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The climate crisis as a driver for pedagogical renewal in higher education

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ABSTRACT

The planetary crisis facing humanity makes essential the incorporation of learning about climate change and sustainability in the university curriculum. Yet the ooting of climate change in values, knowledge systems and societal structures means that this incorporation must be more than just addition of knowledge content into a pre-existing curricular template. This article argues that the shifts required in a deep treatment of the climate crisis serve a broader purpose in driving positive change in university teaching and learning. Even within the confines of existing disciplinary divisions and mainstream epistemologies, possibilities exist for deepening critical reflection, pushing boundaries and opening imagination. The article explores this potential through an assessment of three spheres of enquiry: the ontological, epistemological and axiological. The teaching of these areas should be underpinned by the complimentary pedagogical foundations of critical questioning and deliberation, leading to a virtuous cycle of deepening of understanding and connection.

Ikisiri

Janga la kidunia linaloikabili jamii ya binadamu limefanya iwe muhimu kuingiza ujifunzaji wa mabadiliko ya tabianchi na uendelevu katika mitaala ya vyuo vikuu. Hata hivyo, kuweka misingi thabiti kuhusu mabadiliko ya tabianchi katika maadili, mifumo ya maarifa na miundo ya kijamii inamaanisha kwamba uingizaji huo ni lazima usihusu kuongeza tu maudhui ya maarifa kwenye violezo vya mitaala vilivyopo tayari. Makala hii inajenga hoja kuwa mabadiliko yanayotakiwa katika kushughulikia kwa kina janga la tabianchi yana dhima pana katika kuleta mabadiliko chanya ya ufundishaji na ujifunzaji katika vyuo vikuu. Hata ndani ya mipaka ya nyanja za kitaaluma zilizopo na mikondo mikuu ya kiepistemolojia, kuna uwezekano wa namna mbalimbali wa kuimarisha tafakari makinifu, kusukuma mipaka na kufungua ubunifu. Makala hii inatalii uwezekano wa kutumia masuala ya tabianchi katika kutengeneza upya ufundishaji katika elimu ya juu kwa kutathmini nyanja tatu za uchunguzi ambazo ni ontolojia, epistemolojia na uhakika dhahiri. Ufundishaji wa maeneo haya unapaswa kujikita kwenye misingi ya utoaji elimu inayoheshimu kuhoji na kujadiliana kitunduizi, na kuleta mzunguko wa kiueledi wa ufahamu na uhusiano wa kina.

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Introduction

Efforts to create a better society encounter a fundamental contradiction: new structures, institutions and practices are needed, and yet we need to start working from the position of our current, deeply flawed ones. Education is no exception in this regard. The dominant global paradigm of formal education is based on partly arbitrary divisions into year groups, areas of knowledge and learning spaces, underpinned by rigid distinctions of role, by epistemic and pedagogical standardisation, and by privileging of competition over collaboration (McCowan 2022; Orr 1994; Silova 2021). While most agree that an altogether different system of education is required for achieving a sustainable and just world, and overcoming the 'wicked' problems[1] that face us (Head and Alford 2015; Rittel and Webber 1973), we cannot afford to wait until the new system is in place.

This article addresses the dilemma in relation to the university curriculum. Facing up to the climate crisis requires new forms of transdisciplinary thinking, and yet the reality is one of deeply entrenched disciplinary divides within both teaching and research. This study argues that there are ways of working within our current educational structures that allow us to put forward a critical sustainability agenda, to push the boundaries of disciplines and to open possibilities of a deeper transformation. In this way, it responds to the challenges put forward by Misiaszek and Rodrigues (2023) and in their editorial to this special issue, *Higher Education Teaching of Environmentally Just Sustainability*. There, the authors lay down the gauntlet for educators to address in their practice and scholarship the need for justice-based environmental sustainability, involving transdisciplinarity and epistemic pluralism.

Importantly, these changes – while highly demanding – do not necessarily require sacrifice. One of the barriers of climate campaigns to date and the possible explanation of the extraordinary inertia that our societies display faced with impending self-destruction, is the association of climate action with austerity, deprivation and removal of luxuries, at least for those in the privileged world (Klein 2019; Marshall 2014). In relation to the curriculum, the inclusion of issues of sustainability and climate change may seem like an unwelcome imposition in an already overcrowded programme, given the extensive institutional, disciplinary and professional demands on syllabus content and teaching format. Instead, this article will argue that engaging deeply with these issues will bring about a reinvigoration of teaching and learning in higher education, addressing not only the needs for environmental protection and regeneration, but the general educational aims that underpin the university.

The primary aim of this article, therefore, is to explore how university educators can drive forward a critical sustainability agenda within the confines of existing structures. It proposes an engagement with issues of climate change and sustainability through three dimensions of the ontological, epistemological and axiological, fundamental aspects of any university course or discipline. The article is conceptual in nature, but is influenced by three forms of engagement with empirical contexts: the author's own experience of university teaching, the published literature on climate change in higher education, and the applications and innovations undertaken in a variety of contexts as part of the *Transforming Universities for a Changing Climate* (Climate-U[2]) research project.

