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## Abstract

Learning about climate change is widely recognised as an important outcome for higher education students. However, there is uncertainty as to the best way to incorporate issues of climate into the curriculum, whether as a stand-alone module, through infusion across courses, through interdisciplinary provision, or informal activities. Furthermore, there is resistance in some quarters to introduction of this content, on account of the contested values involved, the overcrowding of the syllabus, and lack of specialist experience. This paper addresses the arguments for including climate change in the higher education curriculum, assessing the different forms of learning needed by citizens and professionals, the role of the university as institution, and the different potential forms of integration.
The paper puts forward a proposal for a *topography* approach, one that sees the role of the university not as teaching climate change, but as curating a diverse environment of learning experiences. The proposed framework sees learning as being distributed across three spaces (classroom, campus and community) and characterised by features of access (availability, voluntariness and continuity), ownership (agency, malleability and certification) and connection (embeddedness, application, disciplinarity, transmodality, collaboration and experientiality). While universities will display diverse topographies depending on their contextual characteristics, there are important normative considerations which must be taken into account, namely: building on students' existing knowledge, criticality, non-coercion and epistemic pluralism.


## Introduction

If education is a preparation for life, then inescapably it must address the challenges of climate change. Unless there is urgent action, average temperatures will continue to increase, leading to mounting impacts for the planet in the course of this century, involving rising sea levels threatening low-lying countries, prevalence of extreme weather, risks to agriculture and health, among many others. To address climate change, there needs to be strong popular commitment to decisive action, as well as the knowledge and skills to navigate the complexities of the interlocking systems of human societies and the natural environment. None of these are possible without education.

This clear need for education would seem to make simple the role of schools and universities: surely they should just devote more of their time to teaching about climate change? Yet the task is much more complex. Climate action involves not only possession of a series of facts, but also a range of practical skills, adherence to values relating to humanity and nature, and shifts in personal lifestyles and collective modes of organising that can be deeply challenging. Furthermore, students need to be equipped to engage critically and autonomously with complex and evolving debates and evidence around climate, rather than absorbing a neatly defined and bounded package of knowledge and beliefs. To make matters more complex, in any classroom students enter with a diverse array of existing knowledge, capacities and attitudes around climate, and are already engaging with these issues and actions in their daily lives.

Calls for greater attention to climate change in the curricula of schools and universities around the world have been very welcome. If dealt with at all, climate change has historically been included in natural sciences and geography, and the important task of integrating into other disciplinary areas requires some unsettling of conventional course content (Hess & Collins 2018; Leal Filho 2010; Nugent 2021; Reimers 2021; Rousell & Cutter-Mackenzie-Knowles 2020). Yet while carving out greater space for climate change within the formal curriculum is undoubtedly important, it is just part of how climate change can be integrated into the educational experience.

This paper puts forward a vision for the role of education based around the idea of a curriculum 'topography'. This approach sees the school or university as an educational environment with a diverse range of opportunities for learning – taught, self-directed and through peer collaboration – in distinct spaces within and beyond the campus and virtual space of the institution. The task of the educational institution is to curate this curriculum topography to provide the richest possible learning environment in which all students can develop their understanding of, commitment to and action in response to climate change.

The paper aims to address these issues specifically in relation to higher education. Universities and other higher education institutions have characteristics that mark them out from compulsory school-level provision for children, in terms of institutional make-up, with a variety of functions such as research and public engagement outside of their educational offering, and learners who are predominantly adults, with high levels of choice over their studies. The availability of research on curriculum relating to climate change in higher education is growing. Yet for the most part these are analyses of specific courses (e.g. Amos & Carvalho 2020; Fahey 2012), or integration across the taught curriculum (e.g. Hess & Collins 2018; Gomes 2020), with some studies of teaching and learning approaches in formal and informal spaces (e.g. Bush et al. 2017; Rooney & McMillin 2010; Senbel et al. 2014). This working paper takes a broader approach in assessing the whole of the learning environment within the university, and beyond, seeking to understand the relationships between the diverse spaces and the structural features underlying them.

The curriculum is here understood as encompassing opportunities for learning that are organised by and through the university, involving not only formal taught courses, but also interactions on the university campus, and voluntary and professional work outside – whether lecturer-led or student-led. In discussing curriculum, it is always important to bear in mind the gaps that may exist between intentions and pronouncements (the official curriculum), and what ends up being carried out in practice (the taught or unofficial curriculum), not to mention the submerged rituals that may not be apparent even to those engaged in them (the hidden curriculum). Across the various levels of education, the vast majority (95%) of the 194 countries reporting to the UN Framework Convention on Climate Change (UNFCC) state that they offer some climate change education in their curricula (UNESCO 2019), yet there is little evidence that this official integration filters into the classroom. The PISA results show poor learning outcomes relating to the environment even in the relatively privileged OECD countries (OECD 2012).

There are some aspects of the question that cannot be dealt with in full in this paper. First, there is not space here to specify the exact content that will go into climate change courses (whether palaeoclimatology, geo-engineering or wind energy). Second, the paper will not deal comprehensively with questions of pedagogy, teaching methods or learning styles; these will be addressed in a separate working paper. Third, while there is discussion of accreditation, there will not be a detailed treatment of assessment, though it is acknowledged that curriculum in practice may be strongly determined by what is assessed and that constructive alignment is crucial. Fourth, there are complex questions in curriculum studies about the culturally specific or alternatively universal nature of knowledge (White 2019; Young 2008; Santos 2015), linking in with the movements for decolonisation of higher education in recent years. These are relevant for climate change education, and will be touched on here, but are dealt with in greater depth in other publications. In addition, the analysis presented in this paper will chart the broad contours of climate change in the university experience, but the ideas presented must, needless to say, be contextualised in the specific circumstances of each university.

In addressing the question of how climate change should be integrated into the university curriculum, this paper will progress through a series of questions. First, it will address the basic rationale of why it is important for people to learn about climate change, and the different forms of learning that are valuable. Even if it can be shown that learning about climate is strongly justified, it is not necessarily the case that the task should be carried out by universities, so the following section addresses the appropriateness of this specific form of education institution. Following that, there is an analysis of how climate change can manifest itself in the curriculum, and in response a topographical scheme for understanding the interlocking spaces and forms of curriculum integration is proposed. Finally, the paper draws out implications for how climate change can best be worked with in the university.

## Why is learning about climate change important?

The severity of the climate crisis is by now well known, and there are numerous accounts, both specialist and for the general reader, of the manifestations, causes and impacts of anthropogenic global warming (Anderson, K. 2012; IPCC 2018; Klein 2014; Mann et al 1998). This paper will not rehearse these points in full, but a few are important to recall. First, there is significant urgency to bring change: targets such as achieving carbon neutrality by 2050 hide the fact that tipping points may be reached much earlier than that, and the later that change happens, the harder it will be to achieve. Second, climate change is rooted in the contemporary model of society and its modes of economic organisation, and so challenges fundamental aspects of humanity's beliefs and practices. Third, and as a result of the previous point, responses to the climate crisis involve changes at all levels, from individual behaviours and consumer choices to business practices, government regulation and international cooperation. Change is extremely hard at all of these levels for different reasons, at the macro-level because of the interests of powerful corporations and states either directly or indirectly benefiting from fossil fuels, and at the micro-level on account of entrenched habits and attachments to carbon-heavy lifestyles, particularly in the wealthier parts of the globe.

The necessity for change in practices as well as policies, the rooting of climate change in values and beliefs, and contestation over it, means that learning is essential. Without transformation of understandings and behaviours, the only option left will be an authoritarian approach to climate regulation, with all of the obvious harm that would bring. Technology is without doubt crucial to overcoming the challenges of climate change, yet it is surely wishful thinking to imagine that no changes in social organisation, lifestyle or consumption levels will be necessary in addition.
Changes at both the individual and collective levels are, therefore, needed (Reimers 2021). Individuals need to confront the substantial psychological barriers to change (Marshall 2014), and transform their lifestyles, consumer habits and other choices. Yet collective

change and action are also necessary. To ensure the necessary transformation at the macro-level, civic action in a variety of forms is needed, from voting, to critical scrutiny of government and big business, and popular mobilisation.

