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Aiming Higher? Implications for Higher Education of Students' Views on Education for Climate Justice

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Abstract: In 2023, a high number of climate disasters were recorded globally, highlighting the urgent dangers inherent in climate change and the inequities that result from its uneven impacts. Higher education institutions (HEIs) potentially play a crucial role in furthering climate justice through their research, teaching, community engagement and public awareness. Many students enter HEIs with high expectations concerning their education regarding climate change and more broadly of their institution's contribution to climate action. In this article, we explore these expectations alongside the perceptions of students regarding how HEIs are delivering on them, i.e., the extent to which students are satisfied with their HEIs' policies and practice on climate change. We employ data from a large-scale survey of more than 4000 students conducted by the Transforming Universities for a Changing Climate (Climate-U) project collected in nine HEIs in three countries (Brazil, Fiji and Kenya) during 2021–22. Results indicate that satisfaction among students in the sampled HEIs is often low, while expectations are typically high. There is some evidence that students in contexts already more directly exposed to the impacts of climate change were somewhat more active and more satisfied. Overall, students frequently expected to learn more about climate change than they were in fact learning and expressed high levels of environmental concern as well as some dissatisfaction with HEIs' wider activities to limit the impact of climate change and to promote understanding of the issues. We discuss the findings in relation to the gaps between what students expect from their HEIs and what HEIs are currently doing in the three countries. Furthermore, we consider how HEIs in Brazil, Fiji and Kenya may improve their engagement with issues of climate change and respond to students' views and expectations, including the promotion of preparedness for and resilience to the climate crisis and its effects.

Keywords: climate change education; climate justice; education for sustainable development; environmental concern; student survey

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1. Introduction

1.1. Universities, Students and Climate Change

In 2023, a high number of climate disasters were recorded globally, highlighting the urgent dangers inherent in climate change and the inequities that result from its uneven impacts. Higher education institutions (HEIs) have a major role to play in furthering climate justice, through a range of channels including research, teaching and curricula development, teacher education, community engagement and raising public awareness, as well as addressing the impacts of their own operations and activities [1]. Higher education can exert a major influence on students' knowledge, attitudes and practices, most obviously

through taught courses, but importantly by fostering active participation among students in wider climate-related activities [2,3]. Universities may need, however, to strengthen curricula and pedagogy to successfully play an active role in shaping attitudes and behaviors through teaching and learning. In all their activities, engaging students in local solutions to the global problem of climate change is crucial if universities are to successfully leverage their important position in relation to future generations [4]. Moreover, the impacts of climate change and the need to mitigate these are distributed unequally and the fair sharing of responsibilities requires proper representation and protection of those especially vulnerable to climate change, that is, to issues of climate justice. Debate surrounds the conceptualization and orientation of the role of universities in relation to climate change and more broadly to 'sustainable futures'. Given the enormity of the challenges ahead, it may be argued that what is required from higher education is to facilitate the transformation and paradigmatic shift towards an ecological worldview and a focus on sustainable human progress at the heart of the mission of higher education [5,6].

Many recent studies have found that levels of awareness of climate change among undergraduate students globally are high and their attitudes are strongly in favor of environmental protection [7]. The prevalence of climate skepticism among this age group is typically found to be low, with a vast majority of students attributing climate change primarily to human activity [8]. However, studies focusing on students' knowledge of climate change show more mixed results, indicating notable 'knowledge gaps' in some cases [9] or limitations of understanding especially in terms of the causes of climate change [10].

Students, like the populations to which they belong, develop beliefs, attitudes and perceptions about climate change linked to their socio-cultural backgrounds and geographic contexts including urban/rural location. Other influences include political environments and students' own experiences of adverse impacts of climate change [11]. Coverage of climate change in formal education can be a major influence, while this may differ widely by institution and study discipline. Some studies also show variation in students' attitudes, beliefs and perceptions by factors such as religion and gender. The situation is a dynamic one given the pace of climate change and changing responses to it. Perhaps unsurprisingly, some evidence suggests that students are becoming increasingly concerned in relation to environmental sustainability and the impacts of climate change over time [12,13]. Also somewhat unsurprisingly, comparisons between university students and the general public indicate at least a slightly greater awareness among students [14].

The question of how awareness of climate change varies across higher and lower income contexts is complex. Leal Filho et al.'s global survey of 424 students conducted in 2020 showed a strong overall belief among students that climate change 'is happening', with 70% attributing it entirely or mostly to humans [2]. Liu and Sibley's survey of 6651 university students across 34 countries found that perceptions of the importance of global warming predict self-reported willingness to make personal sacrifices on behalf of the environment; this association being stronger in countries with a higher human development index (HDI) [15]. However, there is high variation within countries. Howe et al.'s study in the USA found that while 75% of respondents in Hawaii believed climate change 'is happening', the figure for West Virginia was only 54% [16]. This study links greater skepticism in the Midwest to the significant presence of greenhouse gas-producing industries in that region. At the same time, recent events in Hawaii including the devastating wildfires in 2023 in Maui highlight the immediacy of concerns in that context. Caretta et al. draw a similar conclusion based on a survey to 446 students in the Appalachian region of the USA, arguing that students 'in fact think that climate change is happening elsewhere and will not affect them', arguing that 'the social economic and cultural values associated with extraction influence their attitudes towards the issue' [17].

Universities' responses to the challenges of climate change vary widely, and while the evidence on universities' contributions to research in the field is extensive, it is sparser regarding students' satisfaction with what universities are doing, including in their teaching, especially outside Europe and North America.

