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Climate Change Education in the Context of Education for Sustainable Development: Rationale and Principles

YOKO MOCHIZUKI AND AUDREY BRYAN

Abstract

Although the role of education in addressing the challenges of climate change is increasingly recognized, the education sector remains under-utilized as a strategic resource to mitigate and adapt to climate change. Education stakeholders in many countries have yet to develop a coherent framework for climate change education (CCE). This article underscores the critical role that education can and should play in addressing and responding to climate change in all of its complexity. It provides rationales as to why CCE should be addressed in the context of Education for Sustainable Development (ESD). Advancing CCE in the context of ESD, or Climate Change Education for Sustainable Development (CCESD), requires enhancement of learners' understanding of the causes and consequences of climate change and their readiness to take actions to address it. The article presents key organizing principles of CCESD and outlines key knowledge, skills, attitudes, dispositions and competences to be fostered through it.

Keywords: Education for sustainable development, climate change, climate change education, UNESCO, UNFCCC Article 6

INTRODUCTION

Whereas climate change (CC) continues to be high on the international agenda, educationalists, climate scientists and those shaping or making climate

Yoko Mochizuki (Corresponding author), Programme Specialist, Section of ESD, United Nations Educational, Scientific and Cultural Organization (UNESCO), Paris.

E-mail: y.mochizuki@unesco.org

Audrey Bryan, Lecturer in Sociology, St. Patrick's College, Dublin City University, Dublin, Ireland.

E-mail: audrey.bryan@dcu.ie

or education policy still have limited understanding of what addressing CC through education should entail. During the latter half of the UN Decade of Education for Sustainable Development (DESD, 2005–2014), UNESCO launched a Climate Change Education for Sustainable Development (CCESD) programme as a flagship programme of the section of Education for Sustainable Development (ESD).¹ We are cognisant of the fact that ESD has yet to fulfil its potential as holistic and transformational education towards a more sustainable world and are equally aware of criticisms which have been levelled against the ‘closing circle’ of ESD (Selby and Kagawa, 2010). However, for the purposes of this article, we use the term ESD rather uncritically to refer to a set of processes, pedagogies and practices which seek to ensure that education systems are responsive to, and prepared for, current and emerging sustainable development challenges. This broad understanding recognizes the need for CCE to be approached from an interdisciplinary and systems perspective, so that the scientific, ecological, economic, political, ethical and social dimensions of CC can be more fully appreciated.

The purpose of the article is to present a comprehensive overview of, and rationale for, climate change education (CCE) within the context of ESD. First, it seeks to demonstrate why education should be a more central and visible part of the international response to CC by underscoring the critical role that it can play in addressing and responding to CC in all of its complexity. Second, it provides a number of interlinked rationales as to why CCE should be addressed in the context of ESD. In so doing, it argues that CCE can be a strategic and meaningful entry point for promoting the principles and practice of sustainable development through education. Finally, the article presents key organizing principles of CCESD and outlines key knowledge, skills, attitudes, dispositions and competencies to be fostered through it.

WHY EDUCATION? POLICY IMPLICATIONS

CCE refers to processes aimed at improving the degree to which an education system is prepared for, and is responsive to, the challenges of climate change (CC). There is an urgent need for policymakers to better understand the systemic effects of CC (see Figure 1) to enhance climate responses through education. The realities of CC are such that we need to learn new knowledge and skills and make significant behavioural changes in order to manage the risks associated with CC and reduce our vulnerabilities to these risks by building adaptive capacity and resilient societies. CCE, therefore, demands both immediate and longer-term responses to CC. The new knowledge and skills—as well as institutional and behavioural changes that are needed to cope with the realities of CC—will require a multi-pronged educational approach, involving non-formal, large-scale public awareness campaigns targeting people of all ages, to more formal educational responses engaging learners at all levels of the system. Central to these educational and awareness-raising efforts are the concepts of ‘mitigation’ and ‘adaptation’—two complementary actions that make up an overall strategy to reduce greenhouse gas emissions and CC impacts.