This article is based on an understanding of climate change as a civilisational crisis, with its roots in the Industrial Revolution, and the underpinning ideas of accumulation

and exploitation of the natural environment for human benefit that characterise contemporary societies. Rather than a technical issue that can be resolved through a technological advance – however ingenious it might be – it is a challenge that pervades our institutions and practices, and so requires transformation in all sectors of society and at all levels. As a corollary, the educational requirement is one that is needed across all types of course and for all people, rather than being confined to a small cadre of scientists and environmental professionals who will resolve the problems for everybody.

It is important to note that while focusing on teaching in the mainstream curriculum, in a 'classroom' context, this article does not assume that this is the only or even the most important sphere of learning. As argued in a previous paper (McCowan 2021), climate action depends not only on being taught, but also on self-directed and collaborative peer learning, occurring not only in formal courses but also in other spaces on campus and beyond in diverse sectors of society. We need to understand these forms of learning in conjunction, and all are essential.

The article will first explore the possibilities that climate change presents for deepening ontological, epistemological and axiological enquiry across all disciplinary areas. It then addresses the foundational pedagogical dimensions of critical questioning and deliberation that underpin approaches to addressing these three areas. The article is rounded off with some final discussions on the task facing educators in incorporating these elements in diverse contexts and the broader challenge of renewal in higher education.

Three dimensions of human enquiry

The pressing questions of human existence can be divided into three types: ontological – those relating to being, the nature of the self and the other entities that make up the world we live in; epistemological – those relating to knowledge, how we acquire it and what makes it valid; and axiological – the values that underpin what we do in our lives, the good and the just (Bhaskar 2013). These three philosophical categories may not encompass all areas of human enquiry, but they do represent the most weighty questions facing us. However, we do not need to see these categories as ones purely pertaining to the subject of philosophy. Instead, they are the bedrock of any educational endeavour. Whatever we set out to learn (and at whatever age or level of education), the process should engage us in reflection on questions of being, knowledge and value – as applied to the specific subject or content.

Climate change in this way has ontological, epistemological and axiological elements. It alerts us to questions of being (who we are and how we relate to the natural world), of knowledge (whose version of events should we trust) and value (what might be a fair distribution of the burdens of change). What this article will argue is that climate change is a particularly conducive issue for fostering deep reflection and for transforming learners. It serves not only its own agenda of equipping learners to act in the climate crisis, but is a driver for a more powerful and transformative educational experience overall.

The sections that follow will address these three spheres of human enquiry in turn, drawing out the aspects of relevance to climate change, and the ways in which they can be explored in the classroom. In the space available, the discussion will highlight

just a few ways in which climate change can be viewed through these three perspectives – undoubtedly there are many others.

Ontological

The most immediate ontological concern is with the nature of the climate system, and by extension the nature of the world we live in. The temperature on earth and its weather patterns are the result of an intricate interplay of factors involving the sun, the atmosphere, land, oceans and ice sheets, as well as living organisms. The consequences of changes in temperature are also multiple (e.g. melting of permafrost, changes to ocean currents), and many of them in turn influence the temperatures themselves, leading to positive and negative feedback loops within the cycle. These loops create the possibility of tipping points, and the risk of stages of no return in temperature rises (Lenton et al. 2019). The key ontological idea that emerges here is interdependence, and through a study of these processes, learners can reflect not only on the concrete and practical considerations of the causes of climate change and possible interventions, but also on the deeper interconnectedness of the natural environment. In order to operate in the world we designate categories and attach terms to them (e.g. cloud, carbon, plants) yet when we reflect on their existence, it is clear that they are not entirely separate from other phenomena.

There is a long tradition of writing about interdependence in ecology, for example James Lovelock's (1972) Gaia hypothesis, Lynn Margulis's (1998) symbiosis, Fritjof Capra's (1996) web of life and Anna Tsing's (2015) assemblages. While these accounts have been challenged and reframed, and should not be presented as doctrine, they serve a vital role in disturbing our conventional notions of separateness and independence of phenomena, and allow new understandings to emerge. Many argue that this interconnectedness requires of us new forms of thinking: Lehtonen, Salonen, and Cantell (2019), for example, propose 'phenomena-based' learning in place of fragmented disciplinary divisions, through which wicked problems can be approached with systemic and holistic thinking.

The second main area of ontological reflection is the human being. Climate change also challenges our conceptions of who we are individually and collectively. These reflections are in part similar to those above around interdependence. We have a physical body that occupies its own space, but on reflection we soon see how even our bodies are not really 'ours', made up as we are of millions of bacteria, and of water that is constantly recycled. Our mental world also is constituted by interactions with others and collectively constructed languages and concepts. The distancing of the human being from the natural environment in early modern Europe, and Francis Bacon's exhortation to human dominion over nature, can thus be seen not only as damaging but also based on a misconception (Merchant 1980; Silova 2021)[3]. These questions can be fruitfully explored in the university curriculum, with arts, humanities, media and cultural studies having an important role in analysing the changing nature of human beings and human societies and the implications for the climate crisis. Studies of literature in universities might be considered an area in which it is difficult to integrate teaching of climate change, but analysis of artistic works can be a highly generative means of developing understanding of framings of the self as separated from 'nature' and from human communities.

As part of the pedagogical process of reflecting on ontology, it is useful to present alternative ontologies to those many students will be accustomed to (Komatsu, Rappleye, and Silova 2021). In a Western context, ideas of *sumak kawsay* (or *buen vivir*, good living) from the Andean region of South America and *ubuntu* from Southern Africa, which present a worldview of interconnected existence, are helpful in opening up the imagination (Assié-Lumumba 2017; Brown and McCowan 2018; Olivera Rodríguez 2017).