1.2. The Present Study

In this article, we focus on students in three universities in each of three countries, i.e., Brazil, Fiji and Kenya, which may be considered markedly different contexts. We employ data from a large-scale survey conducted by the Transforming Universities for a Changing Climate (Climate-U) project. The Climate-U project aims to provide evidence to inform the improvement of universities' efforts to mitigate and adapt to the effects of climate change and to contribute to climate justice. McCowan provides a theoretical framework for understanding the impact of universities on climate change that informs the work of the project and that outlines the pathways of impact of universities including in relation to mitigation and adaptation [18]. The three countries were selected to provide high levels of diversity of case. While all three are united in grappling with challenges of climate change, they are located in three different regions (South America, Sub-Saharan Africa and the Pacific Islands) and have markedly different cultural heritages, histories of colonialism and higher education systems. These differences can be generative in teasing out factors influencing attitudes and experiences of university students around the world. We focus on country and institution-level descriptive patterns rather than associations at the individual level, to examine and interpret differences in satisfaction among students with their learning about, and their universities' action on climate change. This is contextualized by differences in students' beliefs about the causes of climate change and their participation in climate-related action across institutions and countries. While universities pursue very different policies and activities, an international basis for action by higher education institutions has existed for more than thirty years, in the form of The Talloires Declaration. The declaration, created in 1990 and signed by more than 500 university presidents and chancellors to date, commits signatories to a 10-point plan of action for sustainability, including raising awareness of environmentally sustainable development, educating about environmentally responsible citizenship and fostering environmental literacy for all.

1.3. Study Contexts

The three contexts in question are characterized by notably distinct geographical, economic, political and cultural factors. The Pacific islands, including Fiji, are considered special cases owing to their uncommonly high exposure to climate change and its impacts [19]. According to Hay, 'most people living on Pacific islands will be detrimentally affected by various aspects of climate change' [20]. In particular, rising sea levels and frequent extreme weather events such as tropical cyclones are major concerns [21]. Vulnerability in some parts of the region is exacerbated by reliance on donor support. Engagement in adaptive solutions is crucial and the region provides many examples of 'traditional coping strategies' [22] as well as innovations. In relation to students' attitudes, Scott-Parker et al.'s relatively large survey of 1226 students at the University of the South Pacific (USPc), which is included in the present study sample, found that students almost unanimously believed that climate change was happening (98%) and that they believed strongly that they had a responsibility to act (96%) in the expectation that they could make a difference to climate change (87.5%). When asked if they had read anything about climate change produced by USPc, 81.3% replied positively while only 19.6% said they had never discussed climate change at USPc [19].

The situation in Kenya, as in many sub-Saharan African contexts, may also be considered vulnerable to climate change, because of an arguably low capacity to adapt based on resource scarcity, and due to heavy dependence on rain-fed agriculture (see [4]). Leal Filho et al. found that responses to their global survey from Africa were most likely to indicate a belief in an equal role for human and natural causes of climate change [2]. It is unclear whether this may reflect lower levels of knowledge about climate change, although Akrofi et al.'s survey of students in Africa showed weaker understanding of causes of climate change such as livestock rearing and waste disposal, when compared to deforestation, for example [9]. Huho's survey of undergraduate students in two public universities in Kenya found a high level of comprehension of climatic change like decreased and delayed

rainfall, severe droughts, floods and warmer nights [23]. Indeed, 96.3 per cent of students showed awareness of climatic change. However, students often did not understand more technical concepts like global warming or carbon sequestration. Umwigama et al.'s survey found, somewhat unsurprisingly, that undergraduate students with a more specialist discipline, i.e., those in the School of Environmental Studies at Kenyatta University, showed a fuller understanding of climate change, when compared to those from the School of Humanities and Social Sciences and the School of Business [24].

Brazil's diversity of contexts includes regions such as Amazonia, where vulnerability to climate change is high profile and where the protection of the environment has global importance, but also wealthy urban contexts where impacts may be less immediate. The impacts of climate change in Brazil include events such as drought, torrential rains, landslides, intense winds, tornadoes and tropical cyclones, which have intensified in recent years. Moreover, the country has been experiencing increases in average annual temperatures, aligning with the global rise in temperatures [25,26]. A number of studies have examined students' perceptions regarding climate change and sustainability issues. Alves et al.'s survey of students studying Architecture and Urbanism and Interior Design found that most students believe climate change is happening, but only around half showed personal interest in and concern about the issue [27]. Higuchi et al. surveyed students living in the Amazonia region and found that scientific knowledge on climate change and on the role of the forest can act as a modulator for beliefs, attitudes and ultimately pro-environmental behaviors [28]. In a smaller recent survey of teacher training students in Amazonia, Gomes et al. found that 58% of respondents stated that their course discussed issues of sustainability, with a similar proportion answering that they felt equipped to teach issues of sustainability themselves in their professional careers [29].

While we do not seek to generalize from these three albeit diverse contexts to contexts not included in the study or to a global setting, comparisons across these contexts provide useful illustrations and insights of potentially broader relevance and interest.

2. Method

The Climate-U survey was designed to examine undergraduate students' attitudes and experiences in relation to climate change and their universities, including their engagement in climate action and their perceptions of what universities are and 'should be' doing in relation to climate change. It employed a single questionnaire instrument comprising three parts: (i) student background questions, (ii) questions on experiences and activities at university and on perceptions of universities' initiatives and actions, and finally (iii) an environmental attitudes inventory. This paper focuses on the data from the second part of the questionnaire. Salvia et al. describe the design and implementation of the survey in detail and provide the full survey instrument [30]. Questionnaire development was based on the UNESCO guide to mitigation and adaptation [31] as well as the World Climate Change Survey [32].

