an East Asian model of climate change awareness: A questionnaire study among university students in Taiwan

PLOS One, 13 (10) (2018), p. e0206298

View PDF

CrossRefView in ScopusGoogle Scholar

E. Bakaç

Engineering Faculty Students' Perceptions on Climate Change

Environment and Ecology Research, 6 (4) (2018), pp. 240-247, 10.13189/eer.2018.060404
View PDF
View in ScopusGoogle Scholar

S. Pfautsch, T. Gray

Low factual understanding and high anxiety about climate warming impedes university students to become sustainability stewards: An Australian case study

International Journal of Sustainability in Higher Education, 18 (7) (2017), pp. 1157-1175, 10.1108/IJSHE-09-2016-0179
View PDF
View in ScopusGoogle Scholar

IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press.

Google Scholar

M.A. Ochieng, J. Koske

The level of climate change awareness and perception among primary school teachers in Kisumu municipality, Kenya

International Journal of Humanities and Social Science, 3 (21) (2013), pp. 174-179

View in ScopusGoogle Scholar

M.T.A. Chowdhury, K.J. Ahmed, M.N.Q. Ahmed, S.M.A. Haq

How do teachers' perceptions of climate change vary in terms of importance, causes, impacts and mitigation? A comparative study in Bangladesh

SN Soc Sci, 1 (2021), p. 174, 10.1007/s43545-021-00194-7
View PDF

This article is free to access.
View in ScopusGoogle Scholar

A.M. McCright

The effects of gender on climate change knowledge and concern in the American public

Popul Environ., 32 (2010), pp. 66-87

View article

CrossRefView in ScopusGoogle Scholar

W. Elke

What shapes perceptions of climate change?

Climate Change, 1 (3) (2010), pp. 332-342

Google Scholar

A. Brody, J. Demetriades, E. Esplen

Gender and climate change: mapping the linkages

BRIDGE, Institute of Development Studies (IDS), UK (2008)

Google Scholar

Islam, S.N. & Winkel, J. Climate Change and Social Inequality. DESA Working Paper No. 152. ST/ESA/2017/DWP/152. Retrieved 10-01-2021 from https://www.un.org/esa/desa/papers/2017/wp152_2017.pdf. (2017)

Google Scholar

M.I. Kabir, M.B. Rahman, W. Smith, M.A.F. Lusha, S. Azim, A.H. Milton

Knowledge and perception about climate change and human health: findings from a baseline survey among vulnerable communities in Bangladesh

BMC Public Health, 16 (2016), p. 266, 10.1186/s12889-016-2930-3
View PDF

This article is free to access.
View in ScopusGoogle Scholar

Z. Shahid, A. Piracha

Awareness of Climate Change Impacts and Adaptation at Local Level in Punjab, Pakistan

B. Maheshwari, B. Thoradeniya, V.P. Singh (Eds.), Balanced Urban Development: Options and Strategies for Liveable Cities, Springer:, Cham (2016), 10.1007/978-3-319-28112-4_25
View article

Google Scholar

J. Cook, N. Oreskes, P.T. Doran, W.R.L. Anderegg, B. Verheggen, E.W. Maibach, J.S. Carlton, S. Lewandowsky, A.G. Skuce, S.A. Green, D. Nuccitelli, P. Jacobs, M. Richardson, B. Winkler, R. Painting, K. Rice

Consensus on consensus: a synthesis of consensus estimates on human-caused global warming

Environmental Research Letters, 11 (4) (2016), p. 48002, 10.1088/1748-9326/11/4/048002
View article

Google Scholar

A.M. van Valkengoed, L. Steg

Meta-analyses of factors motivating climate change adaptation behaviour

Nature Climate Change, 9 (2019), pp. 158-163, 10.1038/s41558-018-0371-y
View article

View in ScopusGoogle Scholar

T. Grothmann, A. Patt

Adaptive capacity and human cognition: The process of individual adaptation to climate change

Global Environmental Change, 15 (2005), pp. 199-213

View PDFView articleView in ScopusGoogle Scholar

J. Bethlehem

Selection bias in web surveys

International statistical review, 78 (2) (2010), pp. 161-188, 10.1111/j.1751-5823.2010.00112.x
View article_

View in ScopusGoogle Scholar

(IUCN/WEDO 2007

Google Scholar