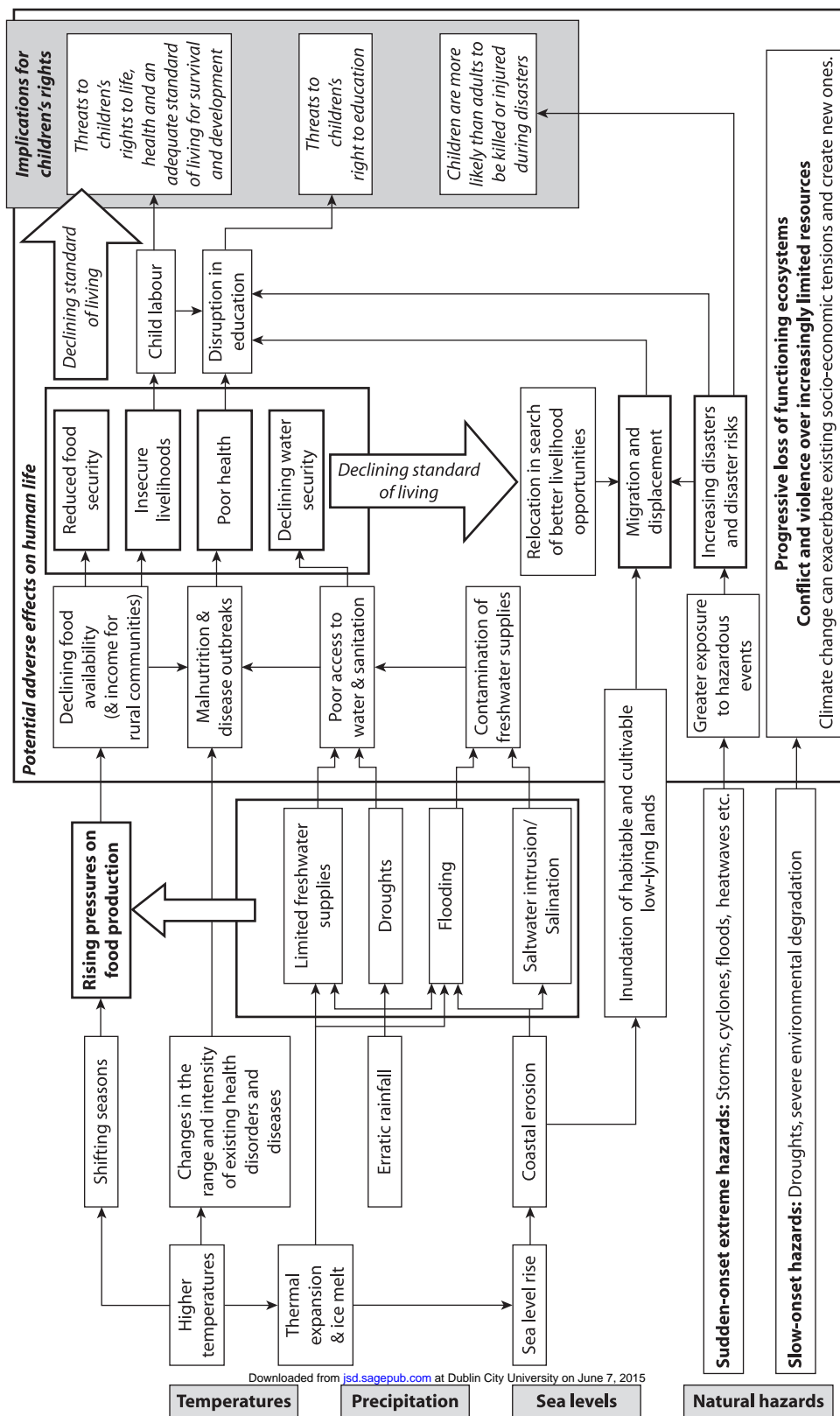


Figure 1 Understanding the Systemic Effects of Climate Change

Climate Change Mitigation is defined by the United Nations as a human intervention to reduce the sources of greenhouse gas emissions primarily linked to human actions of production and consumption (UNESCO/UNEP, 2011). Mitigation efforts include a range of interventions to stabilize and reduce greenhouse gas concentrations such as: investing in renewable, non-polluting energies and designing greener technologies, conserving energy, promoting changed consumption patterns and lifestyles, and re-orienting economies, social structures, value systems and ideologies that have resulted in the emission of excessive greenhouse gases.

Climate Change Adaptation refers to the process of building resilience and reducing the vulnerability of natural and human systems to the impacts of CC. The 'adaptation' dimension involves developing the knowledge, skills and dispositions to better cope with already evident and looming climate impacts. It will usually have a strong local focus (UNESCO/UNEP, 2011: 60–61). Adaptation is closely aligned with the concept of Disaster Risk Reduction, which comprises numerous efforts to minimize the vulnerabilities and disaster risks in society, in order to prevent, mitigate and prepare for the adverse impacts of natural hazards, and to facilitate sustainable development.

Education as an Untapped Opportunity to Combat Climate Change

Article 6 of the United Nations Framework Convention on Climate Change (UNFCCC) directs countries to consider education, training and public awareness as integral responses to CC.² Averting the worst of CC will require profound lifestyle changes, paradigm shifts, and international cooperation on an unprecedented scale (Gowdy, 2008). The climate crisis cannot be addressed through political agreements (e.g., pledges to regulate and limit emissions), green taxes and financial incentives, and technological solutions alone. Existing attempts to reduce emissions through taxes or technologies have not proven successful in inducing mitigation or adaptation, thus far at least (United Nations Task Team on Social Dimensions of Climate Change, 2011). While technological and financial policies undoubtedly have a role to play in CC, broader structural, cultural, perceptual, behavioural and ideological shifts are also necessary. In other words, transformative shifts in how we think and act, and how we relate to present and future generations are necessary. This is where education has a crucial role to play in climate responses.

Despite the relatively slow pace of climate negotiations globally, at national level, there is evidence of an increased political commitment to addressing CC. A 2012 survey covering almost all UN member states indicated that between 2007 and 2012, the number of countries that have either climate legislation or climate strategies has increased significantly, particularly among densely populated and 'emerging economies' in Latin America and Asia. By 2012, 39 per cent of countries had either climate mitigation legislation or a climate mitigation strategy, up from 23 per cent in 2007 (Dubash et al., 2013).³ Furthermore, since 2009, nine of the world's least

developed countries (LDCs) have announced plans or strategies which incorporate elements of both CC mitigation and adaptation (Fischer, 2013). A number of countries (e.g., China, Canada) have developed CC action plans which include specific education initiatives, sometimes as a direct response to the clearly visible local effects of CC (UNESCO Bangkok, 2012).

The proliferation of strategic plans and documents on CC at the national level indicates a growing awareness on the part of national governments about the urgent need to stabilize the climate system and to prepare citizens and their societies for the challenges of CC. It is often the case, however, that the education sector is not explicitly addressed in these strategy documents, despite its critical role in the response to the challenges posed by CC. A report published in 2009 found that the need for CCE was recognized by many national governments, but that thinking about the implementation of CCE was still very much in its infancy (Læssøe et al., 2009). While some national governments have made considerable progress in recent years in terms of furthering the CCE agenda, much more still needs to be done before it is mainstreamed within education policy and practice (Anderson, 2012; Bangay and Blum, 2010; Læssøe and Mochizuki, this issue; UNESCO Bangkok, 2012).

Education as an Ethical and Cost-effective Means of Addressing Climate Change

Education has been identified as both an ethical as well as cost-effective approach to dealing with CC and advancing sustainable development (UNICEF, 2012). The human as well as economic costs associated with CC are substantial. Taken together, CC and the carbon economy are thought to be responsible for five million deaths each year and cause illness in tens of millions people globally (DARA/Climate Vulnerable Forum, 2012). The losses incurred already exceed—by a significant margin—any costs of reducing emissions in line with a low-carbon transition, suggesting that tackling CC makes economic, as well as ethical sense.

Mainstreaming CC throughout the entire education system is one of the most effective as well as financially efficient means of tackling the climate crisis through its multiplier effect. Education has the potential to play a significant role in enhancing ‘bottom-up’ solutions to CC that cannot be addressed by ‘elites’ (UNESCO/UNEP, 2011: 36). The multiplier effect of education means that entire families and communities benefit when individuals share what they have learned. Education offers a sustainable source of local capacity and solutions as the knowledge learners acquire about CC adaptation and mitigation can be passed on to others and to future generations. Once informed, citizens are more able to participate in civil society and to influence decision-making in areas that affect them, particularly at the local level.