The survey data were collected during 2021–22 by partner institutions in the Climate-U project. In Brazil, these comprise the University of Passo Fundo (UPF), the University of São Paulo (USP) and the Federal University of Pará (UFPA). In Fiji, they are the University of the South Pacific (USPc), University of Fiji (UoF) and Fiji National University (FNU), and in Kenya, Kenyatta University (KU), Kisii University (KSU) and the Kenya Methodist University (KeMU).

Table 1 details some basic characteristics of the universities participating in the Climate-U survey.

Within the participating universities, sampling strategies aimed to include students from a variety of disciplinary areas across the natural and social sciences, arts and humanities. Sampling approaches differed somewhat between universities, but were aimed at achieving diversity, while not being statistically representative of the institutions or country contexts [30]. For example, in some (smaller) universities, the survey was shared with all

undergraduate students, while in others, it was shared with a random sample of students enrolled in a selection of courses.

Table 1. Characteristics of survey sample universities.

University		Location, Context	Foundation	Public /Private	Students
University of the South Pacific *	(USPc)	Suva, capital of Fiji	1948	Public	29,918 (2017)
University of Fiji	(UoF)	Lautoka, Fiji	2004	Private	2253 (2021)
Fiji National University	(FNU)	Suva, capital of Fiji	1885	Public	27,000 (2019)
Kenyatta University	(KU)	Nairobi, capital of Kenya	1965 College 1985 university	Public	11,000+ (2016)
Kisii University	(KSU)	Kisii County, agricultural high food insecurity	1965 college 2013 university	Public	Over 10,000
Kenya Methodist University	(KeMU)	Meru (main campus), agricultural area	1997	Private	7180 (2017)
University of Passo Fundo	(UPF)	Passo Fundo, Rio Grande do Sul, South of Brazil	1965	Private	12,000 (2023)
University of São Paulo	(USP)	São Paulo, São Paulo, Southeast of Brazil	1827 Law academy 1934 University	Public	97,000 (2023)
Federal University of Pará	(UFPA)	Belém, Para, Amazon Region, North Brazil	1912	Public	58,478 (2013)

* the present study includes only students studying in Fiji.

The survey was conducted in English in Kenya and Fiji and in Portuguese in Brazil. Remote administration was employed using the SurveyMonkey platform. The COVID-19 pandemic was ongoing at the time, and results should be interpreted in the light of this, including the fact that many students were studying remotely. Recruitment of student respondents employed various strategies depending on the institution [30]. The final sample of students totaled 4790:1407 in Fiji, 1828 in Kenya and 1555 in Brazil. While the sample was relatively large and efforts were made to minimize non-response, it must be borne in mind that students who choose to respond to an internet-based survey of this kind may have more positive attitudes towards climate change than the whole student population. Table 2 reports the sample by institution. Full details are available in [33].

Table 2. Climate-U survey student sample.

	University	USPc	UoF	FNU	KU	KMU	KSU	UFPA	UPF	USP	Total
Sex *	Female N	490	323	126	433	131	160	281	283	374	2601
	Female %	66	67	64	44	35	32	63	66	55	54
	Male N	244	146	66	534	242	319	160	143	289	2143
	Male %	33	30	34	54	65	63	36	33	42	45
Discipline	Education	100	13	51	343	120	336	148	13	8	1132
	Humanities & Arts	10	39	2	39	8	41	49	51	156	395
	Social Sciences, Business and Law	350	109	36	272	15	49	68	103	145	1147
	Science	175	43	20	39	47	20	98	105	238	785
	Engineering	33	0	22	101	0	0	45	116	97	414
	Agriculture	43	0	7	30	14	49	15	21	8	187
	Health & Welfare	0	266	58	37	166	11	22	19	27	606
	Services	30	0	0	85	5	1	0	0	3	124
	Total	741	470	196	946	375	507	445	428	682	4790

* A small number (1%) of respondents selected 'other' or 'prefer not to say' in response to the question about sex.

3. Results

The results present an overview of the students' attitudes and beliefs about climate change and their participation in climate change activities at their universities.

3.1. Students' Attitudes and Beliefs about Climate Change at Their Universities

Students were asked what they considered to be the main cause(s) of climate change, a question which may serve as an indicator of climate skepticism, as depicted in Figure 1. Only a tiny minority of students in any of the countries responded that climate change is 'not happening' or is entirely or mainly the result of natural processes. Almost all students in Brazil attributed climate change either entirely or mainly to human activity, while students in Kenya were most ambivalent concerning anthropogenic causation, with almost half identifying human and natural causes in equal measures. This result coheres with Leal Filho et al.'s survey responses from Africa that found students in Africa are more likely to attribute climate change to both natural and human causes [2], although it is not clear whether or not the finding can be linked to the knowledge gaps on the causes of climate change found in [9].