A third series of reflections concerns the notion of change itself. What is the nature of change, and what implications does its inevitability have for our understandings of space and time? Mortality, the fragility of human existence, the possibility of the end of the human species and continuation of planetary life without human beings, are all brought into the foreground. Naturally, some of these are disturbing topics and have to be dealt with in delicate ways, particularly in the context of widespread anxiety amongst young people (Hickman et al. 2021; Ojala 2016). Nevertheless, a careful treatment can be an important part of the deepening understanding of self and the future of humanity.

Epistemological

Epistemic concerns are as old as conscious human beings, but have taken on particular complexity in the contemporary age. These shifts can be attributed variously to the coexistence of strongly contrasting epistemologies and ontologies within and between societies; development of information and communications technology that brings individuals into closer contact with that diversity; the ready availability of huge stores of information through the internet, but without a clear criterion of sorting and selection; and the deliberate use of social media to spread misinformation and manipulate audiences.

Climate change provides a focal point through which all of these contemporary trends can be brought out into the open and reflected on in the classroom. It is an issue that is subject to significant contestation, in its most extreme form involving outright denial of its existence, but also a range of reasoned positions on how best to address the challenge. Understanding and navigating this contestation is essential, not only in maintaining some degree of social cohesion and cooperation, but also in finding valid solutions – given the highly complex nature of the climate emergency.

Climate change deniers have successfully been able to exploit the general value of scepticism in science, claiming that the environmentalist lobby is shutting down debate and stifling dissenting views, utilising the peer review system and other outlets of communication for their ends (Morano 2018). The academic community is then forced into either an unenviable position of asserting uniformity of view – an anathema to science generally, and not entirely true, since even amongst those in agreement with anthropogenic climate change there are some differences of position – or one of climate science as an open question, which lays open cracks into which the denial lobby can hammer their wedges (Marshall 2014).

Many of these debates have involved the scientific consensus on climate change. Deniers have paraded the small number of scientists who contest anthropogenic global warming, and challenged the existence of a consensus. A bibliographic analysis (Cook

et al. 2013) showed, however, that 97% of published articles with a position on climate change endorsed human-caused global warming. In order to navigate these contradictory messages, therefore, scientific literacy in relation to climate change is essential for all students of higher education and the general public. Naturally, it is impossible for all people to have a comprehensive knowledge of climate science, or the technical expertise of climate scientists, but a basic understanding is essential for underpinning one's own actions and navigating the epistemic conflict around climate change. Importantly, however, this kind of awareness is not only one of separating the true from the false, but ofdeveloping a more nuanced awareness of different epistemologies that might provide multiple valid readings.

The role of higher education teachers then in relation to climate change is both to provide a space for learners to explore their own epistemological positions, individually and in relation to one another, and to present the contested epistemic terrain on which battles around climate change are being fought. Students, for example, could be asked to analyse a television debate between a climate scientist and a fossil fuel lobbyist, assessing the rhetorical devices and communication approaches used by each, as well as the factual basis and reasoning employed in their arguments. They could then be encouraged to reflect on their own positionings in relation to the contrasting positions. These contestations involve an intertwining of questions of fact and value, of the contrasting logics of different disciplinary areas, of different epistemological and ontological foundations, and of complex systems (societal and environmental) without predictable linear outcomes.

Climate change also raises awareness of academic disciplines, the relationships between them, their contributions and limitations. In no sense can the phenomenon of climate change be limited to a single discipline: while certain disciplines may have a key role in identifying changes in climate and their immediate impacts (geology, geography, meteorology etc), the wide-ranging disruption to plant and animal life, human societies and all aspects of the natural and physical world mean necessarily that all disciplines are involved. Economics, for example, now necessarily involves treatment of the question, including calculating the economic impacts of different temperature levels, the building in of environmental damage as part of cost–benefit calculations, and the question of 'discounting' (the perception of decreasing value of benefits that occur in the future). The complexity of the topic makes essential not only contributions from different disciplines, but also that disciplines will work together in news ways, in transdisciplinary as well as multidisciplinary modes.

Another important dimension of epistemological awareness relates to the diversity of knowledge traditions. Human cultures have generated a variety of worldviews which involve distinctive ontologies, epistemologies and axiologies. To acknowledge the value of understanding and engaging with these diverse knowledge traditions is not to slip into a limp relativism: different traditions may have their strengths and weaknesses, their areas of contribution and their applicability to different contexts and situations, or simply reveal different dimensions of human experience. While a problematic term in its own right, what we think of as 'Western' knowledge dominates higher education in today's world – through its formation of the inductive scientific method that provides the gold standard in our epistemic space, and through the institution of the European university which has spread through the world. Western academic knowledge has many positive qualities and has brought undeniable achievements, but does not have

an exclusive claim to truth or value; furthermore, Western traditions are themselves plural, and even practice in the natural sciences involves a variety of epistemic approaches, including intuition, imagination and tacit knowledge (Polanyi 2009; UNESCO 2022).