The Role of Education in Complementing and Advancing Multiple Agendas

The issue of educational quality cannot be considered in isolation from the overarching environmental context. The universal provision of basic education and

literacy are pre-requisites for quality environmental learning which is critical to enabling learners to understand and respond to complex global concerns like CC. Moreover, in contexts where environmental conditions affect a child's ability to access quality education, educational outcomes will be diminished. CC impacts have direct effects on educational access, enrolment and provision associated with increasing incidence of severe weather events (e.g., drought, flooding, cyclones, heat waves). Incremental environmental changes (e.g., sea level change, desertification, soil erosion, etc.) are also likely to impact poor families' ability to make a living, thereby reducing household budgets, and in turn affecting access to education and nutrition for children. In addition, the significant financial burden associated with rebuilding schools and other learning environments in the wake of extreme weather events has the potential to undermine long-term investment in the improvement of education provision (Bangay and Blum, 2010).

Enhancing the education sector response to CC is therefore one of the key mechanisms through which national governments can ensure and demonstrate their commitment and adherence to national and international frameworks pertaining to human rights, education, the environment and sustainable development. Not only is enhancing climate responses through education an obligation of parties to the UNFCCC, it will also allow national governments to contribute to Education for All (EFA) and the Millennium Development Goals (MDGs) by ensuring quality and inclusive education.⁴

CC is a risk multiplier which disproportionately affects the most vulnerable groups in society; as such, it is increasingly regarded as a human rights issue. Stronger climate responses in the education sector will also allow national governments to fulfil their obligations under the UN Convention on the Rights of the Child, which calls for education to be child-centred, inclusive, participatory and protective. Many international child-focused organizations advocate for education to be used as a means of safeguarding and promoting children's rights to survival, development and protection, as well as their right to participate in decision-making processes that affect their lives (see, for example, UNICEF UK, 2008, UNICEF East Asia and Pacific Regional Office, 2011; UNICEF, 2012; Polack, 2010). There are emerging positive synergies between education sector responses to CC adaptation and educational responses to disaster risk reduction (UNESCO/UNICEF, 2012; UNICEF, 2012).

WHY ESD? PEDAGOGICAL IMPLICATIONS

Although CC is often thought of as primarily a scientific or environmental issue, its root causes and actual and anticipated impacts are wide-ranging. CC has far-reaching repercussions for where people can settle, grow food, maintain built infrastructure and rely on functioning ecosystems. It therefore touches upon multiple aspects of sustainable development, ranging from human displacement to food security, economic growth and biodiversity loss. Given that CC encompasses environmental, political, social and economic factors, the holistic framework of ESD is an optimal framework to advance CCE. The 2005 EFA Global Monitoring

Report—The Quality Imperative (UNESCO, 2004)—identifies two key dimensions of educational quality: the promotion of learners' cognitive development, and the cultivation of skills, knowledge, values and attitudes necessary for responsible, active and productive citizenship. Addressing CCE in the context of ESD (or CCESD) is an ideal way for learners of all ages to understand the causes and consequences of CC and take action to address it.

Increasing People's Understanding of Climate Change and their Role in Alleviating or Exacerbating It

Members of the public tend to have a partial, incomplete and often poorly-formed understanding of CC (Gonzalez-Gaudiano and Meira-Cardesa, 2010). The complexity and scale of CC makes it difficult for people to comprehend its severity, or to recognize their role in contributing to, or alleviating it. Greenhouse gas emissions can have climate effects anywhere on the planet, regardless of where they were emitted. The risks of severe CC tend to be substantially deferred to future generations and to impact citizens who live far away from the emission source. Moreover, the total harm of global CC results not only from present emissions but from the total human-induced increase in atmospheric greenhouse gas concentrations that began with the industrial revolution. Additionally, it is only when combined with the emissions of others that individual emissions make a decisive difference in the atmospheric concentration of greenhouse gases. These complex realities can make it hard for people to grasp the connection between causes and effects which may in turn undermine their motivation to act (Gardiner, 2011). Furthermore, because it is the *aggregate*, as opposed to *individual* use of fossil fuels which is harmful for the environment, it can be difficult for individuals to appreciate their role in CC, or to see that they can play an important role in ameliorating or resolving it (Gonzalez-Gaudiano and Meira-Cardesa, 2011). Increasing people's understanding of the processes and activities driving CC is an essential first step in motivating and empowering them to take action to ameliorate it. People are also more likely to feel responsible for the well-being of future generations and geographically distant others if they recognize that there is an identifiable 'causal relationship' between their ordinary, day-to-day actions and the climate-induced harm that others will experience (Dobson, 2006).

Engaging Learner with the Social Processes Driving Climate Change

While individuals might appreciate the importance of living sustainably, the way that societies within emissions-intensive economies are currently organized makes it very difficult for them to dramatically reduce their emissions (Kawall, 2011). Over the last century, consumerism and materialism—supported by the marketing and advertising industries and the availability of cheap energy—have become prevalent in market-based societies. These ideologies and practices are quickly spreading to other regions of the globe as other countries become more industrialized. Meanwhile, many, if not most jobs in industrialized societies are dependent—directly or otherwise—on

a fossil-fuel driven economy. Furthermore, many of the behaviours and practices that contribute to climate-related harm, such as, driving a car, travelling abroad, watching television and using a computer are considered 'normal' and are taken for granted by many of those who live in consumer capitalist societies. As these practices are rooted in social and cultural norms, and/or can make life more convenient and pleasurable for people, they are difficult to change. In fact, tackling CC has been likened to 'build[ing] a movement against yourself' because of the practical, social and psychological benefits cheap fossil fuels provide—directly or indirectly—to those who live in greenhouse gas intensive economies (McKibben, 2012).

The actual process of behaviour change is highly complex. If people are aware that acting in isolation, their individual actions will not make a decisive difference in the atmospheric concentration of greenhouse gases, there may be little incentive for them to voluntarily alter their behaviour unless they perceive that everyone else will. To overcome this difficulty, ESD can include exposing learners to debates about 'green virtues'—the question of whether individuals should develop a set of ecological virtues by taking responsibility for their personal choices *irrespective* of how others respond (Jamieson, 2007). It is also important to create a space for engaging directly and meaningfully with the tensions and complexities associated with questions about individual and institutional responsibility for transnational harm (Dobson, 2006).