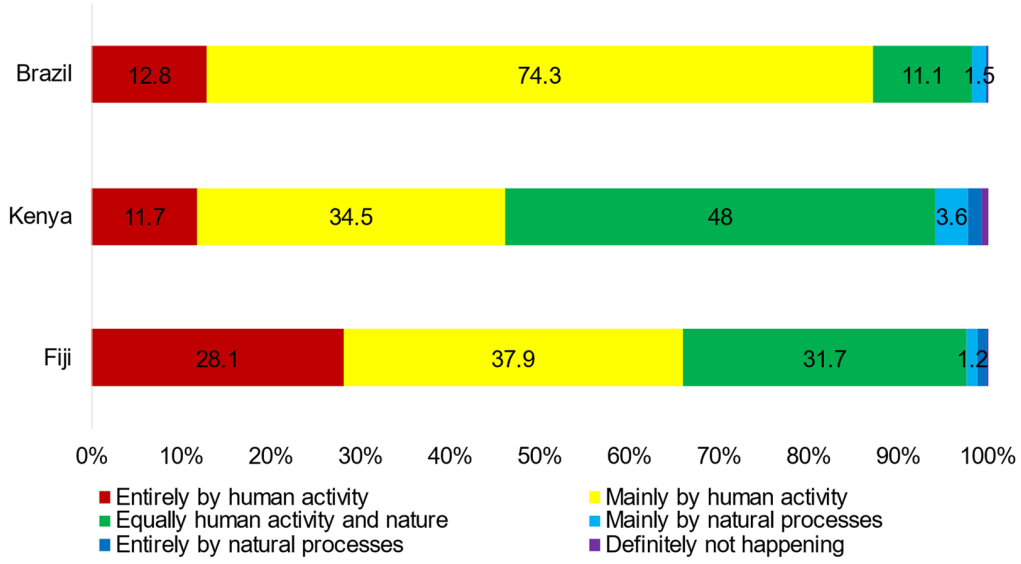

Figure 1. Students' beliefs about the causes of climate change (%).

Students were asked whether they would be willing to volunteer in climate change-related activities at their universities. Figure 2 illustrates the results, with a very large majority of students in Kenya and Fiji being willing to volunteer. A notably smaller proportion of students in two universities in Brazil responded that they would be willing to volunteer, especially the University of Passo Fundo. Opportunities to volunteer of course differ widely by institution and context and may influence students' awareness and perceptions. However, at least in this sample, there is little to suggest that more apparent ambivalence about anthropogenic causation in Kenya is associated with reduced willingness to act in the form of volunteering. Willingness to act may be associated with recent high attention to climate change issues in Kenya, but may also be linked to the inclusion of these universities in particular, two of which are located in rural/agricultural areas and all of which involved in notable outreach activities as discussed below.

In Fiji, the impacts of climate change are arguably most immediate and visible, but in addition, it may be suggested that cultural values of *solesolevaki* (working together to address an issue or assist each other) and *veinanumi* (looking out for neighbors or relatives) have an influence on willingness to volunteer in this context. Compared to other countries, students in Brazil were least likely to be willing to volunteer in climate change-related activities, despite showing little skepticism about climate change and human activity as its primary cause. This may be linked to fewer opportunities to volunteer or to schedules in urban areas, allowing less time for extracurricular activities, but this is not clear. UFPA's students showed greater willingness than others, likely because of the location of the university and its greater involvement in Amazon preservation and related issues.

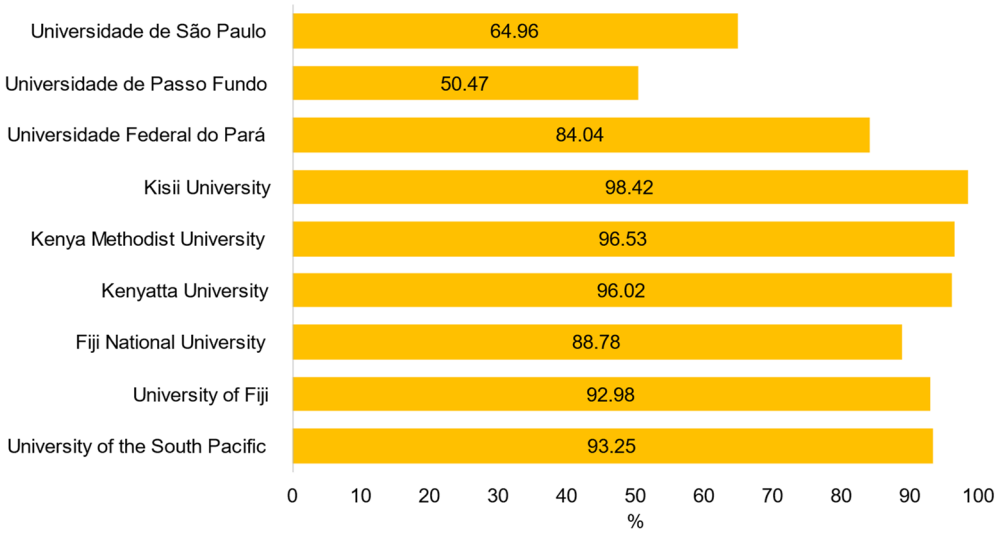

Figure 2. Students' willingness to volunteer in climate change-related activities (%).

Students were asked to respond to normative questions about the role of universities in relation to climate change, as reported in Figures 3 and 4. These questions used a 1–5 response scale where 1 denotes 'totally disagree' and 5 'totally agree'. Averaged responses lie between 4 (agree) and 5 (totally agree), indicating that, overall, students felt strongly that universities and education more generally should have an important role in relation to climate change; in terms of universities, they are trusted spaces to discuss the issue and are leaders of community education initiatives.