In order to safeguard this epistemic pluralism, and as a question of justice for colonised and subjugated peoples worldwide, there have been worldwide calls for decolonisation of higher education, spurred on by the Rhodes Must Fall movement in South Africa (Del Monte and Posholi 2021). Indigenous movements have called for the inclusion of their knowledge traditions, not instead of but alongside mainstream ones, corresponding to what Santos (2015) calls an 'ecology of knowledges'.

Given the complexity of the ecological challenge, and the forms of thought which led us into trouble in the first place, it is not unreasonable to believe that an ecology of knowledges will in fact be necessary to address climate change. Dialogue is needed between universities and external communities, between mainstream academic knowledge and local knowledge systems, and between different cultures and positionalities. Co-construction of knowledge becomes therefore a question of justice (so as to include participating communities as *subjects* rather than *objects* of the process of knowledge production and application), but also the most effective form of building lasting responses to the climate crisis. More fundamentally, many have argued that a whole new paradigm for humanity is needed (Silova 2021), to haul ourselves out of the pit created by millennia of exploitative relations with the non-human environment, made catastrophic by the increase in technological power since the Industrial Revolution, and through the increase of incentives for accumulation from the growth of capitalism. Different visions of this relationship can be found in philosophies such as *sumak kawsay* or *ubuntu* discussed above, but also within marginalised Western traditions, such as ecofeminism and deep ecology (Assié-Lumumba 2017; Brown and McCowan 2018; King 1995; Olivera Rodríguez 2017; Sessions 1987).

Axiological

Climate change is contested not only in terms of its sources of evidence and paradigms of understanding, but also in the value sets that accompany them. Many, in fact (e.g. Marshall 2014; Norgaard 2011), have argued that climate change denial is better understood as a conflict of values and emotions than a dispute over facts. The value contestations relate to various areas: the good life and forms of living that are seen to be worthwhile, questions of justice, what a fair distribution of the burden of change and disruption should be, as well as to questions of authority and freedom, of the legitimacy of coercion and forms of organisation necessary for achieving global sustainability.

There is at the present moment an indisputable situation of climate injustice in which the wealthiest communities and countries as a general rule bear disproportionate responsibility for causing climate change, while the poorest communities and countries bear the brunt of the negative impacts and lack the financial resources to protect themselves from them (Klein 2014, 2019). While mitigation (preventing the root causes of climate change), adaptation (adjusting to the new conditions) and regeneration (creating new forms of sustainable community and environment) are needed globally, the burdens of adaptation and regeneration on some are caused by the lack of attention to mitigation

on the part of others. This is a geographical, political and economic divide (designated imperfectly by the Global North/Global South labels) but also involvesinequalities within countries – leading to a focus on 'most affected peoples and areas', cutting across different locations. These injustices have an intersectional dimension (Crenshaw 2017), in that social identities such as gender and race can compound the economic and social class disadvantage and create configurations that cannot be addressed in isolation.

While the facts of the case are clear, the implications are hotly contested. Do wealthy regions have responsibility for atoning for historical actions (e.g. the Industrial Revolution in Britain) or only their current emissions? Should the largest emitters of greenhouse gases make financial payments to compensate other regions affected by the impacts? Should low-income countries be inhibited from developing fossil fuel-based industry when other regions of the world have historically generated their wealth from them? Addressing these questions head-on in pedagogical spaces is important both for ensuring all are aware of the injustices, but also in refining learners' abilities to reflect, deliberate and position themselves on these complex issues.

Important value questions are also raised over the forms of social organisation necessary and permissible. Much of the opposition to environmentalism has been provoked by the constraints that it is seen to impose on individual freedom: that the movement is 'green on the outside, red on the inside' (Delingpole 2012), communism by the back door, big government or even global rule by the United Nations. While these concerns are wildly inflated (and many environmentalists are equally concerned about constraints on individual freedoms and the dangers of excessive state power), resolving the climate crisis may indeed require limitations on individuals and corporations, and the establishment of new forms of global coordination (Helm 2020). If people do not make the necessary changes of their own volition, should they be forced to do so, and at what proximity to the precipice of species destruction would authoritarian measures be justified?

Finally, there are questions about the good life. Is our task as humanity to maximise (through technology and economic management) the possibilities of continuing the high consumption lifestyle that those in privilege parts of the world have become used to? Or is a more frugal and less wasteful lifestyle, closer to nature and valuing the spiritual over the material, in fact a richer life in any event? Major religions have had ambiguous relationships with climate action, with Christianity on the one hand being held responsible for the root cause of the crisis in positioning the human being as 'master' of nature, but on the other hand, as seen in Pope Francis's (2015) *Laudato Si'*, advocating for major pro-environment shifts. Climate change challenges and causes us to question all aspects of the values with which we live.

Engaging with these values is a complex matter. Transmitting a predefined set of values to learners is challenging with young children, butalmost impossible with adults of university age, and of dubious legitimacy even if it were feasible (McCowan 2021). What universities can do is to allow space for learners to grapple with these complex questions head-on, to appreciate their underpinning principles, to understand diverse positions and expand their moral reasoning to those in different positions, places and points in time. Arts, humanities and social sciences subjects will engage more readily with these value contestations, with teaching of history, for example, having an important role in generating understanding of the role of empire, slavery and capitalism in the

progressive destruction of natural environments. Yet it is important that they are brought into STEM areas as well, with crucial ethical and civic issues that must be at the centre of science teaching in universities and beyond (Salinas et al. 2022; Torres-Olave and Bravo González 2021). For example, discussions of geo-engineering and carbon capture should involve not only the technical aspects, but also questions of justice surrounding those who own and control the technology, and the impacts on diverse communities.