Engaging Learners with the Emotional Complexities of Climate Change and Climate Change Responses

The magnitude of the crisis and the injustices associated with CC can be psychologically overwhelming for people, thereby diminishing their sense of being able to respond effectively to it and hence their motivation to act (Hiller, 2011). The ESD framework acts as an antidote to the sense of helplessness and disempowerment that citizens might otherwise feel in the face of CC knowledge, by positioning them as active change agents and equipping them with a range of cognitive and analytical tools which will help them to deal with uncertainty, to take both individual and collective action, and ultimately to derive solutions to CC. Coming to terms with one's own culpability as well as vulnerability in the face of climate-related threats can be emotionally as well as cognitively difficult for learners (Gardiner, 2011). Because of its capacity to engage learners with the cognitive, practical, as well as ethical and emotional dynamics of teaching and learning, ESD is an ideal framework through which to grapple with the challenges associated with teaching and learning about global CC. ESD is premised on a range of teaching and learning methodologies that are participatory, experiential, critical and open-ended. These methodologies enable learners to engage critically and productively with the complexities of climate science in ways that are dynamic, interactive and innovative. Technological, scientific, financial and global governance responses to the climate crisis are therefore enhanced by theories of learning which address the cognitive, psychological and affective factors affecting citizens' motivation to act in relation to CC.

Enabling Social Transformation

Reducing individuals' personal emissions is part of the solution to the CC crises, but it should not be the sole or indeed primary focus (Kawall, 2011). Ensuring sustainability will also require major transformations in technology, industry and governance at national, regional and global levels (Gowdy, 2008). Recent research shows that nearly two-thirds of historical carbon dioxide and methane emissions can be attributed to 90 companies, half of which have been produced in the past 25 years alone (Heede, 2014). This means that a relatively small number of entities—albeit the largest multinational and state-owned producers of crude oil, natural gas, coal and cement—are responsible for producing the fossil fuels that are the primary sources of human induced greenhouse gases that are driving global CC. Energy companies possess proven recoverable energy reserves that will, if mined and emitted, further intensify CC and greatly exacerbate the human, social and political challenges associated with it. While these companies have strong economic incentives to access their energy reserves and oppose efforts to leave their carbon reserves in the ground, social and legal pressure could be brought to bear on them to shift these incentives and to meet their ethical obligation to help address climate destabilization (Gardiner, 2011; Heede, 2014).

The ESD framework is underpinned by the concept of transformation at multiple levels—personal, institutional and socio-political—and is therefore centrally concerned with the role that both *individual* as well as *collective* action can play in mitigating the CC crisis. In addition to equipping individuals with the knowledge, skills and dispositions to help them to live more sustainably in their daily lives, ESD equips learners with a sense of agency and the responsiveness to take action to influence the decisions, institutions and socio-economic structures affecting their communities, societies and the wider world they inhabit. In this sense, CCESD is critical to ensuring that education systems are not only responsive to, and prepared for, current and emerging challenges, but that they also serve as a *proactive force* in moving the sustainable development agenda forward.

Individual level actions might include reducing the amount of energy one consumes, changing one's consumer practices, or using renewable forms of energy. At the collective level, this might involve working with others to ensure greater CC accountability on the part of energy companies and governments whose policies and practices are intensifying the production of climate-destabilizing emissions of greenhouse gases and placing the future of the planet and its people in jeopardy. Acting collectively, citizens can help to ensure greater commitment from energy companies and governments to leave fossil fuels in the ground and to embrace clean, sustainable and renewable sources of energy through solar, wind, hydro and geothermal power.

KEY CHARACTERISTICS OF CCESD

The scale and complexity of the climate crisis demands a robust educational response which critically engages learners with the scientific, technical, behavioural, ethical,

affective and practical dimensions of CC. It also requires the promotion of key areas of knowledge and skills which will be needed at all levels of the system (primary, secondary, tertiary and adult education) and via diverse modes of delivery (formal, non-formal, informal) (Bangay and Blum, 2010). Although there are some exclusive elements within CC adaptation and mitigation which need to be addressed separately, adaptation and mitigation are complementary approaches. CCE for adaptation and mitigation should be approached as an integral process which seeks to empower people, communities and organizations to exercise significant positive influence on their livelihoods and well-being—under conditions of environmental sustainability, social justice and economic equity and viability. The next section presents an overview of what it means to practice CCE in the context of ESD. It presents key organizing principles of CCESD and outlines key knowledge, skills, attitudes, dispositions and competencies to be fostered through CCESD.

Key Organizing Principles of CCESD

Ensuring an integrated and interdisciplinary approach to knowledge about climate change

If citizens are to develop a comprehensive and nuanced understanding of CC and its far-reaching effects, it needs to be taught from an interdisciplinary perspective. Scientific knowledge—while vital to promoting climate awareness and climate literacy—provides a partial understanding of CC; attention must also be focused on the wider social, political and economic processes that need to be transformed if CC is to be meaningfully addressed (Gonzalez-Gaudiano and Meira-Carteia, 2010).

Knowledge of climate science is obviously critical to coming to a deeper understanding of the causes and consequence of CC, and therefore should be at the heart of any effort to educate citizens about CC. An integrated approach to knowledge about CC, however, also involves respecting indigenous knowledge. Indigenous people—comprising about six per cent of the global population—play a crucial role in the fight against CC (Global Humanitarian Forum, 2010). CC issues are of particular interest to indigenous people for two interlinked reasons. First, they have a particular physical and spiritual relationship with land, water and associated ecosystems and tend to be among the most vulnerable to CC. Second, they have a specialized ecological and traditional knowledge relevant to finding the best solutions to CC (Gerrard, 2008). Indigenous knowledge systems and resource management practices are important tools for both mitigating and adapting to CC. Indigenous knowledge is increasingly recognized as a powerful tool for compiling evidence of CC over time, and is beginning to be seen as a tool for forecasting seasonal climate information.

The multidimensional and interdisciplinary nature of CC highlights the need for cooperation across knowledge boundaries. On the one hand, it requires cooperation between professionals from diverse disciplines in order to develop effective approaches to CCESD (UNEP, 2010). It also requires educational policy-makers and curriculum developers to engage with indigenous communities to ensure that CCESD plans are informed by the specialized traditional knowledge and practices

of indigenous peoples. Culturally inclusive curricula and methods which include indigenous perspectives also help to create educational experiences that are more relevant to indigenous learners and to ensure that multiple and diverse intercultural perspectives are embraced in the learning environment.