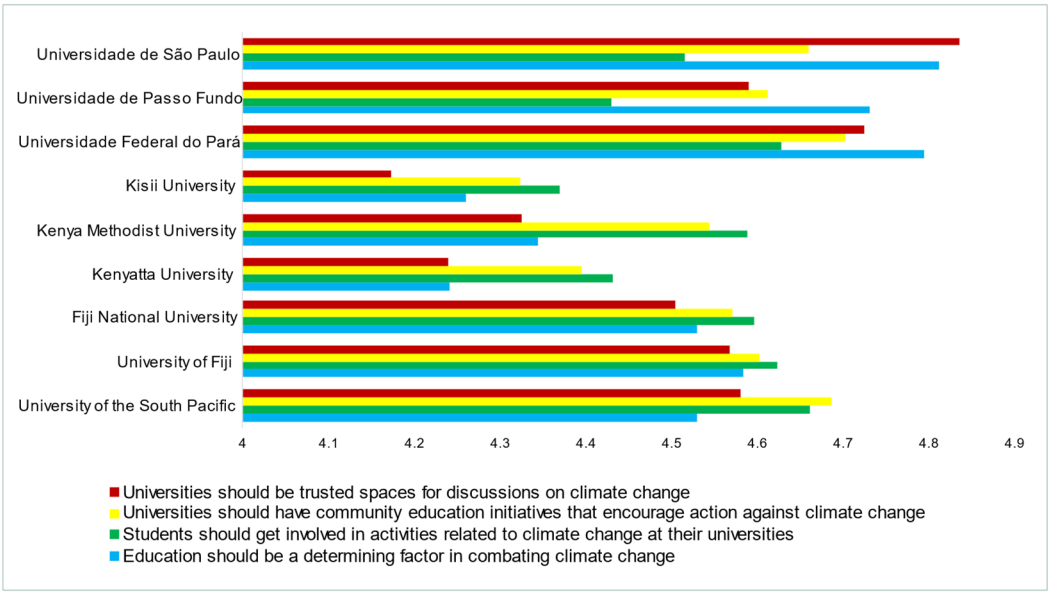

Figure 3. Students' views about the role of universities in climate change (i).

Students' views were especially in favor of a key role for education and universities in Brazil, with almost all students in the University of São Paulo, for example, answering 'totally agree' to the statement that universities should be trusted spaces for discussing climate change and the statement that education should be a 'determining factor' in combating climate change. While still expressing strong support, students in Kenya were slightly more ambivalent. It may be however suggested that the notable politicization of

climate change issues in recent years in Brazil plays a role in driving strong views about the importance of 'trusted spaces'.

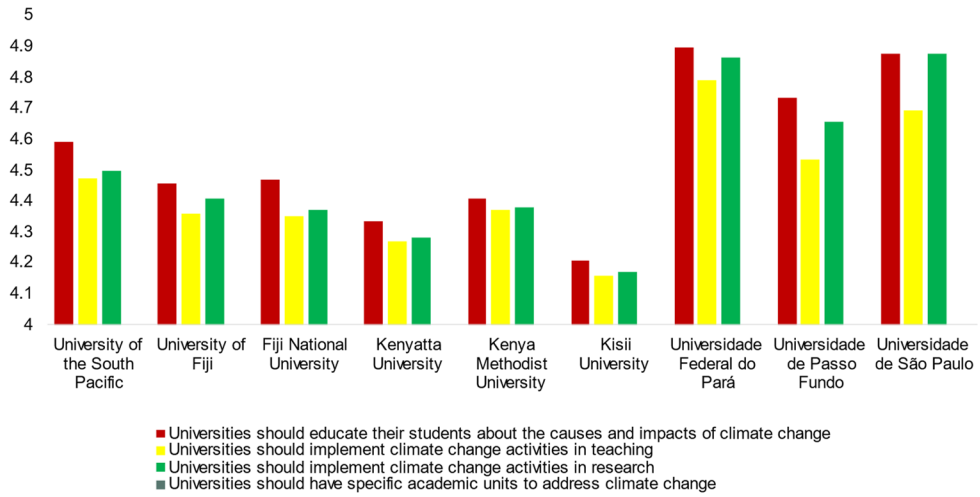

Figure 4. Students' views about the role of universities in climate change (ii).

Students in Fiji and Brazil, especially at USPc and UFPA, expressed especially strong support for the idea that students should get involved in activities relating to climate change at their universities and that universities should have community education initiatives encouraging action on climate change. 'Learning through practice' is considered to be a 'favored pedagogy' among Fijian students, while at the same time, universities are traditionally considered 'authorities'. Both may in part explain the strong support in Fiji. Moreover, fairly high levels of involvement in community activities in Fiji, as discussed below, mean that students can expect to be able to make use of knowledge and skills relating to climate change in real contexts.

On related normative questions about slightly more specific activities of universities in relation to climate change, the pattern of responses was similar. The same response categories are employed as for the question above. Students in Brazil expressed very strong support for the idea that universities should educate students about climate change, implement climate change activities in teaching and research and have specific academic units to address climate change. Responses were slightly less supportive of these ideas in the Kenyan and to a lesser extent in the Fijian institutions, while still being notably in favor. Strong views in Brazil may in part reflect high levels of concern about climate change as caused by human activity and a consequent need to inform and educate, perhaps particularly where there has been a notable political controversy. In Fiji, the important role of communities, faith-based organizations and of a broad collaborative and intersectoral approach emphasized in relation to climate change may be considered as possible contributors with a slightly lower emphasis (when compared to Brazil) on what 'universities should be doing' per se.

