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Climate Change Education for Sustainable Development

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Synonyms

Climate change education (CCE)

Definition

In this entry, climate change education for sustainable development (CCESD) is defined as a multi- and interdisciplinary response to climate change that enhances knowledge and awareness of the basic science, causes, and impacts of climate change; encourages changes in individual and societal behaviors and lifestyles; and increases individuals' and societies' adaptation and mitigation capacities.

Introduction

"Climate change is not a concern of just one or two nations. It is an issue that affects all humanity, and every living being on this earth . . . We have to take serious action now to protect our environment and find constructive solutions to global warming" voiced Tibetan leader the Dalai Lama to participants of the 24th Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) at the recent conference in Katowice, Poland, in December 2018 (Dharpo 2018). According to the Intergovernmental Panel on Climate Change (IPCC), the international United Nations (UN) entity for assessing climate change science, climate change "refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer" (IPCC 2015, p. 120). While there is natural climate variability brought about by natural internal processes within the climate system, the phenomenon and terminology of "climate change" attributes alterations in the atmosphere to human or anthropocentric activities. The human induced nature of climate change is underscored in the UNFCCC, a multilateral environmental agreement on climate change, in which climate change is defined as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UN 1992, p. 7).

There is widespread agreement that climate change is a real and present phenomenon affecting the global community. The authors of a recent IPCC report have stated that "human influence

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has become a principal agent of change on the planet, shifting the world out of the relatively stable Holocene period into a new geological era, often termed the Anthropocene" (Allen et al. 2018, p. 53). In an earlier report, the IPCC also articulated that "human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems" (IPCC 2015, p. 2). "Fossil-fuel based material consumption and changing lifestyles" have increased Greenhouse Gas (GHG) emissions of, for instance, carbon dioxide, methane, and nitrous oxides (Allen et al. 2018, p. 53). As a consequence, climate change impacts include but are not limited to increased floods and droughts, sea level rise, biodiversity loss, loss of agricultural productivity, and risks to human health (IPCC 2015). Climate change therefore seriously undermines sustainable development globally (Anderson 2012) but also particularly for those nations most vulnerable to its impacts.

In addition to some of the effects outlined above, with respect to education in particular, climate change and its associated impacts can disrupt the normal functioning of education systems as floods or storms, for instance, can destroy educational institutions or cause disruptions to school terms or years, as two examples. At the same time, Climate Change Education for Sustainable Development (CCESD) "has a central role to play in helping the general public and especially the next generations understand and relate to the issues, make lifestyle changes to reduce greenhouse gas emissions, and adapt to the changing local conditions" (UNESCO 2010a, p. 5).

Climate Change Education and the Global Agenda

Education is indispensable for enhancing individuals' capacities to address climate change and its impacts. Kagawa and Selby forcefully write "At such a moment of enormous human challenge, formal, non-formal, and informal education have a potentially crucial role to play. In both school age and adult learning communities, learners of all ages can be invited to take up the challenge of understanding and rethinking the world, of shattering assumptions, shibboleths and the taken-for-granted, of deliberating where to go at this critical fork in the road" (2010, p. 5). A number of international agreements, initiatives, and programs of action speak to the importance of education as a mechanism to address climate change. Article Six of the UNFCCC highlights the importance of Education, Training, and Public Awareness, calling on State Parties to undertake a range of actions including, developing and delivering education and public awareness programs on climate change and its impacts, as well as creating educational and awareness materials; developing training programs, and training various personnel; facilitating public access to climate change information; and fostering public participation in addressing climate change (UN 1992). Article Ten of the Kyoto Protocol to the UNFCCC similarly calls on State Parties to develop and implement climate change education and training programs, and enhance public awareness of climate change and access to relevant information (UN 1998).

More recently, in 2015, the international community adopted the Sustainable Development Goals (SDGs), expressing a common commitment to achieving the 17 SDGs by 2030. Amongst the SDGs is Goal 13, which calls on nations to "take urgent action to combat climate change and its impacts," with Target 13.3 speaking to the need to improve education, awareness, and human and institutional capacity on climate change (Open Working Group Proposal for Sustainable Development Goals 2017). Additionally, under Goal Four, which focuses on inclusive and equitable quality education, Target 4.7 speaks to ensuring that all learners acquire the knowledge and skills that align with and facilitate sustainable development through education. This, therefore, also emphasizes the importance of education as a means of addressing climate change since tackling this global issue is an important aspect of pursuing sustainable development by the world's nations. In Article 12 of the Paris Agreement, it

calls on Parties to the UNFCCC to pursue measures "to enhance climate change education, training, public awareness, public participation and public access to information, recognizing the importance of these steps with respect to enhancing actions under this Agreement" (UN 2015).