Addressing local and global perspectives on climate change

Addressing the risks of CC requires global as well as local action to reduce greenhouse gases and to reduce vulnerabilities to CC impacts. The relationship between the local and the global—and how they shape each other in mutually interdependent ways—is one of the central organizing principles of ESD. It has particular relevance where CC is concerned. The production and consumption of energy and goods in one part of the world have been shown to have serious detrimental effects globally. In other words, although CC is by definition a global issue, the human activities that lead to CC ultimately take place locally.

CCESD seeks to highlight the connection between the global consequences of local everyday choices, actions or behaviours and to demonstrate how wider internationally derived decisions and issues affect people's day-to-day lives at a local level. When CC is framed as a local issue, it enhances learners' sense of connection to and understanding of CC; allows for engagement with practical, concrete issues and initiatives; promotes the development of local and regional solutions that could be applied to the national and global arenas, and inspires future action on a global scale (Centre for Research on Environmental Decisions, 2009).

Addressing the global dimensions of CC enables learners to see what other societies elsewhere are doing (or not doing) to exacerbate the warming of the planet; it exposes them to knowledge about what other people are thinking and doing in relation to CC. It also enables them to understand the global economic, social and political forces that are driving CC; it introduces them to practical and successful actions that other groups and communities have or are undertaking to mitigate or adapt to CC (UNESCO, 2013a). Framing CCESD in global terms is an important means of enabling transnational alliances to be forged so that individuals in different places can work collectively towards improving the fate of the planet and its people. If CC is to be meaningfully addressed, it will require individual behaviour change and altering the policies and practices of governments and industries that are accelerating the problem.

Taking a climate justice perspective

CC is a problem characterized by impacts of varying geographic intensity, as well as different degrees of accountability for historical and current greenhouse gas emissions. CC has been described as a problem of skewed vulnerabilities because it disproportionately affects people and countries (mostly in the developing world) who have actually contributed least to the problem and who are least well-equipped to deal with it (Gardiner, 2011). Poorer nations are disproportionately located in more climate-sensitive regions which tend to be more prone to flooding and more

dependent on agriculture (the most climate-sensitive sectors of the economy). Those communities which are most affected by CC are often living on the brink of survival and therefore lack the resources or physical and financial infrastructure which would help them to protect themselves from climate-related events (e.g., insurance) (Stern et al., 2006). Furthermore, many of those who will be adversely affected by present-day human activities that produce global warming are not yet born; as such, CC is fundamentally concerned with issues of intergenerational justice (Gardiner, 2011).

To combat this ‘double injustice’—where the groups and populations likely to be most harmed by CC are the least responsible for causing it and have the least resources to cope with it (Gough, 2011), educational interventions targeting the most vulnerable populations (CCE for adaptation or DRR education) are absolutely necessary but not sufficient. It requires educational efforts to recognize human beings as both the ‘drivers’ of CC and the ‘essential agents for redirecting development trajectories’ (UN System Task Team on Social Dimensions of Climate Change, 2011: 5). While mechanisms to address accountability, compensation and redistributive justice are not yet very well developed in relation to CC (Gardiner, 2011), CCESD can encourage exploration of complex and thorny political questions about whether, how and to whom those institutions, countries, companies and/or individuals who are most responsible for causing CC (‘drivers’) should compensate those who are worst affected by it (‘sufferers’). These ethical aspects of CC can be approached directly within formal or informal education, with potentially strong outcomes in terms of giving rise to critical reflection (UNESCO/UNEP, 2013). Addressing CC from a social justice perspective can enhance learners’ capacity to hold the agencies and institutions which are most implicated in CC to account and encourage them to imagine alternatives to existing political-economic arrangements and ideologies which promote unjust global relations and practices (Westheimer and Kahne, 2004). Not only should CCESD address the needs of the most vulnerable populations, it should also encourage rethinking of the current model of progress and empower people to take action to ameliorate the effects of CC.

The ESD Competencies Framework and its Application to CCESD

This section addresses a set of specific competences, capabilities and dispositions that CCESD seeks to cultivate and develop in learners. CCESD should contribute to new understandings, dispositions, attitudes and values that reflect the local, national and global needs in order to ensure environmental sustainability, social inclusion and equitable prosperity. The ESD framework is widely compatible with a range of learning capabilities (knowledge, skills and competencies, attitudes and behaviours, and values) that have been identified as necessary for the twenty-first century (Haichour et al., 2007). This section presents competencies for addressing CC based on four pillars of education: learning to be, to know, to do and to live together—which were identified in a 1996 report to UNESCO of the International Commission on Education for the Twenty-first Century (commonly known as the ‘The Delors Report’) (Delors, 1996).

Learning to know: Understanding the causes and consequences of climate change

To make informed decisions, people need a basic understanding of the causes (who, what and how) and severity of the impacts of CC (who is affected and how they are impacted by it), as well as the range of different mitigation and adaptation options which are available. Having an understanding of the causes and consequences of CC requires knowledge of the factors that make people vulnerable to CC impacts in the first instance.

Understanding the multidimensional and interconnected nature of causes and consequences of CC. CC is one of the best examples of how issues are interrelated and people's lives deeply interconnected, albeit in ways that are not always immediately apparent or visible to us. The social and scientific dynamics of CC provide us with a very clear illustration of how our daily lives affect, and are affected by, what people on the other side of the world are doing. CCE should seek to promote critical consideration of how individual lifestyle choices, including consumption and production practices, can influence social, economic and environmental development (UNEP, 2010).

Climate change cuts across multiple issues and sectors; thus any attempt to inform people about it must take an integrated and holistic approach. Its causes and consequences are multidimensional—spanning the ecological, economic, political, ethical and social domains. For example, CC can affect such far-ranging issues as economic growth, political governance, water shortage, agriculture, energy supplies, class tension and the distribution of goods; CC exacerbates many of the socio-economic factors that make people vulnerable to it in the first instance. Through its impact on the systems and institutions that sustain human health and well-being, including ecosystems, livelihoods and employment, and the provision of social services, CC perpetuates existing drivers of vulnerability (United Nations Task Team on Social Dimensions of Climate Change, 2011). For these reasons, CCE must be conceptualized as more than simply climate science, and must be addressed from an interdisciplinary and systems perspective.