3.2. Students' Participation in Climate Change Activities at Their Universities

Students were asked to report which kinds of climate-change related 'outreach' activities they had been involved in at their universities, as shown in Figure 5. Students were most likely to have participated in 'community activities' or 'promotion of awareness'. Students in Brazil were least likely to have been involved across all categories of participation, with less than 20% (and usually less than 10%) having participated in any of the listed activities in the Brazilian institutions. While students in Brazil were least likely to have participated, it was noted above that, at least in Sao Paulo and Para, students felt strongly that they 'should get involved in activities relating to climate change at their universities', indicating a somewhat apparent disconnect, because such opportunities are not available.

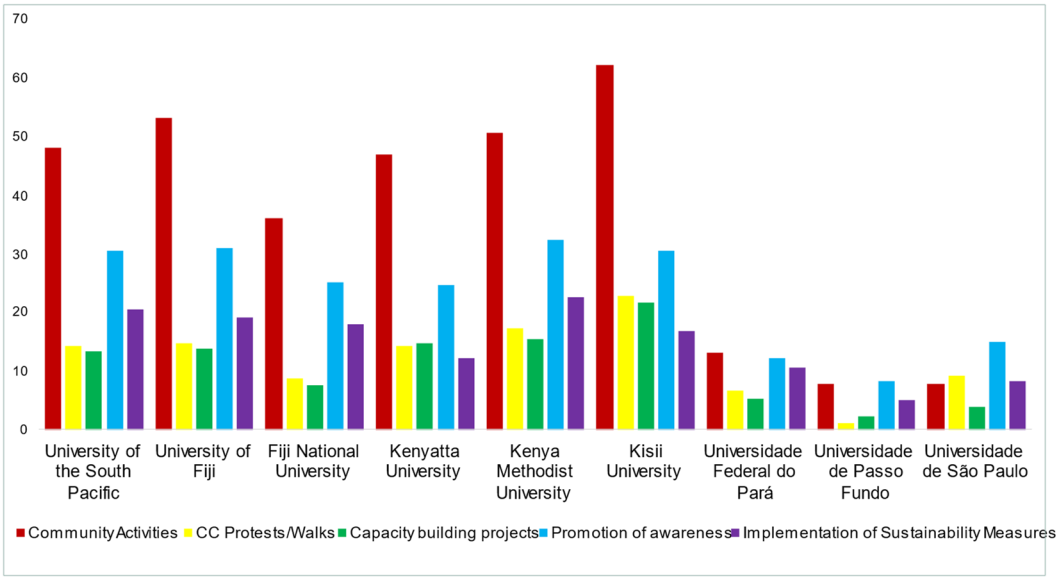

Figure 5. Students' participation in universities' outreach activities (%).

Levels of participation were higher and notably similar overall in Kenya and Fiji. Participation was highest overall in Kisii University where more than 60% of students had participated in community activities related to climate change. Kisii University is situated in an agroecological zone facing a decline in food productivity due to human activities that have destroyed fragile ecosystems. Experiences of communities surrounding Kisii University, which are affected by the extremes of climate change, may have contributed to the students' enhanced engagement in climate action.

Climate change topics are, to varying extents, addressed in all three participating universities in Fiji, and schools at all levels are encouraged to implement climate activities, sometimes as a condition of funding. Moreover, climate change issues receive much attention in the media, and not just because of the strong impacts of climate change on the Fijian economy. Accordingly, awareness and opportunities to participate are generally high in the Fijian context, but not generally higher than in the participating Kenyan universities.

Students were asked to consider the adequacy of their universities' action on climate change in relation to implementing precautionary measures and in their teaching, as shown in Figure 6. The same response categories were employed with average responses being lower than for the questions above (2 denotes 'disagree' and 3 'neither agree nor disagree'). Students were also asked whether their teachers or lecturers address climate change topics adequately and whether coverage in curricula had helped them to understand the urgency of the issue. Students in Fiji believed most strongly that their universities had instituted precautionary measures and while those in Brazil least strongly believed so, especially in São Paulo, where on average students disagreed that their university had instituted such measures.

On teaching and learning, students in Brazil were most ambivalent about the adequacy of provision, with those in Kenya and Fiji giving more positive responses overall, although with an exception of the University of the South Pacific, responses fell short of agreement on average that provision was adequate. The students in the three universities in Kenya perceived their exposure to climate change content as adequate, even though they registered their wish to learn more about the phenomenon. The somewhat positive responses in the University of the South Pacific may be influenced by the long-standing agreements with funding agencies (e.g., EU and USAID) to support climate activities (research, programs, technical advice and community engagement). Moreover, USPc hosts the Pacific Centre for Environment (Sustainable Development) whose mandate is to provide climate education to empower the citizens of its member countries. Climate change is mainstreamed in the

university's research strategy, and research students are expected to align their research topics to it.