Amongst the international community, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has been called upon to drive climate change education and is a lead agency in promoting Education for Sustainable Development (ESD) and CCESD. During the 15th COP of the UNFCCC, UNESCO launched its Climate Change Initiative, which includes as one of its four thematic areas, climate change education in the context of ESD and the development of an accompanying CCESD program with three core objectives. These are to strengthen its Member States capacities to deliver CCESD at the primary and second levels, to encourage and enhance innovative approaches to CCESD in schools and to raise climate change awareness through nonformal education (UNESCO 2010a).

Climate Change Education for Sustainable Development

Education is critical for addressing the global sustainable development challenges facing the world. From 2005 to 2014, the UN Decade of Education for Sustainable Development (DESD) propelled global action on ESD and sought to engage stakeholders in two key areas: both the transformation of education and educational systems and the embedding of sustainable development in education (Tilbury 2011). Importantly, during the second half of the DESD, climate change was one of the global sustainable development issues prioritized for focus by the international community (UNESCO 2010b). As one of the critical issues affecting the sustainable development pathways of nations, UNESCO recommends that climate change be integrated into ESD learning content (UNESCO 2014). Additionally, policy makers and other stakeholders working in the area of climate change are encouraged to utilize ESD as an overarching framework to tackle that and similar issues (UNESCO 2014).

Mochizuki and Bryan (2015) outline some key organizing principles for ESD with reference to climate change, as follows:

- An integrated and interdisciplinary approach to climate change knowledge – in order to ensure an understanding of underlying social, economic, and political causes of climate change and priorities for transformation
- Addressing local and global perspectives on climate change – in order to highlight how localized behavior and actions can have impacts at the global level, and to identify solutions at local, national, regional, and global levels
- Advancing a climate justice perspective – in order that climate inequities and inequalities are acknowledged and can be advocated for (e.g., it is very often those least responsible for causing climate change and who have the least financial, human, and other resources to address it who are most vulnerable to its devastating impacts.)

Further, drawing on the four pillars of learning outlined in the Report of the Delors Commission – *Learning: The Treasure Within* (Delors et al. 1996) – Mochizuki and Bryan (2015) also offer how CCESD can be tied to these core learning pillars:

- Learning *to know* – CCESD would involve understanding basic climate science, various dimensions and connections with respect to the causes and consequences of climate change, and adaptation and mitigation strategies.
- Learning *to do* – CCESD would encompass the development of relevant skills and action competencies such as critical thinking, problem solving, and systems thinking skills, lifelong learning skills, and the skills to adapt and cope with risks and uncertainties.

- Learning *to live together* and *to be* – CCESD would introduce individuals to a range of knowledge, skills, and attitudes such as knowledge of global issues, respect for values such as peace, human rights, and justice, and empathy for and openness to varying perspectives.

Climate Change Education and Mitigation

Climate change education in its narrowest form encompasses climate science and literacy and can, therefore, be seen by some as relegated to scientific subjects. On the contrary, however, CCESD needs to be more broad-based and multidisciplinary to support mitigation and adaptation. Both mitigation and adaptation strategies are critical to addressing the challenges of climate change, and education is essential to both types of strategies.

Mitigation refers to human interventions that can reduce the sources of or enhance the sinks of GHGs (IIED n.d.), such as forest conservation. Cordero et al. (2008) emphasize that "an educated citizenry is required to make wise decisions regarding policies and practices aimed at reducing greenhouse gas emissions and the human impact on the Earth's resources" (p. 866). To support climate change mitigation efforts, for instance, education can help humankind learn to change their consumption patterns, use renewable forms of energy, and design and utilize green technologies (Anderson 2012). Climate change education for sustainable development therefore needs to be transformative in nature in order to bring about the cultural, lifestyle, and deeper social, economic, and governance systemic changes that will support mitigation efforts.

Institutions of higher learning in particular can contribute to climate change education for mitigation through a range of initiatives. Of course, enhancing awareness and knowledge of climate change is one key means of so doing through formal courses and programs. For instance, TERI University in India has a Master Program on Climate Science and Policy which focuses on mitigation (and adaptation) and other issues surrounding climate change (UN Department of Economic and Social Affairs 2015). The University's Master on Public Policy and Sustainable Development also has courses focused on climate and related issues (UN Department of Economic and Social Affairs 2015). At Nottingham Business School in Nottingham Trent University in the United Kingdom, final year undergraduate students take on the role of consultants to local businesses to help them to reduce their GHG emissions as part of their curriculum (Thomas 2015). Thus, curricula development is important.