Knowledge of climate science. One of the key goals of CCE is to ensure a climate-literate public that understands the basic principles of the earth's climate system; knows how to assess scientifically credible information about climate; can relay information and participate in dialogue and debate about CC to others; makes informed and responsible decisions and acts in ways that help to ensure more equitable, sustainable and resilient societies. CCE curricula should be characterized by curricular continuity (Driver et al., 1994) that is, sequenced in a way that takes into account learners' conceptions about CC and moves them towards scientific understanding (Shepardson et al., 2011).

CCE curricula should include and delineate between the different scientific concepts and processes associated with CC. This includes both specific, content-based knowledge (e.g., climate, deforestation, habitat loss, water cycle, soil erosion, air pollution) as well as awareness of strategies to address pressing environmental concerns (e.g., reducing carbon consumption, encouraging low-carbon development, reducing deforestation through sustainable forest management, improving water and

waste management). It also requires a good understanding of the time-space dynamics of CC, including the delayed consequences that current greenhouse gas emissions hold in store for the quality of life, security and development options of future generations. CCE should also seek to provide knowledge about, and enable learners to distinguish between, certainties, uncertainties, projections and risks associated with CC, and should also incorporate knowledge of the history and interrelated causes of CC (including its technical, scientific, ecological, social, economic and political dimensions).

Knowledge of mitigation and sustainable consumption and production. CC mitigation is concerned with identifying the causes of CC and developing the knowledge, skills and dispositions required for individual and societal action to rectify those causes. Mitigation-based educational programmes seek to equip individuals with the values, knowledge and skills to make choices and decisions that minimize the use of natural resources, emissions, waste and pollution, while contributing to the development of new solutions to the climate crisis. It enables people to rethink the way they live, buy and consume. CCE for mitigation also entails rethinking how our daily lives are organized, altering the ways in which people socialize, exchange, share, educate and build identities (UNESCO/UNEP, 2011). In terms of mitigating immediate causes of CC, CCESD curricula should include topics pertaining to energy consumption, the shift to non-polluting and renewable energy sources, environmental conservation, re-forestation and re-greening (leaves storing CO₂). At a deeper level, CC mitigation education involves examining economic systems, social structures, cultural patterns, lifestyle expectations, consumerism, wealth distribution, aspirations and value systems and their underlying responsibility for excessive greenhouse gas production.

Knowledge of CC adaptation and DRR. CC adaptation seeks to reduce the vulnerability of natural and human systems to the impacts of CC and enable them to adapt to a changing climate through adjustments in social, ecological or economic systems. It is closely aligned with the concept of Disaster Risk Reduction (DRR), which comprises efforts to minimize the vulnerabilities and risks of disaster in society, in order to prevent, mitigate and prepare for the adverse impacts of natural hazards. Adaptation strategies at the community level are often very similar to, if not the same as, DRR strategies. Consequently, adaptation efforts can be embedded within existing DRR tools and there are a range of tools and methodologies that have been developed for this purpose, including community disaster committees, community evacuation and rescue plans and local first-aid training (UNESCO Bangkok, 2012).

Knowledge of local environmental conditions, associated risks and management strategies. As the specific nature of climate threats varies considerably within and between countries, the nature of the knowledge about local environmental conditions, associated risks and management strategies to be addressed in CCE will depend on local and national contexts and concerns. Possible topics might include: the annual flood cycle and how to manage it; sustainable agricultural methods; existing areas of pollution and potential strategies for improved water, soil and waste management; sustainable forest management; and awareness of valuable endemic species (both flora and fauna) and how to protect them (UNESCO Bangkok, 2012).

Learning to do: Transversal/cross-cutting skills

CCE should seek to promote a range of transversal skills and capabilities that cut across the cognitive and affective domains, such as: learning to cope with one's emotions; learning to adapt to new situations; envisioning alternative futures and reasonable paths of action leading to these; and developing new values, creativity, problem solving and social transformation skills. Cultivation of such skills requires methods that are participatory, experiential, critical and open-ended to enable learners to engage critically and productively with the complexities of climate science in ways that are dynamic, interactive, innovative and solution oriented.

Managing information and thinking critically about CC. Although attitudinal and behaviour change are critical to ensuring a more just and sustainable future, CCESD should not be reduced to a series of educational interventions and inputs concerned with ensuring that learners engage with CC in a prescriptive way by adhering to a predetermined set of appropriate actions and behaviours (such as conserving energy and recycling). As human beings are primarily responsible for creating and intensifying CC, their capacity to derive their own solutions to the problem should be encouraged and promoted through CCE (Andreotti, 2011). As such, CCESD should support learners to develop and enhance a range of analytical skills that will enable them to consider the multiple causes and dimensions of CC, and determine possible courses of action and consequences of potential solutions to this complex problem. Key learning capabilities associated with CCESD include:

- critical thinking, systems thinking and problem solving skills (reasoning, recognizing and questioning patterns);
- dealing with rapid change and uncertainties;
- analyzing, synthesizing and evaluating information;
- planning and management skills;
- life-long learning skills (learning how to learn, to adapt knowledge to new contexts, and to engage in self-directed learning); and
- information, media and technology skills.

CCESD should also be informed by a critical literacy approach to teaching and learning in order to promote deeper understanding of different worldviews on sustainable development (i.e., different ways of defining the problems and identifying the solutions of sustainable development challenges). Critical literacy approaches (e.g., Andreotti, 2011) enhance learners' awareness of who the most powerful drivers of CC are; promote understanding of the different interests that shape different responses to CC (e.g., business interests, consumer interests, farmers' interests, political interests, future generations' interests, etc.); and help learners to critically judge the validity of these interests in relation to the public good. Climate literate citizens should be able to acquire, assess and use information on the consequences of consumption, particularly in terms of its effects on the environment, and be able to recognize, decode and reflect critically upon messages from the media and the market (UNEP, 2010). For example, equipping learners with critical media literacy skills is important as a means of encouraging citizens to challenge the taken-for-granted

view in consumer capitalist societies that consumption leads to self-enhancement and self-fulfilment and that an individual's identity is determined by what he or she consumes. Furthermore, because nominally 'scientific' arguments are frequently used to discredit CC concerns and to promote CC denial, learners need to be equipped with media literacy and research skills that will enable them to critically evaluate media and research-reports and to remain denial-sceptical (Hamilton, 2009). These skills of discernment and critical thinking are important as a means of promoting more responsible forms of consumption and more critically informed and climate-aware citizens.