These points relate to the kinds of learning needed by all members of society; yet there are certain individuals who have specific roles in relation to climate change, and who therefore require particular forms of learning. These will include professionals working directly with environmental or social questions relating to climate change, and to scientists and scholars researching the phenomenon, both of which are most likely to be trained in universities. This dual role for the institution – in forming professionals and educating citizens – has particular implications for the way climate change is addressed in the curriculum, as will be explored in the sections that follow.

It is also important to distinguish between two aspects of the response to climate change – mitigation and adaptation. Mitigation refers to the reduction or prevention of the causes of climate change, primarily the emission of greenhouse gases; while adaptation involves the changes needed in light of the impacts of climate change, in ensuring survival and well-being despite the challenges. All people will need to be involved in both prevention and adaptation, though some communities have disproportionate responsibility for emissions and therefore for mitigation, and others bear the brunt of climate impacts and therefore have a greater burden of adaptation. To these it is also important to add actions focused on regeneration, "producing social systems or land use systems that are able to create positive benefits for restoring biodiversity, healthy ecosystems and viable communities" (Facer 2020: 15). These processes involve both altruistic and self-interested motivations, in minimising negative impact on others, but also protecting one's own quality of life. The global disparities referred to above also bring into play questions of climate justice and environmental justice more broadly, the need to develop a 'moral imagination' (Reimers 2021) and the need to understand the centrality of inequalities to the current crisis.

A final reason why learning relating to climate change is important is that it is such a complex and contested issue. We might as a global community be faced by a critical and urgent issue, but one whose causes and solutions were more straightforward – for example, asbestos exposure. The need for widespread action would be extensive, in mobilising and regulating to remove use of asbestos in construction, but the learning required would be fairly minimal. Climate on the other hand is a highly complex system (McCowan 2020, Tikly 2019) and responses need a significant degree of sophistication and responsiveness to feedback loops and changing circumstances in social as well as natural domains. Furthermore, there is a high level of contestation, from outright denial of anthropogenic global warming (see, for example, Booker 2009; Morano 2018), to scepticism as to the risks and the ways of addressing it (e.g. Lomborg 2007). Extensive knowledge, understanding and skills of analysis are required to navigate these debates, as will be explored further in the section that follows.

## What kinds of learning about climate change are needed?

The question of where climate change might fit into the curriculum is strongly linked with that of what exactly needs to be learnt about climate change. Educational aims have conventionally been split into knowledge, skills and values. While the term knowledge can also refer to acquaintance or to know-how or procedural knowledge (closer to skill), generally it is used to refer to factual or propositional knowledge. To the knowledge element we can add *understanding*, which is the deep absorption of knowledge so it is grasped and becomes meaningful for the individual in question. In the case of climate change, these will include, amongst other elements, knowledge and understanding of the evidence surrounding changes in temperatures over time, the causes of anthropogenic climate change in greenhouse gas emissions, the aspects of human behaviour that lead to greenhouse gas emissions, and ways of absorbing carbon from the atmosphere. The knowledge component is the focus of the widely used *Sulitest*[1], which assesses sustainability literacy among students and the general public.

Skill involves practical abilities to do, rather than just to know. A distinction is often made between hard skills – technical or profession-specific skills – and soft skills – generic ones related to personal and interpersonal abilities such as teamwork. In relation to climate change, the skills needed may be those of research and analysis, but also political ones of advocacy, organisation and campaigning, and those related to environmental protection and use of new technologies. Currently in vogue is the idea of 21st-century skills (IT literacy, creativity, collaboration etc), seen as essential to address the challenges of our complex post-industrial societies, including climate change. UNESCO (2006: 21) provides the following list of skills seen to be essential for addressing sustainable development:

> [C]reative and critical thinking, oral and written communication, collaboration and cooperation, conflict management, decision-making, problem-solving and planning, using appropriate ICTs, and practical citizenship.

Finally, there are values. Values relate to different spheres (including aesthetic), but those most relevant here are the political and the moral. We may see values as having intrinsic importance, but they also have an instrumental relevance in relation to climate change as they shape beliefs, attitudes and behaviours. Values relating to climate change include those relating to the natural world (what Orr [1994] calls *biophilia*), but also importantly those relating to social justice, equality and liberty. Since greenhouse gas emissions are the result of social, political and economic organisation, reducing them necessarily entails changing the organisation of society and the distribution and use of resources.

[1] https://www.sulitest.org/en/index.html

Knowledge, skills and values are all essential for human beings to engage in climate action. Literature on the topic has shown convincingly that simple awareness raising and development of knowledge about climate change is insufficient for ensuring action and changes in behaviour (Anderson, A. 2012; Facer 2020; Facer et al. 2020; Munroe et al, 2019; Rousell & Cutter-Mackenzie-Knowles 2020; Stevenson et al. 2017). Research by Ojala (2016) also shows the necessity of engaging with climate change as an affective or emotional issue, not just a cognitive one. Others (e.g. Nussey 2021) have argued for the importance of cultural, artistic and aesthetic engagement with issues around climate. The reality of university provision may be somewhat different, however: the UNESCO (2019) analysis of country submissions under the UNFCC reported that at the tertiary level, 75% of courses focused on knowledge, 0% on skills and 25% on socio-emotional skills.

We might question the divisions between these three elements of knowledge, skill and values. The fragility of the distinctions between them can be shown by their usage in different languages, even amongst relatively similar languages such as those in the Indo-European family. In Spanish and other Romance languages, for example, there are two words for knowledge, which can distinguish between more theoretical and formal knowledge, as opposed to more practical or day-to-day knowledge. This distinction starts to blur the line between knowledge and skill. We could also argue that it is hard to extract values entirely from either knowledge or skill. The acquisition of knowledge can lead to the development of certain values: prejudice against migrants and foreigners may be based on misconceptions (for example that they are 'stealing our jobs' or 'sponging off the state') that can be shifted with exposure to the actual evidence; meeting and interacting with people from a hostile outgroup (knowledge as familiarity) can lead to seeing their common humanity and changing feelings towards them. Likewise, skills – particularly complex sets of skills involved in trades and professions – often come with an embedded set of values towards the practice itself, for example pride in and commitment to the high standards and aesthetics of glassblowing or landscape architecture. Similar debates are played out in relation to critical thinking, which is at first sight a skill or a set of skills, but is hard to disentangle from the disposition to be critical (Schendel et al. 2020).

The objectives of learning are often framed in terms of 'competences' or 'competencies', (e.g. Burandt & Barth 2010, Barth et al. 2007; Pérez Salgado et al. 2012). Competences are another example of the merging together of aspects of knowledge, skill and values, signifying the combination of attributes necessary for success in a particular activity or profession, or generally in life. This idea has become popular in the field of education for sustainable development, for example in the notion of *Gestaltungskompetenz* (literally 'shaping' competence, or capacity for transformation) in the German language debates. In the field of climate change, there have been attempts to define competences in this way, with Burantdt & Barth (2010), for example, putting forward the following set of four:

1. analysing multiple networked, complex problems of (non-) sustainable developments and the perspectives of sustainable changes;
2. dealing with uncertainties and thinking proactively;
3. using, shaping, handling and sharing different sets of information and knowledge;
4. assessments, ethical orientations and proactive thinking in order to secure a capacity to act.

Competencies are seen to be a progressive approach to framing the curriculum, since they move beyond inert knowledge content and rigid disciplinary approaches and towards multidimensional and real-life abilities, combining knowledge, skills and attitudes. Yet they bring with them some other problematic elements. One of these is that competencies represent an exogenous frame for learning: they determine what individuals should be able to do and how they should act on the basis of tasks or jobs that need completing. That may be entirely appropriate in assessing individuals for a particular form of employment, but fall short of a holistic vision of education based on learner agency. Competence-based frameworks do not always contain a sufficient element of criticality and reflection, and in this regard can be more akin to *training* than *education*. (This risk is real in the field of climate change, with technical approaches bolstered by some of the international frameworks – Nussey et al 2021). In addition, if they are viewed as a rubric to be completed, they can ignore the continuous dimensions throughout the whole of life: one does not reach a point at which one has sufficient imaginative thought or problem solving and can stop developing them.

There are uses of competencies that avoid the above issues, and put forward more open conceptions of interculturality, empathy and interdisciplinary work, on a lifelong basis. Nevertheless, even in these instances, it is not clear whether the notion addresses adequately the value dimension, for example whether we should ever describe as a competence a person's commitment to protecting their community from a mining project or campaigning for racial justice, or even treating their work colleagues fairly and respectfully on a day-to-day basis.