This section on the three dimensions has argued that climate change can act as a positive driver for change in teaching and learning, in opening up the profound ontological, epistemological and axiological questions that all education should address. It is true that any issue that one could choose to study (whether the ancient Greeks, US–China trade relations, genetically modified crops or quantum computing) could potentially be addressed from these three different angles. But climate change is particularly conducive to opening up crucial questions and dilemmas in these areas through its complexity, its moral urgency, its comprehensiveness (in touching on all aspects of human existence) and its global reach (in involving all humanity).

Pedagogical foundations

The above sections have set out three broad areas of enquiry in relation to climate change, ones which provoke deep questions about ourselves and the world, and are conducive to the transformation of self and society. Yet there are a range of possible ways in which these questions can be addressed in the classroom. Some attention, therefore, is needed to the *process* elements, of orientations of teaching and learning in the classroom (Alexander 2010). This section will not outline specific teaching techniques or resources, but instead highlight two fundamental principles – critical questioning and deliberation.

Given the urgency of the issue, and the high degree of scientific agreement, it might be tempting to present climate change as a settled set of facts, commitments and actions to be instilled in students. Yet, as argued by Jickling and Wals (2008) in relation to education for sustainable development, a campaigning or advocacy approach is never justifiable in the classroom. In an educational setting, particularly one involving adults, learners must exercise their own agency to engage with the material and acquire new understandings through processes of critical reflection. Research in fact has shown the dubious efficacy of awareness-raising of a purely cognitive nature (Anderson 2012; Bangay and Blum 2010; Facer 2020; Facer et al. 2020; Monroe et al. 2019; Oberman and Sainz 2021; Rousell and Cutter-Mackenzie-Knowles 2020; Stevenson, Nicholls, and Whitehouse 2017). In the case of climate change, the complexity of the issue means that creativity and imagination must constantly be employed to adapt to the emergent properties of the system and form new responses to the crisis. Conditioning, non-reflexive training or even subliminal messages might be successful in bringing about pro-environmental behaviours in the short-term. But it is not a solution to the climate emergency – and it is certainly not 'education'.

Processes are needed, therefore, through which learners can become aware of their own understandings and positions, engage with other perspectives and worldviews, challenge their assumptions and construct new possibilities. The dual processes of critical questioning and deliberation are central here. These two principles are fundamental to the educational process as they encourage reflection, perspective and possible revision

of our views and understandings. As principles they are applicable to any educational setting and any subject matter, though they are far from straightforward to implement and can be challenging, as they disturb the comfort of our familiar and entrenched ideas.

Questioning and deliberation are approaches that we as educators bring to the teaching of climate change with a normative orientation (Freire 1970; Gutmann 1987; Nussbaum 1997). They emerge from commitments to human agency, of respect for persons and the value of human understanding, rather than unreflective survival or subordination of the human being to external goals and technologies. Nevertheless, these prior commitments require conducive subject matter in order to be operationalised in an educational setting. The complexity, profundity and contestation around climate lend themselves both to processes of critical questioning and to vibrant group discussions, leading to a virtuous cycle of mutual reinforcement through which the principles can be deepened.

Critical questioning

Educational spaces can be structured so as to encourage learners to question their existing beliefs, perspectives and assumptions. This process operates on a continuum from relatively mild revising of factual knowledge, to a fundamental about turn in one's identity and worldview. It is opposed to learning approaches that are transmissive, involving an unquestioning flow of knowledge from teacher to student, and also to learner-led processes that involve accommodation of new knowledge entirely within existing assumptions (Browne and Freeman 2000; Kuhn 1999; Lipman 1988).

While promotion of critical questioning is largely a matter of underlying orientation of the teacher, and can manifest itself in multiple ways, there are some recognised formal approaches. The Socratic method is the root of many of these approaches in the Western tradition. Socrates aimed to spark insights in his interlocutors by taking them through a series of searching questions that would force them to reassess their unexamined assumptions. This generation of new knowledge through questioning has been an ever-present current in the Western higher education tradition, alongside traditions of transmission of knowledge and memorisation (Barnett 1997). Socrates described himself as a 'gadfly', niggling at and disturbing the complacency of Athens. The idea of this form of questioning as being uncomfortable is a common theme in critical approaches (e.g. Sterling 2011): while challenges to and reframing of our fundamental assumptions are ultimately beneficial, they are unsettling and at times painful. Another, more work-oriented manifestation of these ideas in the contemporary age is 'problem-based learning', popular in the health sciences, through which students develop their competencies through engagement with challenging real-world issues (Schendel et al., 2020; Williams 2001).