Collectively, these critical and analytic skills lead to more responsible thought and action in relation to CC by supporting learners to engage ethically with the world; to analyze the relationships among their practices and broader inequalities and injustices; to make critically informed and reflective decisions and consider to understand the potential implications of their thoughts and actions and various responses to CC; and to imagine alternative futures and create reasonable paths of action leading to these (UNEP, 2010). Pedagogies which seek to promote critical thinking, and to encourage critically informed, reflective decisions, typically involve discussion, analysis and application of values. As such, they often draw upon the arts using drama, play, music, design and drawing to stimulate creativity and imagine alternative futures (UNESCO, 2012).

Coping with the emotional realities of CC. Effective responses to CC will also require people to develop the ability to negotiate and cope with change, complexity, uncertainty and insecurity in different contexts and to develop skills and capacities to cope with the emotional realities of CC. Contemplation of actual as well as potential climate-related hazards and disasters as well as climate-changed futures is likely to elicit strong emotions in the learner that need to be addressed (UNESCO/UNICEF, 2012). Furthermore, critical engagement with the causes and consequences of CC—and the gravity of the injustices we are implicated in—is likely to raise uncomfortable questions about who we are and what we want to be (Gardiner, 2011).

Coming to terms with the reality that there is a vast amount of harm caused by greenhouse gas emissions and that our everyday actions are causing harm to the Earth and its inhabitants can lead to despair, distress, pain and guilt. For those directly and adversely impacted by CC, spaces must be created where feelings of anger, despair, grief can be expressed and addressed. Given the increasing incidence of disasters globally, pre-disaster learning will increasingly occur within post-disaster environments (UNESCO/UNICEF, 2012). Thus, socio-affective learning (i.e., learning that addresses involve sharing of feelings, emotions and sensibilities) is a critical component of effective CCESD. CCE educators need to be comfortable addressing the range of emotions that learners may feel, and to engage productively with the feelings of despair, powerlessness, guilt and denial which they may encounter in their classrooms. Consideration of these emotions needs to be balanced against the transformative dispositions and capabilities which are also important affective dimensions of CCE.

Preparing for sudden and slow-onset disasters. Preparing for disasters induced or exacerbated by CC requires not only adaptation strategies at the community

level such as community evacuation plans or certain analytical skills or coping skills, but also cultivation of skills directly pertaining to survival in specific local contexts. Whereas reducing individuals' vulnerabilities to CC takes much more than early warning, simulation drills, training in first-aid skills and so on, it is crucial for people to have opportunities to develop essential survival skills based on local environmental conditions and associated risks. The specific nature of climate threats varies considerably within and between countries. For example, teaching children how to swim was identified as one of the specific actions to be taken in a national ESD initiative based on a partnership between the Vietnamese Ministry of Education and Training (MOET), UNESCO and Samsung.⁵ In coastal areas prone to flooding, learning to swim is critical for survival, but it will not even be associated with CC or DRR in other contexts. Identifying what constitutes essential survival skills and creating opportunities to equip people with these practical skills are an important part of enhancing climate responses through education.

While preparing for fast-onset disasters may make intuitive sense to policy makers, there is a need to prepare not only for sudden but also for slow-onset disasters caused by CC. Preparing for slow-onset disasters—daily stresses pertaining to basic human needs—means aligning CCE with existing efforts to end poverty, improve health and address equity through education. For example, health and hygiene education are important in guarding people against diseases that will become more prevalent because of CC such as malaria. Raising awareness about mosquito breeding sites should be considered an important part of CCE in certain regions (UNICEF, 2012).

Preparing for 'green jobs'. CC and its consequences in the form of changing weather patterns, shifting agricultural production and new health risks—coupled with rising populations, accelerating urbanization and rapidly diminishing natural resources—will raise the need for new skills on a large scale. Higher education institutions as well as training institutions such as agricultural colleges, engineering schools, and Technical and Vocational Education and Training (TVET) institutions should be used as vehicles for building 'green skills' such as ecosystem management and other human capacities for a green economy. There is a need to foster human resources for 'green jobs' in renewable energies, environment and new technologies, including those related to building and managing resilient and sustainable urban infrastructure and developing sustainable models of food production.

In addition to creating a new labour demand for green jobs in sectors such as agriculture, water, energy, construction and waste management, the transition to a green economy will also change the scope and nature of existing jobs. In other words, all jobs can potentially be 'greener'. Not all of the new skill needs for 'green jobs' are technical in nature (ILO/Cedefop, 2011). Core skills for employability affect the ability to learn new skills, and generic green skills such as entrepreneurship and risk management are indispensable for moving economies to greener solutions. ESD seeks to enhance learners' skills for problem solving, analyzing complexity and synthesizing the acquired insights, and exploring and experimenting with more sustainable forms of social organization, material production and consumption. There are obvious overlaps, therefore, between generic 'green skills' and ESD competences.

Learning to live together and learning to be: Global citizenship education and CCESD

The concept of global citizenship does not entail a legal status or formal membership but rather refers to a sense of belonging to the global community, with its presumed members experiencing solidarity and collective identity among themselves and collective responsibility at the global level (UNESCO, 2013b).⁶ While the values associated with global citizenship education (GCED) are not new, GCED as a purpose and as an area of teaching and learning is relatively recent, with growing interest among UN Member States. GCED aims to empower learners to engage and assume active roles both locally and globally to face and resolve global challenges and ultimately to become proactive contributors to a more just, peaceful, tolerant, inclusive, secure and sustainable world.

Core competences of GCED which can be readily applied to the theme of CC include: (a) knowledge and understanding of specific global issues and trends, and knowledge of and respect for key universal values (e.g., peace and human rights, diversity, justice, democracy, caring, non-discrimination, tolerance); (b) cognitive skills for critical, creative and innovative thinking, problem-solving and decision-making; (c) non-cognitive skills such as empathy, openness to experiences and other perspectives, interpersonal/communicative skills and aptitude for networking and interacting with people of different backgrounds and origins; and (d) behavioural capacities to launch and engage in proactive actions. GCED is transformative, giving learners the opportunity and competencies to realize their rights and obligations to promote a better world and future. As a solution-focused and action-oriented process, GCED seeks to generate actions and engagement among, and for, its members through civic actions in the public domain to promote a better world and future. As it positions learners as active change agents and empowers them to take both individual and collective action, GCED is ideally suited, as an educational process, to the goals of CCE.