Another set of distinctions is useful here, that between learning 'about, for and through', one that has been used frequently in relation to education for sustainable development, as well as citizenship education and human rights education (McCowan 2009; 2013). This triad distinguishes between, in the first place learning *about* climate change, the gaining of information on the topic, and understanding of the debates surrounding it – therefore linking in strongly with the element of knowledge outlined above. The second – learning *for* climate change – is primarily related to skill, although there involves elements of knowledge and value as well, in developing the capacity to act:,either directly in climate change mitigation or adaptation, or indirectly through campaigning, mobilising and influencing. The

third, 'through', involves experiential learning, taking place not in formal educational settings such as the classroom, but through activities relating to climate change in the broader society, such as environmental projects, political action or community engagement work. This final element may also involve acquisition of knowledge, skills and values, but has some unique characteristics in going beyond simulations to show the messiness and blockages but also the inspiration of real life settings. Nevertheless, these real life settings are unpredictable and not always accessible, and they may not provide the best location for the development of knowledge and skills, so simulations within the university space will also be vital. There will always be a place for learning about and for, in addition to through.

Thus far we have addressed this question from the perspective of covering comprehensively the different forms of learning needed. Yet what students should learn about climate change must to some extent at least be determined by what they want to learn about it. At the higher education level, student agency in relation to learning is both possible and highly important, and particularly in an area such as climate change in which they may already have extensive engagement. Existing evidence shows that university students are already strongly interested in and committed to resolving climate change – a recent survey in the UK, for example, has shown that 90% of students are fairly or very concerned about it (SOS-UK 2021). So coercion in this area appears unnecessary, as well as undesirable. Munroe et al. (2019) conducted a systematic review of the effectiveness of climate change education: while most of the studies identified were at school level, 11 of the 49 were in higher education. The key points emerging as key to success in these cases were: "(1) The programs focused on making climate change information *personally relevant and meaningful* for learners. (2) The activities or educational interventions were designed to *engage learners*" (original emphasis). These findings show how important it is to contextualise the content in ways that are relevant to students – either to their actual lives or their course content – along with use of innovative and experiential pedagogy.

This brings us to one of the most complex questions of climate change education: the extent to which it should instil a particular set of knowledge, skills and values, or alternatively leave students to critique them, and allow them the autonomy to adopt alternative views. At first sight, there appear to be strong reasons for promoting a predefined set. Climate change is a crisis of potentially unparalleled proportions, threatening to wipe out humanity, so is hardly a 'take it or leave it' topic. Furthermore, there is a substantial body of coherent evidence on the trajectory, causes and impacts, leading to clear implications in terms of reduction of emissions of greenhouse gases. From the urgency, the gravity and the need for action, it would seem to be possible to derive a clear educational plan in terms of what all people must know and be able to do – and indeed this has been the basis of much educational action in relation to climate change.

However, while not dismissing the above out of hand, certain caveats are necessary with this position. First, there are still a number of unresolved empirical questions relating to climate change that require further investigation: while anthropogenic global warming may not be in doubt, our understanding of its speed, impacts and causes are constantly being refined, and learners should be aware of the ongoing processes of enquiry. Second, the response needed from the global community to this critical challenge is far from straightforward, and even amongst those both convinced of the reality of the climate crisis and committed to addressing it there are a range of reasonable positions, with different combinations of energy efficiency, changes in consumer behaviour, regulation of corporations, geo-engineering, absolute reduction of resource use, redistribution and paradigm-shifting. It would be entirely inappropriate to present students with a single solution to this conundrum. Thirdly, and most crucially, climate change education at the end of the day is education, and must be part of the general process of developing learners' own understanding, enquiry and critique, rather than unquestioning absorption of information or unreflexive training or conditioning (Jickling & Wals 2008). After all, it was only through this kind of critical scrutiny and challenging of existing beliefs that breakthroughs in climate science and political action were possible in the first place.

As stated by Facer et al. (2020: 3):

> the SDG[2] implies that there is a 'settled' and somehow agreed framing of what constitutes climate change mitigation, adaptation and resilience – and implies that the function of education is to 'promote' this settled understanding, assuming a 'deficit' knowledge approach that arguably seeks to fill in the so called climate knowledge voids in learners' heads, rather than to negotiate mitigation, adaptation and resilience measures as appropriate in each setting.

These questions raise epistemic issues involving sources of belief, climate change denial, truth and expertise which cannot be covered in full in this paper, and require separate treatment. Nevertheless, the implication for the question addressed here is that a predefined body of knowledge around climate change, or even a set of competencies, while playing a role, will never be sufficient as an educational programme in climate change. Ultimately, learners need to develop agency in relation to climate change, to engage in enquiry, construct their own perspectives and generate new knowledge. Furthermore, the need for criticality – and also imagination and creativity – lead us towards a model in which instead of predefined content delivery, students have ample opportunity for self-directed and peer learning. These distinctions and considerations will inform the reflections in the subsequent sections on whether and how the university should incorporate climate change into its educational programme.

## Is it the role of the university to teach about climate change?

Before outlining a curriculum framework for higher education, it is important first to assess whether the kinds of learning outlined above should be acquired in the university, or alternatively

2 Sustainable Development Goal 13 on Climate Action.

at school, in the family or the broader society. Answering this question involves determining what kind of institution a university is and what its general purposes are, a task that on its own could require multiple volumes. Nevertheless, a few words here will be of use. Higher education is generally taken to refer to a level of study undertaken after basic education has been completed, and therefore normally in adulthood, providing substantial depth and sophistication of learning, usually in a specialist area. The institution of university, which now dominates higher education globally, has its origins in mediaeval Europe, though is only one of a number of historical manifestations of higher education institutions around the world (Carpentier 2019; McCowan 2019; Perkin 2009). The university is distinct from some other forms of adult education, vocational education and apprenticeship in that its primary purpose is critical and open-ended enquiry (Collini 2012). While universities come in many different guises, and conduct research and community engagement and other functions to greater or lesser degrees, this would appear to be a unifying factor – their educational approach going beyond mere training of a non-reflexive type.

The characteristics outlined above can shed some light on the place of climate change within the institution. Looking back to the distinction between knowledge, skills and values, few would question whether it is the place of the universities to promote the first of these. University is the knowledge institution par excellence, both in terms of passing on knowledge to students, but also generating new knowledge through research and scholarship. There are, nevertheless, significant debates about what knowledge specifically should be made available to students, whether a broad curriculum such as one would expect at school level or a narrow focused area, or professional or vocational knowledge as opposed to general knowledge. Countries have addressed these questions in different ways in their higher education traditions, with, for example, the USA leaning towards a broader general curriculum (in many cases in the liberal arts) and European nations towards a narrower focus in a single discipline.

Skills are rather more controversial. The skills most naturally associated with higher education are those of intellectual enquiry, including textual analysis and inference, bibliographic searching, empirical data collection, conducting of scientific experiments, as well as debating and public speaking. More specific skills of an academic nature are developed in each discipline. Yet the massification of higher education in the 20th century has led to increasing numbers of vocational courses, with a more practical job-related focus and an emphasis on employability. These trends have opened up the range of skills in the purview of higher education, though not without resistance. While there are calls from industry for work-ready graduates, there is scepticism from some quarters as to whether universities should be promoting non-academic skills, whether of a vocational nature or more general life skills (McCowan 2015). It can be argued that these skills are better developed in other settings (such as in the workplace itself), or should have been developed at an earlier stage (in school or in the family).

Yet it is in the sphere of values that the most doubt exists. While it is likely that most of our fundamental values are already in place by the age that people commonly go to university, some shaping of values is inevitable, as it would be in any long-term experience. With the massification and in some contexts near universalisation of higher education, the civic role of the university becomes more prominent. When the majority of citizens in the country are attending a level of education it inevitably takes on an important role in shaping the interactions and practices of society as a whole, influencing its democratic or alternatively authoritarian character and the level and nature of political participation. The urgency and weightiness of climate change would seem to qualify it as one of those issues that cannot be ignored by an educational institution attending to a substantial proportion of the population.