In addition to dedicated programs and courses, Higher Education Institutions (HEIs) can also create and/or integrate resources into their teaching and learning for climate change mitigation. Faculty at Harvard Business School prepared a brief on climate change impacts, responses and implications for the business sector as a tool to utilize in class discussions (Henderson et al. 2017). World Climate is an example of a multidisciplinary resource for all levels of education (Sterman et al. 2019). This group role play simulation exercise offers students opportunities to represent various countries and blocs and negotiate an agreement to limit GHG emissions. It does so by drawing on a range of disciplines, including, economics, international relations, and science.

In addition to curricula and resource development, through their campus operations, universities can both educate the wider populace and surrounding communities and model behavior, for instance, with respect to the implementation of energy or water conservation measures or sustainable transportation initiatives to lower carbon emissions, design of smart buildings and the utilization of technology to ensure energy efficiency in classrooms and dormitories. Rooney and McMillin (2010) share various initiatives undertaken by the Australian National University in Australia to support sustainability and contribute to climate change mitigation (and adaptation). Some examples include the introduction of the Timely Tredlies departmental bike fleet to the campus to reduce vehicle usage amongst staff and students and, by extension, reduce carbon emissions. A second example includes the HotRot Organic Recycling Project which converts organic waste on the campus into compost, also working to reduce university emissions. By integrating mitigation efforts into their operations and

governance structures, universities can be seen as living laboratories and exemplars of change.

Climate Change Education and Adaptation

Adaptation speaks to making adjustments in natural and human systems in response to the actual or expected impacts of climate change (IIED n.d.), in order to cope with and adjust to associated hazards, risks, or potential possibilities. Education for climate change adaptation therefore focuses on enhancing the ability of individuals, groups and organizations to adapt to climate change (Davidson and Lyth 2012).

An important component of CCESD outlined by Anderson (2012) involves working to ensure that there is minimization of disruption to education systems and learners as a result of climate change impacts, for instance, from storms and floods. This means that learning environments must be made safe and climate resilient through the incorporation of disaster prevention, preparedness, response, and recovery strategies (Anderson 2012) in management and operations, and through considerations of building and site design and maintenance of schools and other learning spaces. This incorporates green building design and the use of green technology, for example.

McKeown and Hopkins (2010) conceptualize climate change education as involving two important aspects – climate and change. Knowledge of the science of climate change therefore falls within the remit of the first concept. While change involves education *for* change and includes six principal components, all of which are relevant for climate change adaptation (and mitigation):

- Issue analysis – understanding the background and root causes of complex issues in order to formulate solutions and pathways forward
- Community and personal decision-making – utilizing knowledge and skills to examine multiple perspectives surrounding issues and crafting personal or communal action plans for change
- Political processes – understanding national political processes, such as legislation and executive orders as well as localized, grassroots political movements as a precursor for action
- Social justice – involves understanding issues of inequity and pathways to change, including values analysis
- Intercultural sensitivity and competence – fostering intercultural sensitivities for an increasingly interdependent global world and, specifically, with reference to climate change, to prepare persons for peaceful, harmonious, and tolerant living in situations where there needs to be coexistence and/or interaction with climate refugees
- Behavior change – to foster action at the level of the individual to change habits and actions to support climate change mitigation and adaptation (McKeown and Hopkins 2010)

As with mitigation, HEIs can develop programs and courses that expose students to teaching and research on adaptation strategies. The University of Nairobi and Maseno University in Kenya have established a Climate Adaptation Research Institute which focuses on areas such as climate change adaptation technologies (UN Department of Economic and Social Affairs 2015). Similarly, at Aix-Marseille Université in France, adaptation is one of the areas given focus (UN Department of Economic and Social Affairs 2015). As one final example, Cranfield University in the United Kingdom has collaborated with international researchers, agribusinesses, and government to explore adaptation options in relation to agriculture and water in various countries (UN Department of Economic and Social Affairs 2015).

Education also can offer the skills needed to adapt lives, livelihoods, and human and natural systems to climate change. Skills within CCESD would encompass those that are needed to address a complex, multi-faceted phenomena such as climate change; these include, critical thinking, problem solving, and collaboration skills.

Different disciplines also have much to offer climate change education. Hergert et al. (2010) report on an interfaculty one semester course in

which students from different disciplines work together to address various questions surrounding climate change adaptation, mitigation, governance, and other issues. These student working groups were supplemented by various course activities including lectures from academics in disciplines such as physics, economics, and the social sciences. While several barriers were encountered in the course, the authors' efforts clearly underscore the need for a multi and interdisciplinary effort in addressing climate change. Lagos Business School in Nigeria has integrated sustainability and climate change into several of their courses (UN Department of Economic and Social Affairs 2015). Down (n.d.) and Ferguson and Bramwell-Lalor (2018) share on the integration of ESD and climate change into various teacher education courses at The University of the West Indies in Jamaica, including a postgraduate literature course entitled Literature and Education for Sustainable Development.