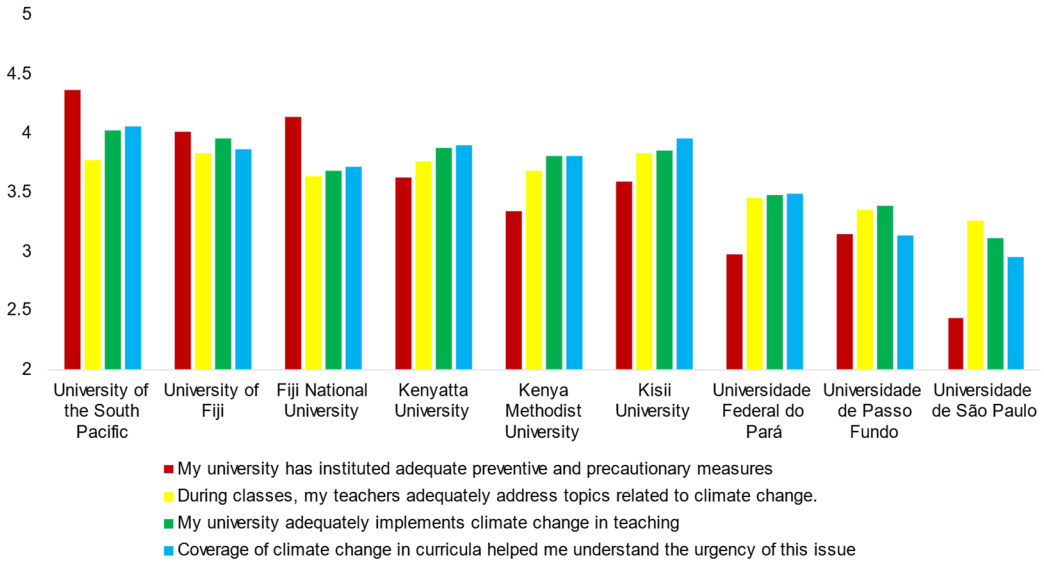

Figure 6. Students' assessment of university action on climate change.

Finally, we examine students' satisfaction with their learning about climate change, depicted in Figure 7. Only a small proportion of students in any university reported being 'satisfied' with what they were learning, reaching 20 percent only in two universities in Fiji. Most students in Fiji and Kenya wanted to learn more, despite learning something about climate change, while students in Brazil were most likely to say they were not learning about climate change, but would like to. Few students said they were not learning and would not like to, with the highest proportion being from the University of Passo Fundo in Brazil. While almost 80% of students in the University of the South Pacific said they were learning about climate change, this figure was less than 45% for the University of Passo Fundo, where notably students were found least likely to be willing to volunteer.

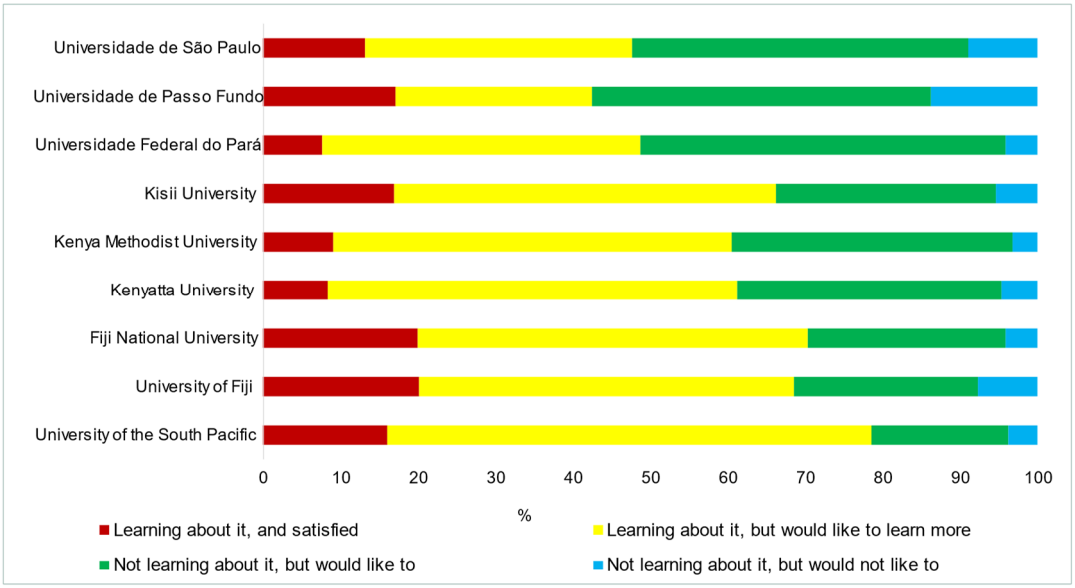

Figure 7. Students' satisfaction with their learning about climate change (%).

4. Discussion

In common with other studies [7,8,27], we find low levels of climate skepticism, except possibly in Kenya, with regard to the role of human versus natural causes, and high levels of enthusiasm for participation in climate change-related activities among undergraduate students. As might be expected, students in universities with lower levels of learning about climate change and of satisfaction with their learning were less likely to provide positive assessments of what their universities were doing, but on average expressed high expectations in normative terms both about what students and their universities *should* be doing. Like a number of other studies, we find potential or suggestive links between the political environments in which debates about climate change may take place and also the likelihood and frequency of more direct experience of the impacts of climate change and students' attitudes to climate change and to the role of universities [11,16,17]. The nature of direction of these relationships is complex, and the role of universities themselves in shaping attitudes is challenging to identify.

Students in Brazil expressed strong beliefs in the role of education and of universities in addressing climate change, but at the same time were most skeptical or critical about what their universities were in fact doing, including in relation to the adequacy of teaching on climate change and to satisfaction with learning. This dissatisfaction may reflect certain features of the higher education (and political) landscape with respect to climate change education and action in Brazil, discussed in [34], which include the diffusion of efforts, the lack of adherence to national guidelines and the dependence on institution-level factors including planning processes and resources. Students in Brazil were least likely to be involved in outreach activities and least willing to volunteer. They were least likely to be learning about climate change, with more than half reporting that they are not learning. This finding is broadly consistent with an earlier study that found coverage of the topic in curricula to be somewhat 'patchy' even in the Amazon region [29]. There is some suggestion here that lower learning levels, lower volunteering levels and lower satisfaction levels are closely related features of the Brazilian context when compared to Kenya and Fiji. Clearly, however, Fiji represents a context in which the issues of climate change are especially of high importance, and the three selected universities in Kenya also represent contexts in which climate change issues receive what may be considered as particular attention.