Climate change is embedded in human civilisation, practices and belief systems and so addressing it involves critical questioning of this sort. The transmission of a body of knowledge relating to climate science is not entirely worthless – certainly there is some factual knowledge that all people should have – but it is unlikely to be sufficient for finding solutions to 'wicked' problems, or bring about the kinds of individual and collective changes that are necessary for a sustainable planet. These various forms such as Socratic questioning and problem-based learning are essential for, in the first place,

sparking realisations about the complex web of causes of our current unsustainable lives and societies, and then, thinking creatively about how to move forward. These approaches can be adopted in the various one-on-one teaching situations in the university (for example in postgraduate research supervision, or in tutoring for an essay or dissertation at undergraduate level) in which Socratic dialogue is readily applicable. Group situations are conducive to problem-based learning, but forms of Socratic questioning through discussion are also possible, along with other methods such as simulations, role plays and thought experiments.

Further to the above, there is a tradition of more political questioning, focusing not so much on challenging assumptions of our identity and existence, or solving problems, but of challenging and overcoming the injustices that exist in our societies. Most prominent of the thinkers associated with this current is Paulo Freire (e.g. 1970), whose primary insight was that education inevitably serves a political purpose – in his terms, either liberating or domesticating. This influence is not so much because of the explicit content – although in some cases there will be direct treatment of political issues in the classroom – but because of a deeper process of formation of the 'subject' or person. Freire observed a correspondence between the disempowerment of the learner in the classroom – and the adult in the community literacy class – considered to be an empty vessel, with their existing learning and knowledge disregarded – and the disempowerment of the citizen in the political sphere.

Questioning in Freire's pedagogy occurred initially through the presentation of visual cues (stylised representations of the present reality) intended to provoke reflection on learners' conditions of living and inequalities in society. More broadly, Freire (1970, 1994) advocated for problematisation or problem-posing education, through which the naturalisation of disparities of power and wealth could be challenged. Problematisation is practised hand-in-hand with *dialogue* in the educational space – respectful, horizontal pedagogical relations – which together lay the foundations for individuals taking the reins of their own destinies in the broader world: a complementarity similar to that between questioning and deliberation, discussed below.

In his own writing, Freire's main concern was poverty and oppression, and not the natural environment, although he was said to be writing a book about the latter at the time of his death (Misiaszek 2020b). However, it has since become clear that environmental concerns are no longer those of the privileged middle class with leisure time to enjoy nature, but intimately bound up with global social justice and with the well-being and survival of the poorest communities (Klein 2014, 2019). Freirean conscientisation in the twenty-first century inevitably involves a critical understanding of climate change and its causes, and coordinated collective action to address it. The kind of action that will emerge from transformative pedagogy is not the isolated, top-down, technical solution of geo-engineering or carbon capture, but a transformation of our local, national and global economic, political and cultural systems to put in place a more caring, egalitarian and sustainable world. These transformations involve not only Freire's initial concerns for working class oppression, but also ones relating to gender, race, coloniality and other forms of social identity.

Freirean approaches of problematisation and conscientisation are, therefore, highly relevant to climate. Collective processes of analysis and reflection can reveal the ways in which climate change is bound up with socio-economic inequalities and asymmetries

of power at all levels, and how the solutions need to be grounded in the fostering of more egalitarian and just societies. Climate change represents a teaching opportunity in this sense, as through sustained analysis and reflection, what initially appears as a neutral technical issue reveals its roots in distribution of resources, modes of political decision-making, power differentials and our entire civilisational model. So, for example, practices with wide acceptance in society such as recycling and green consumer choices can be subjected to critical scrutiny, highlighting their roots in the fossil fuel lobby's deflection from needed structural changes towards individual responsibility.

While there are those (e.g. Bowers and Apffel-Marglin 2005) who argue that the Western anthropocentric currents underpinning Freire's thought are inimical to ecological sustainability, his thought has been integrated with environmental ideas through the ecopedagogy movement (Gadotti 2000; Kahn 2010; Misiaszek 2020a, 2020b). Ecopedagogy is the educational manifestation of the uniting of the social justice and ecological agendas: as Jacobi (2003, 189) states, environmental education must be 'above all a political act oriented towards social transformation[4]'. Critical questioning, in this way runs a full arc from more technical approaches to rational argument, to more political processes aiming for a fundamental transformation of society.

Deliberation

A fundamental part of living in a collectivity is deliberation – at least if we are to avoid authoritarian or absolute rule. Listening to the views of others, communicating our own views, and through the interaction of the two, revising those views is essential both for making the right decisions, but also ensuring justice and inclusion in society. As argued by many commentators over the years (e.g. Gutmann 1987; Mill 1991; Pateman 1970) deliberation is not only a guard against authoritarian rule, but also against forms of majoritarian democracy that reduce the democratic principle to a competition of rigid positions.

Higher education is a highly conducive space for the development of deliberation – a practice that must be learned through experience. The possibilities of deliberation depend in the first instance on policies of access, and ensuring that university spaces do not become segregated on the basis of socio-economic level or other factors. But they also depend on the pedagogical environment created in the classroom. Many developments in teaching and learning in higher education over recent decades have in fact focused on creating a space for deliberation in the classroom, through fostering an environment in which students feel able to raise questions, and protecting the time available for these discussions – particularly through flipped or inverted classroom approaches where the content input takes place largely before the real-time class (Lage, Platt, and Treglia 2000). Deliberation can take place in online fora as well as face-to-face ones, though careful consideration is needed to ensure that the design of the virtual space allows for these forms of interaction.