Yet many argue that it is not the place of the university to promote a set of values – at least values beyond those of the academic discipline, or that justifying higher education on the basis of an overarching civic goal is unduly paternalistic (Martin forthcoming). Universities have been bastions of ethical individualism (Dworkin 1996) in which personal convictions are sacrosanct; it is against the principle of academic freedom to oblige all staff to adhere to a particular set of values – other than, perhaps, procedural values such as that of academic freedom itself. Even if it were not against the principles of the institution, it would be highly difficult in practice to ensure unity of values in such large, diverse and autonomous organisations (Haddock Fraser et al. 2018). Furthermore, in any form of education, while creating space for reflection on and clarification of personal values can be very useful, it is perilous (and of dubious efficacy) to oblige teachers to instil specific values in students that they (teachers) may not hold themselves.

Does the difficulty of ensuring a unified value set make impossible the task of climate change education? And does it put in doubt the advisability of alignment of universities' work to frameworks such as the Sustainable Development Goals (SDGs), which has become increasingly common in recent years (McCowan 2019). Despite the thorny issue of values, there are still strong reasons why universities should incorporate climate change into their curricula. Climate action (mitigation, adaptation and regeneration) is essential for our survival, and inevitably part of all people's existence for the foreseeable future, so we should include it in the university as part of preparation for life. Furthermore, climate change is now a crucial part of academic disciplines, in their attempts to describe and analyse the world around us, so it would be scientifically negligent to exclude this material. Equally, for professional preparation in many areas it is now important to include capacities relating to climate action. Climate change education (or sustainability more broadly) can be pursued in universities, even in light of the constraints on value promotion, in ways that leave the aims and outcomes more open, on the basis of deliberation and enquiry, and are consistent with academic values.

The appropriate response of the institution committed to addressing climate change would therefore be to promote it in those areas of action which it directly oversees (operations, cross-

faculty initiatives, partnerships, external engagement) and ensure an enabling environment for lecturers and students to pursue learning and enquiry in the semi-autonomous spaces in which they operate and interact. It is this approach that will characterise the proposals below. Finally, it is important to emphasise that whatever responsibilities or possibilities higher education has for teaching climate change, it will never be the only important space in which people learn about it, even for students currently studying in higher education. The university needs to view its learning spaces in conjunction with those outside.

## Climate change in the formal curriculum

The most obvious way in which climate change can appear in the university curriculum is as a discrete course – whether degree programme or a subcomponent of it. Full degree programmes do exist, many at the graduate level (for example, the Master of Climate Change Adaptation at the University of the Sunshine Coast, Australia), but also some undergraduate programmes: in the UK it is possible to study a full BSc in climate change in universities such as Greenwich, Northampton and Liverpool John Moores. There are many more dual courses, for example climate change and health, law or international development. These courses are crucial for those looking to forge a career in the various lines of environmental work. Yet few would go so far as to argue that all or most university students should study a dedicated degree in climate change.

More common is the provision of a unit or module on the topic, either as part of specific courses or freestanding. Examples of this form of provision are becoming more common, as are cases in which climate change appears as part of sustainable development or environmental education units. Should then these cross-cutting modules be compulsory for all students, to guarantee coverage regardless of the course studied? This question is complex, for principled and pragmatic reasons. As discussed above, there are constraints on universities as institutions in compelling students to engage in particular activities, given that the learners in question are normally adults who have freely chosen to study there. From a pragmatic perspective, compulsory modules not directly connected with disciplinary content may not be taken seriously, or at worst provoke resistance on the part of students. The dual roles of universities as institutions of both learning (with intrinsic and instrumental value) and accreditation (with exchange value) are brought into tension here. Furthermore, there is pressure for space in curricula, with climate change competing with a number of other cross-cutting areas needing attention, such as peace-building, global health, human rights and citizenship.

In any event, even if it were legitimate and advisable to compel students to engage in a module on climate change, it may not be the best approach educationally. A danger of the discrete subject approach – as seen in other areas such as citizenship – is that students then confine the topic to one part of their learning, and fail to see the broader connections (McCowan 2009). Embedding climate change across all areas of the taught curriculum, while harder to achieve, is likely to be more effective approach, along with availability of discrete models on an optional basis.

A helpful framework in this regard is provided by Molthan-Hill et al. (2019). They distinguish between four approaches to embedding climate change in the curriculum: *piggybacking* – incorporation of content into existing modules; *specialising* – creation of new modules; *mainstreaming* – incorporation across the whole of the existing curriculum; and *connecting* – creating new cross-disciplinary offerings. The dynamics of interest here are the movements between the two axes of narrow/broad curriculum and existing/new structures.

As illustrated in the Molthan-Hill et al. (2019) scheme, climate change education commonly mobilises arguments around interdisciplinarity. Silo working is seen to be one of the main barriers to successful practice in this area – in the university and as regards sustainable development as a whole (hence greater attention to interlinkages between the goals in the SDGs in comparison to the Millennium Development Goals [MDGs]). The primary argument for interdisciplinary working is that the complexity and multifaceted nature of climate change means that solutions will only be possible if it is approached from different angles simultaneously. Moving from the research to the educational function of the university, it is argued that students should be nurtured within this broader perspective, rather than the restricted view of individual disciplines (Facer 2020; McCowan et al. 2021; UNESCO forthcoming).

In clarifying this discussion, it is important to distinguish between multidisciplinarity, interdisciplinarity and transdisciplinarity, which all can be mobilised in support of the above aims, but requiring increasingly deep levels of change. Multidisciplinary work involves researchers from different disciplines applying their disciplinary expertise to solve a common problem; the benefits of multiple perspectives are brought to bear on the problem, but the disciplines remain intact through the process. When applied to teaching and learning this would entail separate sessions from different disciplinary perspectives on a common theme. Interdisciplinary work, on the other hand, brings the disciplines into dialogue with one another. The disciplines are still present, but begin to modify each other as they highlight each other's distinctive characteristics, critiquing and revealing positive qualities. There is a unified final product – whether a research output or outcome of learning – although drawing on the diverse disciplines. Finally, transdisciplinarity takes us beyond disciplines altogether. It is a new way of working that shows no barriers between conventional perspectives.

These distinctions help us to conceptualise the different ways in which climate change can appear in the curriculum. There are various possibilities here. In its simplest form, climate change can appear on the syllabus for a regular disciplinary area – most obviously within areas such as geography, geology or environmental science. A multidisciplinary perspective can be obtained from ensuring that climate change is embedded across many or even all courses (though in most cases it will not be possible for each student to

access the multiple perspectives). An interdisciplinary approach would involve a unit being taken by students from various base disciplines, led by lecturers from a variety of areas, putting their different perspectives (and those of the students) into dialogue.

An example of this kind of course is provided at the University of São Paulo, in the INCLINE centre, in which an interdisciplinary MSc module is provided for students from any disciplinary area, involving perspectives from palaeoclimatology, oceanography, economics, public policy and biometeorology. As argued by Fung (2017) and Burandt & Barth (2010), the interdisciplinary experience can occur as much through the mixing of students on different courses within the same classroom as through the combination of content from different disciplines. Transdisciplinary initiatives at universities are rare, since recruitment and promotion of staff usually follows disciplinary lines, and students normally slot into disciplinary or at least multidisciplinary courses. But an example would be a regular discussion group on climate change for students and staff, a space for learning that breaks with conventional epistemic divides and ensures engagement with the topic from fresh perspectives, organised on thematic rather than disciplinary lines.

There are a range of ways, therefore, that climate change can be integrated into the formal curriculum, alongside other opportunities for learning on campus and beyond. But how can we understand these different possibilities of location of climate change in the curriculum, their relationships to one another, their key characteristics and implications for student learning? The framework put forward in the following section attempts to address these questions.