WAYS FORWARD

CCESD demands both immediate and longer term responses to CC. Whereas the immediate task is to 'climate proof' education systems so that they can adapt to the challenges and impacts posed by climate-related shocks and trends, the longer term task is to enhance and re-orient education systems so that they equip learners with the requisite skills, knowledge and dispositions to deal with current and future challenges (UNESCO Bangkok, 2012: 8). The magnitude and complexity of the climate crisis is mirrored in the enormity of the task of ensuring that educational systems are equipped—physically as well as pedagogically—to be a proactive as well as responsive force in alleviating this crisis.

In principle, CCESD empowers people to assume responsibility for creating a sustainable future by highlighting the multiple opportunities which exist through our individual and collective choices to initiate change and create solutions for sustainable lifestyles. It fosters active citizenship and democratic participation by engaging

learners with questions about how they relate to one another and to the ecosystems that support their lives. Pedagogically, however, this is a daunting task. ESD and other ‘adjectival educations’ that make up this umbrella are often marginalized within the curriculum, even within subjects which are ideally positioned to address it, such as Citizenship Education (Bryan and Bracken, 2011). In some instances, while CC issues are covered in the curriculum, they are addressed in a superficial manner which overemphasizes individual level responses such as recycling, reusing and reducing, at the expense of a consideration of the wider social processes which drive CC (UNESCO Bangkok, 2012).

In the ongoing discussions on the post-2015 global education framework, ESD is recognized as an integral element of quality education. This encourages ESD advocates and practitioners to work more closely with those who are concerned with the centrality of quality teaching in improving student learning outcomes more generally. For example, characteristics of CCESD presented in this article resonate with what are sometimes referred to as productive pedagogies, which promote higher order thinking skills (such as critical thinking and problem solving); are focused on identifying and solving intellectual and/or real-world problems; connect with learners’ background knowledge on a given topic; bring diverse cultural knowledge into play; foster active citizenship and democratic participation; and provide opportunities for sustained dialogue between students, and between students and teachers (Lingard and Keddie, 2013; Lingard et al., 2003).

It is beyond the scope of the present article to consider the enormous capacity-building needs that are required if CCESD is to be mainstreamed in education systems—such as strengthening teacher education, integrating CCESD into curricula, and ensuring good governance for ESD through integrated structures of government. Whereas the other articles included in this special section on CCE and ESD represent initial efforts to understand what is needed to enhance the education sector response to CC in different national contexts, much remains to be done to realize CCESD which can engage learners critically and productively with the complexities of CC in ways that are dynamic, interactive and innovative, while fully considering local and cultural specificities and age-appropriate content and pedagogy.

CONCLUSION

This article has stressed the need for CCE to be approached from an interdisciplinary and systems perspective, so that the complexity and multidimensionality of CC can be grappled with more effectively. It has highlighted the critical role that education can play in addressing and responding to CC and argues that CCE is best addressed within the context of ESD which comprises a range of pedagogical theories and approaches which enable learners to engage critically and productively with the complexities of climate science. It identified a set of core organizing principles of CCESD, as well as a range of skills, attitudes, dispositions and competencies which can be fostered through it, including a set of CC competencies which evolved from the ESD competencies framework which is premised on four pillars of education: learning to be, to know, to do, and to live together identified in the ‘The Delors Report’ (Delors, 1996).

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Notes

1. The UNESCO Strategy for the second half of the DESD (UNESCO, 2010) highlights CC as one of the strategic entry points to operationalize and implement ESD as concrete activities. The strategy requests UNESCO to support member states and other stakeholders in addressing global sustainable development challenges through ESD, by focusing on the following three key action themes: climate change, biodiversity and disaster risk reduction and preparedness. UNESCO's strategic focus on CCE is partly in response to the outcome of the 2009 UNESCO World Conference on ESD Bonn Declaration, which requests UNESCO to 'Intensify efforts and initiatives to put climate change education higher on the international agenda, in the framework of the DESD, in the context of UNESCO's strategy for action on climate change, and as a component of UN-wide action' (UNESCO, 2009a, 16.g). The present article builds on UNESCO's early efforts to conceptualize CCE (UNESCO, 2009b, 2009c), recommendations from a UNESCO expert meeting on CCE (UNESCO, 2011), as well as existing recommendations, guidelines and other guidance documents on relevant themes (e.g., OECD, 2009; UNEP 2010; UNESCO-IIEP, 2011; UNICEF, 2012). The preliminary outline of the present article was discussed at 'Expert Consultation on Guidelines on Climate Change Education in the context of Education for Sustainable Development', held at UNESCO Paris on 8–9 April 2013.
2. Article 6 of the UNFCCC addresses education, training and public awareness and access to information in relation to climate change whereby UNESCO should assist countries to implement activities in the area of education. In particular, UNESCO will collaborate with the UNFCCC on the implementation of the Doha work programme on Article 6 of the Convention.
3. There has been a slight increase in the number of countries with national climate legislation (18 per cent in 2007 to 21 per cent in 2012), and a larger increase in the number of countries with climate strategies (5 per cent in 2007 and 18 per cent in 2012) (Dubash et al., 2013).
4. The UNESCO CCESD programme recognizes the need to move beyond the MDG focus on primary education to fully exploit the potential of the secondary and tertiary sub-sectors. It also stresses the important role that informal education programmes play in responding to CC, which in some areas are the only available educational opportunities and which may also be better placed to have immediate impact (cf. Bekalo and Bangay, 2002; Blum and Diwan, 2007).
5. UNICEF Bangladesh's SwimSafe programme also provides swimming lessons for young children and is included as an example of action on climate change in a publication of the United Nations Joint Framework Initiative on Children, Youth and Climate Change, titled *Youth in Action on Climate Change: Inspirations from around the World*, 2013.
6. Global citizenship education has been identified as one of the three priorities of the UN Global Education First Initiative (GEFI), which was launched in September 2012, and has been included as one of the strategic objectives within UNESCO's medium-term strategy for 2014–2021 (UNESCO, 2014).

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