Deliberation in all spheres involves dealing with disagreements, some of which are sensitive and heated, and relate to value-based questions without clear answers. In higher education these controversial issues are a challenge, but also an opportunity: a challenge because they are hard to present and frame on the part of the teacher, and because they can fuel tensions and conflict amongst students in the classroom; but an

opportunity because their charged and ambiguous nature means that they can provide an intense engagement in the educational space, foster critical dialogue across diversity and expand students' nuanced moral reasoning and action. While levels of concern about climate change are generally high amongst youth populations (Hickman et al. 2021), and (depending on the context) the proportion of those denying climate change outright is likely to be low, there will still be significant differences on views on how best to address the challenge – in line with the axiological divergences outlined above.

In deciding on how to incorporate deliberation into the teaching of climate change, there are certainly arguments in favour of excluding climate denial. Firstly, the evidence and scientific research available to us at the present moment shows that anthropogenic global warming is real (Masson-Delmotte et al. 2021), so any fundamental challenge to that view could be prohibited on the basis of spreading false information. Second, given the Herculean task of transforming an unsustainable society into a sustainable one, and the catastrophic costs of not doing so, allowing voices to undermine that task might be considered too great a risk to take.

On the other hand, allowing climate change denial in the classroom enables exploration of the contested epistemic dimensions of climate, as discussed above: these could be explored theoretically, but may be more vivid if embodied in the views of participants. Another reason is that the exclusion of climate denial puts it underground, which paradoxically allows it to survive and even flourish, as a consciously countercultural view. That said, there may be versions of climate change denial which would in any circumstances be inappropriate in the classroom – particularly if linked with racist, sexist, homophobic or other exclusionary and prejudiced views and incitements.

Monroe et al.'s (2019) systematic review showed the value of '*deliberative discussion* to help learners better understand their own and others' viewpoints and knowledge about climate change' (original emphasis). As discussed in other contributions in this special issue (see those by Stein and by Jimenez & Kabachnik), emotions and climate anxiety must also be engaged with in educational settings. Yet creating this kind of environment is not straightforward, and providing a real space for deliberation in classrooms can at times be threatening for higher education teachers: it involves letting go and allowing the learners to dictate the movement of the discussion, and risks disagreement and even conflict. For learners too, it may be an uncomfortable experience. But as argued by Kwauk and Casey (2021), there is value in disruption of ideas, and even in making learners intellectually uncomfortable as a way of unsettling entrenched and unquestioned views, and contested issues can be useful for this end.

Critical questioning and deliberation are not new ideas, and have been seen in educational traditions around the world from the monasteries of classical India to the Scandinavian folk high schools (Ellis 2019). Yet while ever present, they are always vulnerable to the convenience of the standardised, transmission approach, ones which we associate with either marketised or authoritarian education systems, but which can equally be a temptation when faced with an urgent moral issue such as climate change. They underpin the treatment of the ontological, epistemological and axiological subject matter in the classroom, providing a foundational orientation from which the specific methods and approaches to teaching and learning can emerge. These methods can involve not only group discussion in the classroom, but also arts-based approaches, role plays and simulations, storytelling and many others.

The two qualities are not separate but interact and are complimentary. Questioning is in the first instance an internal process, in subjecting to critical scrutiny the assumptions held by the individual, though will often occur between teacher and student or in a group situation. Deliberation occurs primarily through engagement with others, though can also occur internally, through the process of self-reflection. But deliberation with others is a key means of fostering questioning, and critical questioning is an ever-present part of deliberation. Critical questioning and deliberation, therefore, have their own intrinsic value, but in practice occur in conjunction, with each enabling and strengthening the other. The ways in which they manifest themselves in real-life education depends naturally on the context and circumstances, and can appear in a multiplicity of forms while adhering to the foundational principles.

Towards pedagogical renewal

This article answers the call put forward by Misiaszek and Rodrigues (2023, p. 215) for a 'paradigm shift in HE to much more directly focus on teaching to achieve JBSE [justice-based sustainability education] globally' and for 'thorough and meaningful transdisciplinary incorporation of JBES throughout all HE curricula'. Yet while we need an 'epistemological paradigm-shift for most HEIs, including reinventions of disciplines and their epistemological foundations', this shift is unlikely to take place overnight, at least not in mainstream institutions. Moving towards this aim requires provisionally working within established courses of a disciplinary or professional nature: not conforming to them, but challenging them and pushing their boundaries from within.

Renewal is urgently needed in higher education. While the sector has seen startling growth in recent decades, its positioning a mechanism for labour market allocation has stored up major problems, being unable to fulfil all students' aspirations for social mobility, and simultaneously being distracted from its traditional role of providing a space for intellectual exploration and transformation. Furthermore, as highlighted by the contributions of Stein and Jimenez & Kabachnik in this volume, it is implicated in the continuing mindset of 'progress' based on extraction and exploitation, with institutions'' endorsement of sustainability goals being very often rhetorical or grounded in an illusory 'green growth'. Higher education must become (or return to being) or a deeply transformative experience, leading us to engage with the most profound questions of our being, knowledge and values, avoiding monocultures of the mind (Shiva 1993) and instead developing critical deliberative environments and an ecology of knowledges.