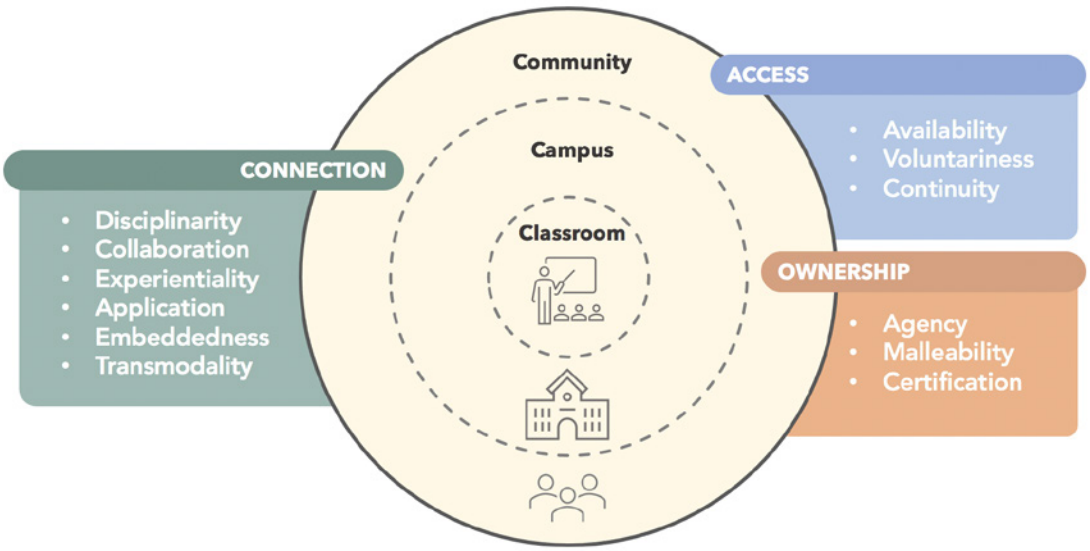
## A framework of curriculum topography in the university

Most approaches to climate change education take one of two approaches: either designing a discrete course, or determining a set of learning outcomes or competencies that will be achieved across a range of taught provision. These approaches more or less correspond to an input or output focus respectively, by determining the kinds of treatment that students need, or the goals that need to be achieved. This paper takes an approach that is different from both of these, one corresponding more to a process approach. It outlines a topography of learning experiences with which students can engage. Topography is here used metaphorically to refer to the varied landscape of learning opportunities, with diverse opportunities for learning about climate change in different spaces, in different formats, from and with different people, and with different outcomes.

Drawing on the discussions in the previous sections, the curriculum topography approach is helpful as it addresses the need for diverse forms of learning (knowledge, skills and values; learning about, for and through); it is based on learner agency rather than coercion; and it incorporates both discrete and embedded forms of learning of a disciplinary and non-disciplinary nature. In order to gauge the kinds of topography present in universities, and to plan for future transformations, we need to understand the spaces of learning that exist, and the relevant characteristics of those spaces.

Figure 1 below outlines these principal spaces and their features. The graphic presents a framework for understanding the topography of learning about climate change in universities. It has two facets: first the sites of learning (classroom, campus and community), the places where engagements take place; and second, the curricular features (disciplinarity, certification, continuity, embeddedness etc.), in three groups – access, ownership and connection. The features can apply to forms of learning occurring in any of the three sites, though some are more likely to go together: for example, formal taught courses (classroom) are more likely to carry credit than engagement in a student society (campus).

Figure 1: Curriculum topography in the university



There are three primary sites of learning, designated by the 3 Cs of classroom, campus and community[3]:

**Classroom:**

The first C refers to the formal curriculum, which may or may not be delivered within a literal classroom. Provision here is likely to take the form of either discrete provision, such as an optional module on climate change, or embedding across all modules.

**Campus:**

Learning also takes place in other parts of the university space, whether physical or virtual. For example, through student associations, artistic and recreational activities, or through engagements in environmental initiatives on campus such as recycling or reducing energy usage.

**Community:**

Finally, learning can take place beyond the campus in activities organised by or through the university. These activities may be part of formal courses, such as research projects, linked internships or work placements. Or they may be entirely independent of students' programmes of study, such as volunteering work, campaigning and mobilisation. Community here is used in a figurative sense, and may not be literally the local community surrounding the university.

Naturally, these sites are not impermeable, and many forms of learning will cut across them: for example, a dissertation project which involves data collection in the community, but also classes in research methods, or a work placement involving subsequent reflective writing for assessment.

In conjunction with these three sites of learning, we can identify dimensions of variation in how climate change appears in the curriculum. In order to understand more fully the nature of the spaces – the kinds of learning possible, the distribution of those opportunities, their relationship to other learning opportunities – we need to look beyond the surface features to their underpinning characteristics. The 12 'features', therefore, highlight structural characteristics of these learning spaces, corresponding to structural features of physical topography such as elevation, relief or landforms. These features cluster according to three key questions: **access** – who is able to engage in the curriculum, and the conditions in which they do so; **ownership** – the locus of influence, control and decision-making over the curriculum; and **connection** – how the curriculum relates to the field of knowledge and other knowledge areas, to other functions of the university and to practice in the broader society. These three dimensions allow us to assess on the one hand the educational dimensions of the curriculum – the learning acquired and the meaning it has for learners, the agency that learners express and the impact on their lives – and the social justice dimensions – the fair distribution of opportunities for learning, and epistemic recognition in the context of diversity.

The specific features[4] are as follows:

**Access**

- *Availability*: is the provision available for all students, or only for those of certain courses? Is it potentially universalisable, or necessarily restricted to limited numbers?
- *Voluntariness*: is the provision compulsory for all students, compulsory for some students, or voluntary? If not officially obligatory, are there *de facto* forms of compulsion?
- *Continuity*: is the learning ongoing throughout students' trajectory at university, available in a specific year, or a 'one-off', appearing at particular moments?

**Ownership**

- *Agency:* who initiated the activity? Is the initiative university-led, lecturer-led or student-led? Who participates in and controls the decision-making process or the content of the activities?
- *Certification:* does the activity lead to the obtaining of credits leading to a degree? Or is there any other formal recognition of the activity that can provide exchange value for students in seeking further study, employment and other opportunities?
- *Malleability:* how open or closed is the content to modification and development? Is it predefined or constructed during the activity?

**Connection**

- *Disciplinarity:* to what extent is the activity linked to a specific academic discipline, and oriented around disciplinary bodies of knowledge, principles of enquiry and methods? Or if not, is it multidisciplinary, interdisciplinary or transdisciplinary?
- *Embeddedness:* is the provision part of an existing taught course or research study or other university programme? Or is it a freestanding activity?
- *Application:* to what extent is the learning abstract and theoretical, or applied to contexts of practice?
- *Experientiality:* Are there experiential elements, involving learners' participation in real life situations? Or alternatively is it preparatory learning, or involving simulations?
- *Collaboration*: what level of collective working does the activity involve? Is it a lone process of learning, or of interaction between student and lecturer, between peers or of multiple forms of actor?
- *Transmodality:* what connections are evident between teaching, research, community engagement and campus sustainability? How porous or isolated are these areas from each other, and to what extent are positive synergies generated?

[3] The three spaces of classroom, campus and community were discussed in a rudimentary form in McCowan (2014).

[4] This framework does not attempt to categorise the forms of learning in play in each of these spaces, for example problem-based learning, memorisation, enquiry or Freirean conscientisation: these may vary in each of the spaces depending on the actors involved, and would require separate analysis.

To consider examples of how this frame can be used to understand initiatives in practice, we can turn to some of the activities undertaken as part of the participatory action research in the *Transforming Universities for a Changing Climate* project. One of the universities participating in this project is running a small grants competition through which students can apply to run a climate action project of their designing. In terms of the spaces, this initiative would be located in the campus or community circles. As to the access feature, it is potentially available to all, though only a small number of grants will be selected, so not reaching all students; it is entirely voluntary; it is a one-off activity with a fixed timescale. In terms of ownership: while the programme is designed by staff the work is entirely student-led; knowledge is constructed during the activity rather than being predefined; and it carries no course credit. Finally, in terms of connection: it may be disciplinary or multidisciplinary, depending on the proposal in question; it is independent of formal courses studied; knowledge is applied rather than abstract; the learning is experiential; it is conducted in collaboration; and there is a high level of cross-fertilisation between teaching, research, community engagement and campus sustainability.

The intervention is, therefore, characterised by a high degree of learner agency – with students designing and managing the experience – with opportunities for interdisciplinary learning, application to real world problems and possibilities of collaboration, elements that are frequently absent in traditional university courses. Nevertheless, the experience is restricted to a relatively small number of students, and is not integrated with the rest of the curriculum, so in assessing the topography as a whole it would need to be combined with other forms of experience.