Students in Kenya were most skeptical regarding anthropogenic causation of climate change but showed a high level of involvement in outreach activities (especially in Kisii University) and strong willingness to volunteer. This appears to suggest that concerns of students in Kenya about climate change and willingness to respond are not predicated on it being necessarily a human-caused phenomenon, which is potentially an important finding. This may suggest that, where students are aware of the impacts of climate change, especially on their local communities, the motivation to act to mitigate or adapt to the impacts may be strong regardless of beliefs about causes. Nonetheless, like other recent studies in Africa [9,23], this raises questions about awareness levels and possible knowledge gaps among university students that require fuller investigation including in terms of assessing knowledge and understanding, which was beyond the scope of our study. Furthermore, most students in Kenya wanted to learn more about climate change according to the present study. This perhaps lends support to Akrofi et al.'s recommendation to provide improved climate change education in appropriate contexts in Africa, including in relation to how climate change may affect other important issues such as conflict, gender inequalities and job insecurity [9].

Students in Fiji show overall patterns similar to those of Kenya, while they are more likely to believe in anthropogenic causation and express slightly stronger views on the roles of universities and education. They provide slightly better assessments of what universities are doing and are most likely to be learning about climate change and to be satisfied with their learning. In these aspects, Fiji presents the most positive picture with regard to students' perceptions and satisfaction. This picture is largely consistent with recent studies [19,20,22] that suggest high levels of awareness and preparedness in relation to

climate change in general, but also higher levels of embeddedness of climate change issues in educational curricula and specifically in university activities. While there is clearly more to be done, the Fijian context provides important examples of sustained engagement with climate change issues in universities and in wider communities that may in turn provide important lessons for settings seeking to progress in this direction. An important question, however, surrounds the question of how transferable lessons may be from contexts where students and communities experience climate change more directly than elsewhere. To the extent that climactic disturbances and disasters become more commonplace, familiarity with such events may be expected to rise globally.

5. Conclusions and Recommendations

This article has presented the findings from a large-scale survey of undergraduate students in Fiji, Brazil and Kenya. The survey provides a strong platform for universities to expand their provision for learning about climate change. While caution is needed in extrapolating to the whole of the student population, and in drawing comparisons between the countries, clear findings have emerged in relation to the desire of students to increase their engagement with questions of climate change within their university experience. The urgency of this engagement among students and of the need for universities to respond, is likely to rise rapidly as reports and experience of climate change and related disasters become increasingly commonplace.

However, findings from survey analysis need ideally to be supplemented by in-depth qualitative studies to explore the lived experiences of climate learning among students, their levels of knowledge and understanding and the nature of their experiences within and outside the university. Our findings suggest that student learning and climate action in universities can form a virtuous cycle. Opportunities for students to learn about climate change—not only within taught courses, but also through campus initiatives, community engagement projects and campaigning—can enhance engagement in university-based climate action, and lead to stronger awareness of and satisfaction with sustainability initiatives in institutions, creating a mutually reinforcing dynamic. Setting this virtuous cycle in motion, however, requires concerted action, involving a conducive policy environment, committed university leadership and space for nurturing grassroots initiatives.

Our findings show that students value the university as a space for learning and action in relation to climate but think that their institutions could be doing more in this regard. The Climate-U survey [33] showed that in all three contexts, social media is the primary source of learning about climate change among the sampled university students. The susceptibility of social media to partiality, bias and manipulation highlights the potential importance of universities further. Our findings support existing calls to bring questions of climate to the center of HEIs' activities and embed them more fully in the curriculum or even to move further in a paradigmatic or transformative shift towards centering sustainable human futures [5,6]. Integrating rich and varied opportunities for learning in HEIs with concerted action through research, community engagement and campus operations is a vital step in addressing the climate crisis.

We provide the following indicative recommendations, based on our findings, in relation to strengthening the role of universities in fostering greater learning and engagement among students with climate change.

1. **Enhance the quality of teaching and learning on climate change**. Students place notable importance on the subject and consider universities to play a crucial role as trusted spaces and as potential centers of community activity in relation to climate change. At the same time, satisfaction with teaching and learning on climate change leaves room for improvement. Enhancing teaching and learning may require updating and developing curricula and pedagogies and in turn may depend on building capacity among academic staff in this area.
2. **Offer extracurricular activities and encourage participation by students in outreach activities.** Students in some contexts showed high levels of participation in

volunteering activities linked to climate change at their universities. Willingness to participate in climate action was found to be high even where actual participation was less so. Alternatives abound for such activities including student clubs, online platforms, community partnerships, workshops, guest lectures by experts and activists and collective action for environmental protection. Student participation can be encouraged in a variety of ways, for example, by providing students with opportunities for internships or fieldwork, by celebrating student contributions to climate change initiatives or by providing scholarships that reward outstanding student projects, research, or activism related to sustainability and climate change.

3. **Improve communication and transparency.** Skepticism expressed by students regarding what universities are actually doing may in part be the result of limited communication and dialogue between university management, staff and students about climate change and the universities' policies and action. Accordingly, improved communications, transparency and consultation may be required both to inform students and to improve responsiveness from students.

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