Fortunately, despite neoliberal designs on higher education takeover, universities have maintained some spaces of autonomy from the market, and institutional traditions provide some protections for counterhegemonic work. As argued by UNESCO (2022), even the Western scientific method is founded on scepticism of monolithic bodies of knowledge – as shown in the British Royal Society motto of *nullius in verba* (take nobody's word for it) – so should in theory at least leave the door open for epistemic pluralism. In recent years, decolonial movements in the Global South and internationalised student bodies in the Global North have also opened a space for challenging conventional curricula and creative possibilities for an ecology of knowledges (Del Monte and Posholi 2021).

As discussed above, one of Freire's (1970, 1994) most powerful contributions was his insight into the inevitably political nature of pedagogical interactions: not only because they often directly deal with political content, but because they involve the formation of agents, leading either to disempowerment or empowerment of the learner and citizen. The implication here is that teachers cannot 'sit on the fence' and remain neutral in their teaching: they are either liberating or domesticating. In the same way, teachers can (no longer) avoid including climate change in their teaching. Its centrality to the fate of humanity means that it is inevitably part of any meaningful discussion of society and the natural environment, and part of each disciplinary and professional area. Not addressing it means supporting the current slide into self-destruction for humanity. Given the questions of environmental justice alluded to above, not addressing climate change also means perpetuating inequalities at all levels.

This article has explored these ideas in relation to the transformative learning that is essential for responding to the climate emergency. Three spheres of human enquiry have been highlighted – the ontological, the epistemological and the axiological – underpinned by critical questioning and deliberation. In each case, climate change can be seen to represent a stimulus to change, a challenging and unsettling one, but one that can bring a much-needed shift. While effective teaching of climate change depends on a pedagogical approach oriented around various factors (an open classroom environment for discussion, building on students' existing knowledge, experiential learning, acknowledging emotions, use of arts, engaging with activism etc. [Ojala 2016; Bryan 2020; Lehtonen, Salonen, and Cantell 2019; Nussey 2021]), it also in turn stimulates these active pedagogies in a virtuous cycle. While this article has addressed those parts of the learning experience of students that are controlled by lecturers – the teaching part – it must be recalled that there are many other aspects (perhaps more important ones) including peer learning and self-directed learning outside the classroom (McCowan 2021).

In addition, while focusing on what can be done in the here and now within conventional (flawed) institutions, we also need to think about more radical transformations and innovations. The challenge of carving out space within mainstream institutions corresponds to Santos's idea of the *pluriversity*, an institution that is turned towards social justice and an ecology of knowledges. However, space is also needed for the emergence of what Santos (2017) calls the *subversity*, an entirely new and possibly unrecognisable form of higher education at the fringes (McCowan and Dietz 2022). Both of these tasks are necessary and can occur in conjunction.

The contribution of Sharon Stein in this special issue provides a rich example of the forms of learning that might take place in these transformed institutions, through the idea of 'education otherwise'. This approach unsettles the foundations of conventional education through its rejection of the narratives of hope, solutions, and innocence, and instead grappling with the coloniality, exploitation and separation that have given rise to climate change. As such it can take place in the cracks of contemporary mainstream universities, moving them towards the conception of the pluriversity, or outside, in counterhegemonic spaces that can become subversities.

Jimenez and Kabachnik in their contribution in fact critique the attention that universities are paying to climate change, arguing instead that 'Indigenous sustainabilities' and

place-based education would be preferable, given the smokescreen that climate action can provide for business-as-usual capitalist coloniality. Their argument is a compelling one, when we consider the greenwashing that occurs in higher education institutions and more broadly in society. Nevertheless, understandings of climate action do not have to be restricted to these palliative measures, but can involve more demanding transformations – given the roots of the climate crisis in industrial global capitalism, and the centrality of Indigenous stewardship as part of regeneration. This article argues that we can use the crack opened by the rhetorical presence of climate change in universities to pursue these more transformative understandings.

A vital point raised in the editorial by Misiaszek and Rodrigues (2023) is the need to interrogate the very concept of sustainable development. There is nothing settled about the notion, other than that it indicates a form of societal organisation that does not extinguish itself, and as such leaves the door open to diverse conceptualisations, including potentially oppressive and unjust ones. Winch (2006) in his analysis of the characteristics of the university, distinguishes between the 'technical' and the 'technological', between mastering procedures and being able to understand, interrogate and recreate them. It is the latter that characterises learning in higher education. We can apply this idea to the forms of learning necessary in relation to sustainability: instead of taking the notion of sustainable development as a given, and developing the knowledge skills and values necessary in order to bring it about, the university should be a space in which the notion is scrutinised, critiqued and recreated. Universities, therefore, and the graduates who emerge from them, should have a constructive, protagonist role, rather than simply one of operationalising and delivering.

Importantly, the task of higher education here is not only to help achieve climate action or sustainability, but to forge the very notion of the society we want (McCowan 2019). Teaching and learning processes in universities need to grapple with the idea of sustainable development, freeing it from its depoliticised technical assumptions, and understanding it as a project for the destiny of humanity. Providing space for this critical engagement with sustainability in the university will prefigure the broader forms of collective dismantling and reconstruction of our way of being so needed if we are to address the climate crisis.

Notes

1. 'Wicked' problems are social and environmental challenges that are highly complex, resist linear technical solutions and are grounded in contested values.
2. https://www.climate-uni.com/
3. This is not a comment on the moral and political desirability of individualism versus collectivism, but an ontological point about the extent of separateness of human beings.
4. Translation from the original Portuguese by the author.

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