Some other common initiatives are displayed table 1 below. These are as follows: a cross-cutting module on climate change, available to all first year students regardless of the course they are enrolled on; an initiative to revitalise the curriculum of philosophy degrees through embedding contemporary dilemmas of ethics relating to the environment and social justice; an outreach project through which final year students conduct their dissertations together with local agricultural communities to support them in adapting to changes in climate; involvement of students in a consulting capacity in the design of a new zero-carbon student building.

Table 1 Topographical features in four curricular interventions

| | **Cross-cutting module** | **Philosophy curriculum** | **Outreach with agricultural communities** | **Design of new student centre** |
|---|---|---|---|---|
| **SPACES** | | | | |
| **Classroom** | √ | √ | | |
| **Campus** | | | | √ |
| **Community** | | | √ | |
| **FEATURES** | | | | |
| **Access** | | | | |
| **Availability** | Available to all | Only philosophy students | Only certain courses | Available to all |
| **Voluntariness** | Voluntary | Compulsory | Compulsory | Voluntary |
| **Continuity** | First year | Continuous | First year | One-off |
| **Ownership** | | | | |
| **Agency** | Staff-initiated and led | Staff-initiated and led | Staff-initiated, student-led | Staff-initiated, student-led |
| **Certification** | Credit-bearing | Credit-bearing | Credit-bearing | No certification |
| **Malleability** | Content predefined | Content predefined | Content constructed | Content constructed |
| **Connection** | | | | |
| **Disciplinarity** | Non-disciplinary* | Disciplinary | Disciplinary | Non-disciplinary |
| **Embeddedness** | Independent of degree courses | Part of degree courses | Part of degree courses | Independent of degree courses |
| **Application** | Abstract and applied | Abstract | Applied | Applied |
| **Experientiality** | Preparatory | Preparatory | Experiential | Experiential |
| **Collaboration** | Individual with some group work | Individual with some group work | Individual and collaborative | Collaborative |
| **Transmodality** | Teaching/ research | Teaching/ research | Teaching/ research/ community engagement | Limited |

** The term non-disciplinary is used here to indicate either multidisciplinary, interdisciplinary or transdisciplinary.*

This frame can serve as a tool for mapping existing provision in universities: for determining the location of learning activities, and their characteristics. It draws our attention to a range of crucial questions such as the relationships between the diverse modalities of the university, as explored in McCowan (2020): not only education, but also research, service delivery, public debate and operations. The most common relationship discussed is that between teaching and research. The 'connected curriculum' framework (Fung 2017) is an important model for higher education generally, in drawing out the benefits of a closer integration between these two. But it has particular relevance to climate change, given the rapid change in knowledge in the field, its contested nature, the need for experiential learning and for bringing impact in the broader society, all of which make engagement through enquiry essential for students. Facer (2020) also highlights the possibilities of climate change as a "shared enquiry" between students and educators, moving beyond either student-led or lecturer-led curricula, and breaking down the boundaries between teaching and research:

> This is not, then, a question of teaching 'about' sustainability. Instead, it is about creating educational spaces in all programmes in which lecturers and students can work through their field of study to inquire together into the broader questions of what human agency and responsibility means in these conditions.

The curriculum topography approach can help us assess and plan for these broader learning opportunities beyond conventional taught courses.

The involvement of students in community outreach and planning of university infrastructure is also crucial, both from the perspective of their learning and in enhancing the work itself. Reimers (2021) highlights another important linkage through the role of university students in promoting climate change education beyond the university, particularly in schools. He argues that – given the bottleneck of teacher capacity in delivering effective climate change education, and the limited abilities of ministries of education to resolve the issue – universities and their students have a vital role in working with the lower levels of the education system.

Another important question is that of how climate change links in with other relevant curricular areas – education for sustainable development, disaster education and so forth. These need to be thought of together, not only from the perspective of curriculum congestion, but also so as to bring out the crossovers and synergies between them. A mapping activity such as that encouraged by the curriculum topography approach should also assess how to make the most of these interlinkages, through the diverse configurations of space, form and discipline. For addressing climate change, it is particularly important to bring out these intersections, for example between the environment and gender equality, racial justice, migration and conflict.

There are no fixed normative implications from the location of an activity on the curriculum map. For example, there is no predetermined hierarchy between classroom, campus and community, or between embedded or freestanding activities, or theoretical and applied learning. In many cases a diverse spread will be the most appropriate, in allowing for different forms of learning to take place, and different types of learner to identify activities with which they can meaningfully engage. There will be inevitable differences between institutions in relation to which kinds of activity they can and should pursue. Yet a marked clustering of activities may be a cause for concern: for example, if none of the climate-related activities in the university are connected with the formal credit-bearing taught provision, or if there are no opportunities for students to develop associational student-led activities outside the classroom.

Having said this, each of these features does have implications for the outcomes of the initiative. As outlined in the framework of curricular transposition (McCowan 2009), slippage of an educational initiative can take place at three stages: in its design, in its implementation in practice and in its effects on students. Decisions taken on the above factors will have a significant impact on these three stages. Designing the climate change intervention from the perspective of chemistry, but without including other disciplinary perspectives (geography, economics, sociology etc.) will have clear implications for the content and impact of the work. Creating a credit-bearing module that cuts across all disciplines will ensure implementation in practice, but may lead to resistance from lecturers who have to reduce their core course content to make way for it. Compelling students to attend a course, and providing reward in the form of credit, will inevitably influence the way they relate to the content, and potentially enhance or undermine, or in any event change, the way they absorb the material.

The scheme above has assumed a 'traditional' campus university, with face-to-face teaching, postgraduate study and research, though it can be applied to any kind of higher education institution. Major growth has been seen in recent years in teaching-only institutions and online providers which have a markedly different model of operation, but can nevertheless incorporate learning about climate change in their curricula in creative ways. Nevertheless, it needs to be recognised that virtual institutions, or those without campuses, research and community engagement, face constraints in their ability to offer the broad range of learning opportunities beyond the formal taught courses.

The curriculum topography approach focuses on learning located within or instigated by the university. But it cannot be a closed system, since forms of learning for students are of course not confined to the university. Students are simultaneously learning through their interactions with friends and family, through media and social media. Youth movements, alternative education providers and community associations all provide opportunities for experiential learning outside the university (Facer 2020).

There are also increasing opportunities for structured learning from other providers, with MOOCs on climate change now being

provided on an open access basis via platforms such as EdX, Coursera and Futurelearn, from institutions in various countries such as the University of Helsinki, Wageningen University and the University of Exeter.

No account of the curriculum is complete without some mention of the hidden elements: those aspects of the organisation of the educational institution and its activities that – while unintentional and possibly unbeknownst to the architects – nevertheless have a significant influence on learners and their learning. The curriculum topography framework is not primarily concerned with the hidden curriculum, and the 12 features outlined above are primarily relevant to explicit, planned activities. However, there are important considerations here for the hidden curriculum too. In the case of an institution that endorses climate action, it is essential that there is not a disjuncture between the espoused messages of environmentalism and social justice, and the workings of the institution in practice – for example, investments in fossil fuel companies or not ensuring a living wage for employees. These contradictions are often evident to students and create an atmosphere of cynicism. At the level of the classroom, and in a more positive vein, lecturers can support the promotion of climate action through the *embodiment* of values, and the creation of a conducive environment of mutual respect, inclusion and commitment to equality. Having said this, it is dangerous to assume that students will necessarily absorb the underlying culture and hidden messages: in some cases, the lack of action in an institution, and contradictory practices, may in fact inspire students to take action and enhance their learning.

## Implications for university practice

The primary argument put forward in this paper is that we should not think about climate change provision at the university primarily in terms of 'teaching' it. This is not because there is anything wrong with teaching, or that teaching should not be included – on the contrary, it is an integral part. But the responsibilities of universities in relation to climate change are those of providing a conducive learning environment. This environment will involve spaces of teaching (of experts and facilitators guiding students through the topic), but also of peer learning – with students engaging with each other – of self-directed learning – students exploring the ideas on their own – and of experiential learning, through actual participation in climate action.

There has been a welcome increase in climate change courses in universities, and many subject areas are now integrating climate issues into their syllabi and professional requirements (see Nugent 2021). These changes are essential, but are just part of what is needed for a learning topography in higher education. Attention is needed to the diverse forms of learning necessary in relation to climate change – ones which can be conceptualised as *about*, for and *through*. A balance is needed between knowledge of science and debates on climate change, skills relating to mitigation and adaptation and political processes associated with them, and experiential learning of real forms of engagement on campus and beyond.