There is a clear role for the field of education in the development of awareness and knowledge, skills development, and behavior change for climate change adaptation and mitigation. Additionally, educational responses can include the use of local and indigenous knowledge as part of adaptive capacity for climate change. A discipline such as history can offer perspectives on the underlying causes of climate change. Science can expose persons to the science of climate change. The humanities can engender affective responses to climate change. Thus, CCESD calls for a response from all disciplines with respect to teaching, research and outreach.

Higher Education Institutions and CCESD

While education institutions at all levels have a role to play in climate change education to support mitigation and adaptation efforts, Leal Filho (2010) argues that "it is in the higher education sector that the need to tackle it in a systemic way is particularly acute" (p. 2), highlighting that university students will soon pursue employment in various fields which will have impacts on the environment in general and climate in particular. Thus, climate change education is critical with respect to enhancing awareness and knowledge. Rooney and McMillin (2010) propose that university campuses can move beyond knowledge delivery and research to drive CCESD through outreach and engagement with communities, institutional behavior, and campus design. From the previous examples, it is clear that universities have responded to this role. There is therefore a unique role for HEIs to exhibit leadership in the areas of (i) education and training, (ii) research, (iii) community engagement, and (iv) campus operations (American College and University Presidents' Climate Commitment (ACUPCC) n.d.). To consolidate and summarize some of the key areas:

(i) In the areas of education and training, higher education must be at the forefront of curricula development across various and multiple disciplines, including the sciences, social sciences, and the arts and humanities as examples. This multidisciplinary approach is necessary in order to ensure that individuals are able to address the complex social, economic, environmental, and political issues of climate change. Additionally, curricular content, and learning outcomes have to be focused on knowledge and skills development, with complementary learning environments and spaces created to allow students to develop and enact various action competencies. Particular focus also has to be paid to pre- and in-service teachers as they can have a multiplier effect in the classrooms. Higher education professional development programs are therefore critical.

(ii) Given that CCESD requires a multidisciplinary approach, research in the various disciplines is necessary. Within the physical and social sciences, for instance, studies are needed, in particular, on localized ecosystems and specific (vulnerable) populations (ACUPCC n.d.).

(iii) Campus design, operations, greening efforts, as well as the impacts of campus GHGs also need to be spaces of modeling for the wider

society. Campus procurement, transportation, energy, water, and other relevant policies must reflect tenets consistent with ESD and CCESD. Additionally, utilizing the physical infrastructure and plant of the campus as learning environments for both students and communities can enhance knowledge, action competencies, and wider community engagement.

(iv) Finally, community engagement is critical in order to ensure that the higher education sector has a widespread impact at local levels through the provision of expertise and resources for action and problem-solving, human capacity for CCESD and sustainability efforts, and collaboration. Community engagement is critical for various reasons. Firstly, it contributes to nonformal CCESD for those individuals who have been out of the formal education system for years or for those who are unable to access formal education. Secondly, it ensures the engagement of various stakeholders apart from students and young persons, such as adults and senior citizens. Thirdly, it supports the action component and competencies that are critical to CCESD. Finally, it contributes to a pooling of knowledge amongst various stakeholders at different levels.

As an example of the role that the higher education sector can take, the Higher Education Sustainability Initiative (HESI) was formed by a consortium of UN entities in 2012 as one of the activities leading up to the UN Conference on Sustainable Development (Rio + 20). The Initiative aims to garner commitments from HEIs worldwide to engage in teaching, research, and campus operations and governance in support of sustainability and climate change mitigation and adaptation (UN Department of Economic and Social Affairs 2015). The ACUPCC is another illustration; this is a network of American HEIs expressing commitment and taking action to address climate change in areas such as those previously mentioned. Activities under the Commitment include the completion of an emissions inventory, establishing a climate action plan, and integrating sustainability into the curriculum. Initiatives such as these align with the recommendations of the second Priority Action Area of the Global Action Programme on ESD, in promoting whole-institution approaches to ESD and related sustainability issues (UNESCO 2014).

Conclusion

Climate change has been characterized as a "wicked" problem, one marked by interdependencies, multiple causes, scientific uncertainty, and high complexity (Davidson and Lyth 2012). Education is one of the critical means of addressing such a problem. Climate change education for sustainable development can contribute to both mitigation and adaptation efforts if transformative in nature, interdisciplinary, delivered through both formal and nonformal means and aimed at not only knowledge and skills but the promotion of action competencies. The higher education sector is well placed to take a lead in CCESD through the areas of curricula development and delivery, research, community outreach, and carbon sensitive campus operations.

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