The formal taught component will best comprise a combination of, on the one hand discrete dedicated provision (i.e. a module specifically on climate change), which would be available to all students on a voluntary basis; and on the other hand, embedding of material related to climate change across all of the disciplinary areas, as appropriate for each subject. Given the instrumentalised nature of higher education, and the life implications of university diplomas, making some activities credit-bearing will be expedient in terms of uptake – though there should also be a range of non-accredited activities. Universities should make available organised extracurricular activities for students to involve themselves in environmental issues, but also allow space for students to develop their own actions, unmediated by the institution. Outside the university, opportunities should be provided for students to engage in voluntary work, internships and other work experience relating to climate change. The curriculum topography framework outlined above provides an analytical lens through which we can understand this distribution of activities.

As outlined in the previous sections, there are broader curricular principles relevant to the construction of this learning environment that must be borne in mind. While there are a variety of different legitimate and effective ways in which climate change can appear in the curriculum, the following four criteria are fundamental:

1. **Criticality**
   Education, to be education and not training, conditioning or indoctrination, must have a critical element. At base, this means that students are enhancing their capacity to make autonomous choices about the validity of claims to truth and value, rather than absorbing in an unquestioning way a predefined bundle of content. Students apply their critical sense during the learning process, and also enhance their capacity for criticality outside of the learning space.

2. **Non-coercion**
   The provision must be non-coercive in the sense that it is not imposed on students in either a *de jure* or *de facto* way. There are principled and pragmatic reasons for making learning about climate change optional for students. There are constraints on the university's ability to present a unitary set of values, and compulsion in learning is rare at this level. In practice, required modules very often foster resentment in students, and could potentially lead to a weakening rather than a strengthening of students' commitment in this area. Having said this, in the context of accredited taught programmes, there will inevitably be some compulsion to attend certain courses or display certain learning in assessment: this should be set in the context of students having freely chosen the overall course of study, and a non-coercive environment within the course.

**3. Students' existing knowledge**

Any curricular provision must build on students' existing knowledge and experience of climate change. Children and young people have been highly active in campaigning and mobilising around this theme – as shown by the Fridays for Future and Extinction Rebellion mobilisations – and many university students will already have knowledge, skill and experience in this area. Failing to build on existing knowledge would be poor pedagogy in any event, and again is liable to alienate more than engage students.

**4. Epistemic pluralism**

Higher education has manifested significant homogenisation globally, and needs to remain open to the variety of knowledge traditions, languages and worldviews, as well as to diversity of forms of knowing within cultures – as highlighted by recent movements for decolonisation. Mainstream Western academic knowledge has much to offer, but needs to be placed in dialogue with other knowledge traditions.

These normative considerations – which are generic to university education as a whole, but have relevance in relation to climate change education specifically – provide basic principles on which a diversity of provision can be built.

While this paper has to a large extent assumed that lecturers and universities have freedom to create teaching content, as emphasised by Fahey (2012), there are a number of pressures from different sources in this regard. Constraints on curriculum will be provided by national governments, quality assurance procedures, professional associations and accreditation requirements, and from tradition itself. Furthermore, if constructive alignment is not ensured, assessment may end up undermining the richness of the broad curriculum, with students focusing only on the activities that will gain them points. In addition, there are obvious constraints of resources available to universities, and to students in pursuing different opportunities. The creation of the curriculum topography of the kind outlined in this paper will, therefore, not be straightforward and require significant commitment from institutions and staff.

Literature on climate change education in schools (e.g. Reimers 2021; Rousell & Cutter-Mackenzie-Knowles 2020) argues that teacher education is a key constraint, since official curriculum pronouncements cannot ensure that the content is delivered in practice as envisaged in the classroom. In higher education this is no doubt the case as well, though with an added complexity, in that lecturers are generally assumed to have autonomy over what they teach (with the exception of some institutions such as those part of for-profit chains). Yet a curriculum topography model releases us from the need to create a 'teacher proof' curriculum and deliver climate change education through lecturers: with a wide range of sources of learning for students, it ceases to be problematic that there is variation in the treatment of climate change in the formal curriculum. Climate change education is delivered through taught courses, but also through a range of other spaces, both formal and non-formal in the university campus and beyond.

This environment does not then need to be perfectly aligned, with everybody 'singing from the same hymn sheet', as is often prescribed. In a university with academic freedom, there will inevitably be different perspectives on a topic like climate change amongst lecturers and students, even if they all believe in its existence, take it seriously and are seeking solutions. Far from being an impediment, the unevenness or even messiness of messaging is part of the rich learning environment, in introducing students to those diverse perspectives and allowing them to build the autonomy to frame their own beliefs and commitments in relation to them. The curriculum topography for climate change is more like an organic landscape garden than a formal symmetrical one.

Haydon (1977) makes the important point that the right to education is not only one of provision, but also of non-interference: that states need to ensure not only that they present opportunities for learning through educational institutions, but also that they do not prevent their populations from educating themselves, through censorship, or otherwise restricting the time or resources people have for accessing information and learning opportunities. We can apply similar ideas to the university in relation to climate change. One of the duties of higher education institutions is not to get in the way – either by crowding out available time with the formal part of the curriculum or in other ways obstructing or devaluing extracurricular learning. Students will naturally create opportunities for these forms of sharing and learning if the conditions are right. These may be formed on a physical campus, but if a physical campus is not possible, then alternative kinds of space, including virtual, can serve this end.

Furthermore, it must be recognised that – despite the substantial attention to sustainability and climate change in universities in recent years (McCowan et al. 2021) – many higher education institutions remain indifferent, and some may even oppose these aims. This unfavourable environment does not, however, preclude the establishment of opportunities for learning about climate change. In part this is due to the diverse and decentralised nature of higher education institutions and the relative autonomy of lecturers in their teaching and of students in organising their own learning. As mentioned above, there may also be opportunities for students to develop important capacities through their opposition to their institutions.

The value of the university as a learning experience, therefore, resides as much in the arena that it provides, as in its intentional programmes of study. The meetings across diversity, the cohabitation of philosophies, foci and disciplines, conducted in the spirit of open enquiry and the quest for understanding, provide an unparalleled space for the development of a new human and ecological paradigm. The emergent possibilities of this space for dialogue and exploration, the arising of unanticipated ideas, connections and becomings, will be vital if we are to retain any chance of addressing the environmental and social crises facing humankind.

## References


Amos, R., & Carvalho, P. (2020) Locating a Course on Environmental Justice in Theories of Environmental Education and Global Citizenship. *Journal of Education for Sustainable Development*, 14(2), 140-155.

Anderson, A. (2012) Climate change education for mitigation and adaptation. *Journal of Education for Sustainable Development*, 6(2), 191-206.

Anderson, K. (2012) Climate change going beyond dangerous—Brutal numbers and tenuous hope. *Development Dialogue*, 61, 16–40.

Barth, M., Godemann, J., Rieckmann, M., & Stoltenberg, U. (2007) Developing key competencies for sustainable development in higher education. *International Journal of sustainability in higher education*. 8 (4), 416-430.

Booker, C. (2009) *The Real Global Warming Disaster: Is the Obsession with 'Climate Change' Turning Out to be the Most Costly Scientific Blunder in History?* London: Continuum.

Burandt, S., & Barth, M. (2010) Learning settings to face climate change. *Journal of Cleaner Production*, 18(7), 659-665.

Bush, D. Sieber, R. Seiler, G. & Chandler, M. (2017) University level teaching of Anthropogenic Global Climate Change (AGCC) via student inquiry, *Studies in Science Education*, 53:2, 113-136.

Carpentier, V. (2019) The historical expansion of higher education in Europe: Spaces, shapes and rationales. In J. L. Rury and EH Tamura (eds) *The Oxford Handbook of The History of Education*. Oxford: Oxford University Press.

Collini, S. (2012) *What are Universities for?* London: Penguin.

Dworkin, R. (1996) We Need a New Interpretation of Academic Freedom. *Academe*, 82(3), 10-15.

Facer, K. (2020) B*eyond Business as Usual: Higher Education in the Era of Climate Change*. Oxford: Higher Education Policy Institute.

Facer, K., Lotz-Sisitka, H., Ogbuigwe, A. Vogel, C., Barrineau, S (2020) TESF Briefing Paper: Climate Change and Education. Bristol: TESF.

Fahey, S. J. (2012) Curriculum change and climate change: Inside outside pressures in higher education, *Journal of Curriculum Studies*, 44:5, 703-722.

Fung, D. (2017). *A connected curriculum for higher education*. London: UCL Press.

Gomes, L. A. (2020) Ambientalização Curricular nos Cursos de Licenciatura na Universidade Federal do Oeste do Pará. Unpublished PhD thesis at the Federal University of the West of Pará.

Haddock-Fraser, J., Rands, P. and Scoffham, S. (2018) *Leadership for Sustainability in Higher Education*. London: Bloomsbury Academic.

Haydon, G. (1977) The Right to Education and Compulsory Schooling, *Educational Philosophy and Theory*, 9 (1), 1-15.

Hess, D. J., & Collins, B. M. (2018) Climate change and higher education: Assessing factors that affect curriculum requirements. *Journal of Cleaner Production*, 170, 1451-1458.

IPCC. (2018). *Global warming of 1.5°C*. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Available at https://www.ipcc.ch/sr15/. Accessed 1 November 2018.

Jickling, B. and Wals, A. (2008) Globalization and environmental education: looking beyond sustainable development, *Journal of Curriculum Studies*, 40:1, 1-21

Klein, N. (2014) *This Changes Everything: Capitalism vs. the Climate*. New York: Simon & Schuster.

Leal Filho, W. (Ed.). (2010) *Universities and climate change: Introducing Climate Change to University Programmes*. Heidelberg: Springer.

Lomborg, B. (2007) *Cool It: The Skeptical Environmentalist's Guide to Global Warming*. New York: Knopf.

Mann, M. E.; Bradley, R. S.; Hughes, M. K. (1998) Global-scale temperature patterns and climate forcing over the past six centuries. *Nature*, 392, 779-787.

Marshall, G. (2014) *Don't Even Think About It: Why Our Brains Are Wired to Ignore Climate Change*. London: Bloomsbury.

Martin, C (forthcoming) *The Right to Higher Education*. Oxford: Oxford University Press.

McCowan, T. (2009) *Rethinking Citizenship Education: a Curriculum for Participatory Democracy*. London: Continuum.

McCowan, T. (2013) *Education as a human right: principles for a universal entitlement to learning*. London: Bloomsbury.

McCowan, T. (2014) *Can higher education solve Africa's job crisis? Understanding graduate employability in Sub-Saharan Africa. Manchester*: British Council.

McCowan, T. (2015) Should universities promote employability? *Theory and Research in Education*. 13 (3), 267-285.

McCowan, T. (2019) *Higher Education for and beyond the Sustainable Development Goals*. London: Palgrave Macmillan.

McCowan, T. (2020) *The impact of universities on climate change: a theoretical framework.* Transforming Universities for a Changing Climate, Working Paper Series No. 1.

McCowan, T., Leal Filho, W. and Brandli, L. (eds) (2021) *Universities Facing Climate Change and Sustainability*. Hamburg: Global Universities Leaders Council

Molthan-Hill P., Worsfold N., Nagy G.J., Leal Filho W., (2019) Climate change education for universities: A conceptual framework from an international study, *Journal of Cleaner Production*, 226, 1092-1101.

Monroe, M., Plate, R., Oxarart, A., Bowers, A. and Chaves, W. (2019) Identifying effective climate change education strategies: a systematic review of the research, *Environmental Education Research*, 25:6, 791-812,

Morano, M. (2018) *The Politically Incorrect Guide to Climate Change*. Washington, DC: Regnery.

Nugent, C. (2021) The Unexpected Ways Climate Change Is Reshaping College Education, *Time*, 16 April. Available at: https://time.com/5953399/college-education-climate-change/ (accessed 22/7/21)

Nussey, C. (2021) Rethinking the unthinkable: what can educational engagements with culture offer the climate crisis? *British Council Cultural Relations Collection*. Available at: https://www.britishcouncil.org/research-policy-insight/research-series/cultural-relations (accessed 12/10/21).

Nussey, C., Brandli, L., Nyerere, J., Lagi, R. and Langa, P. (2021) Considering the higher education mandate of national climate change policies – the cases of Brazil, Fiji, Kenya and Mozambique. Paper presented at the Comparative and International Education Society conference, Thursday 29th April.

OECD. (2012). How green are today's 15 year olds. Available at: https://www.oecd.org/pisa/pisaproducts/pisainfocus/50150271.pdf (accessed 22/7/21)

Ojala, M. (2016). Facing anxiety in climate change education: From therapeutic practice to hopeful transgressive learning. *Canadian Journal of Environmental Education* (CJEE), 21, 41-56.

Orr. D. (1994). *Earth in mind*. Washington, DC: Island Press.

Pérez Salgado, F., de Kraker, J., Boon, J., and Klink, M. van der (2012) Competences for Climate Change Education in a Virtual Mobility Setting. *International Journal of Innovation and Sustainable Development* 6(1), 53-65.

Perkin H (2007) History of universities. In: JJF Forest and PG Altbach (eds) *International Handbook of Higher Education*, pp. 159–206. Dordrecht: Springer.

Reimers, F. M. (2021) *Education and Climate Change: The Role of Universities* (p. 201). New York: Springer Nature.

Rooney, M. and McMillin, J. (2010) The campus as a classroom: integrating people, place and performance for communicating climate change. In Leal Filho. W. (ed.) *Universities and climate change: introducing climate change to university programmes*. Heidelberg: Springer, pp 117–136.

Rousell, D., & Cutter-Mackenzie-Knowles, A. (2020) A systematic review of climate change education: Giving children and young people a 'voice' and a 'hand' in redressing climate change. *Children's Geographies*, 18(2), 191–208.

Santos, B. de S. (2015) *Epistemologies of the South: justice against epistemicide*. New York: Routledge.

Schendel, R., McCowan, T., Rolleston, C., Adu-Yeboah, C., Omingo, M. and Tabulawa, R. (2020) *Pedagogies for critical thinking at universities in Kenya, Ghana and Botswana: the importance of a collective 'teaching culture', Teaching in Higher Education*, DOI: 10.1080/13562517.2020.1852204

Senbel, M., Ngo, V. D. and Blair, E. (2014) Social Mobilization of Climate Change: University Students Conserving Energy Through Multiple Pathways for Peer Engagement. *Journal of Environmental Psychology*, 38: 84–93.

Students Organising for Sustainability - United Kingdom (SOS-UK) (2021) SOS_UK Student Climate Change Tracker. Available at https://www.sos-uk.org/research/climate-change-tracker (accessed 11/10/2021).

Stevenson, R. B., Nicholls, J., & Whitehouse, H. (2017) What is climate change education?. *Curriculum Perspectives*, 37(1), 67-71.

Tikly, L. (2019) *Education for Sustainable Development in the Postcolonial World: Towards a transformative agenda*. London: Routledge.

UNESCO (2019) *Country Progress on Climate Change Education, Training and Public Awareness: An Analysis of Country Submissions Under the United Nations Framework Convention on Climate Change*. Paris: UNESCO.

UNESCO (forthcoming) Report of the Expert Panel on Universities and the SDGs.

UNESCO Education Sector (2006) Framework for the UNDESD international implementation scheme. Paris: UNESCO.

White, J. (2019) The end of powerful knowledge?. *London Review of Education*, 17 (3): 429–438.

Young, M. F. D. (2008) *Bringing Knowledge Back In: From social constructivism to social realism in the sociology of education*. London: Routledge.

Climate-U
Transforming Universities
for a Changing Climate

## About Transforming Universities for a Changing Climate

Climate change is the most significant global challenge of our time, and many of its effects are felt most strongly in the poorest communities of the world. Higher education has a crucial role to play in responding to the climate crisis, not only in conducting research, but also through teaching, community engagement and public awareness. This study contributes to our understanding of how universities in low and middle-income countries can enhance their capacity for responding to climate change, through a focus on the cases of Brazil, Fiji, Kenya and Mozambique. In doing so, it contributes to the broader task of understanding the role of education in achieving the full set of Sustainable Development Goals.

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