



BISHOP
GROSSETESTE
UNIVERSITY

[BG Research Online](#)

Leal Filho, W. and Hemstock, S.L. (2019) *Climate change education: an overview of international trends and the need for action*. In: *Climate Change and the Role of Education*. Springer International Publishing, Switzerland. ISBN 9783030328979

This is an Accepted Manuscript published by Springer in its final form on 29th November 2019 at https://link.springer.com/chapter/10.1007/978-3-030-32898-6_1.

This version may differ slightly from the final published version.

Copyright is retained by the author/s and/or other copyright holders.

End users generally may reproduce, display or distribute single copies of content held within BG Research Online, in any format or medium, for personal research & study or for educational or other not-for-profit purposes provided that:

- The full bibliographic details and a hyperlink to (or the URL of) the item's record in BG Research Online are clearly displayed;
- No part of the content or metadata is further copied, reproduced, distributed, displayed or published, in any format or medium;
- The content and/or metadata is not used for commercial purposes;
- The content is not altered or adapted without written permission from the rights owner/s, unless expressly permitted by licence.

For enquiries about BG Research Online email bgro@bishopg.ac.uk.

Climate change education: an overview of international trends and the need for action

Walter Leal Filho and Sarah Hemstock

European School of Sustainability Science and Research, , Hamburg University of Applied Sciences,
Germany, Ulmenliet 20, D-21033 Hamburg, Germany

Walter.leal2@haw-hamburg.de

School of Humanities, Bishop Grosseteste University, Lincoln, LN1 3DY, UK

Sarah.hemstock@bishopg.ac.uk

Abstract

Climate change is perceived as one of the major challenges of modern times. But in order to help people to comprehend the various messages around climate change, it is important to foster climate change education. This paper reviews the state of the art on climate change education at university level, and examines the problems associated with it. Its novelty is based on the fact that it presents the results of an international analysis, which illustrates different understandings and engagements of a variety of universities with climate change across diverse audiences and geographical conditions. The paper concludes by outlining some of the lessons learned and some areas where interventions are needed.

Key-words

Climate change – education- universities - societies – research- curriculum

Introduction

Education is one of the factors to prepare societies to handle climate change (UNESCO, 2017), which by itself is one of the greatest world challenges (Alberta Council for Environmental Education, 2017). Climate change information is an important part of the formula (Leal Filho 2009). At the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil in 1992, nations agreed to bring to life the United Nations Framework Convention on Climate Change (UNFCCC), which coordinates global efforts in this key field. Among other elements, UNFCCC expressed the need to develop and implement education initiatives to raise awareness about climate change and its impacts, and to develop and share educational programmes and materials (United Nations, 1992).

As a matter of principle, climate change education includes relevant content knowledge on the climate system, climate science, and on climate change impacts. It also requires the following components to be considered: issue analysis, community and personal decision-making, political processes, social justice, inter-cultural sensitivity and inter-cultural competence, behaviour change, stewardship, and connections between climate change and economics (Hopkins and McKeown, 2010; Forrest and Feder, 2011). Climate change education focuses on the institutional environment

in which that content is taught, so as to ensure that education systems themselves foster climate resilient communities (Anderson, 2012).

However, various studies have identified the fact that many teaching staff at both universities and at schools, still lack confidence in their personal subject knowledge, and some of them feel that they are unprepared for the integration of action and content knowledge that characterises climate change education. This is especially so for those teaching science, where subject knowledge tends to be more factual (Oversby, 2015). This paper intends to reiterate the importance of climate change education, and the need to work towards a better handling of climate issues in teaching programmes.

Since the Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation states that, “Inequalities influence local coping and adaptive capacity, and pose disaster risk management and adaptation challenges from the local to national levels” (IPCC 2012, p. 10); it should be acknowledged here that in many of the least developed countries most affected by climate change impacts, such as the Pacific small island states, there is little formal provision of climate change education at university level. For example, studies from 15 Pacific island nations, identified a lack of human capacity and expertise as key barrier to improving national resilience to climate change impacts (Buliruarua et al., 2015). The United Nations Development Programme (2013) established that most Pacific island populations lack climate change awareness and knowledge of appropriate adaptation strategies, leaving them powerless to make informed choices about adaptation to climate change impacts affecting their livelihoods and resources – both now and in the future (UNDP, 2013). This lack of human capacity resulted from the absence of sustainable accredited and quality assured formal education around social, managerial and technical climate change adaptation issues (Buliruarua et al., 2015; Hemstock et al., 2016).

Importance of climate change education

Climate change education is perceived as one of the instruments which may be employed in order to create an informed society, knowledgeable workforce, and enable government officials to make decisions and preparations to help protect communities against climate change and its adverse impacts (UNESCO, 2010; American Chemical Society, 2016). Analysis of global policy frameworks dealing with climate change and disaster risk, for example, the Sendai Framework on Disaster Risk Reduction 2015-2030 (adopted by 187 countries), illustrates that they identify the central role of training and capacity development as being critical for meeting policy goals (Hemstock et al., 2016). Climate change mitigation and adaptation are two main strategies to address climate change. Both require education, which can provide the knowledge and skills needed for redefining lifestyles, change social structures to become more resilient, foster energy efficiency, reduce ecological footprint, change consumption and production patterns, and build adaptive capacity and resilient societies (Anderson, 2012).

Education is to play one of the major roles in the transition towards a global economy characterised by low carbon emissions (Education International, 2017), which gained a new momentum with the

ratification of the Paris Agreement in 2015, due to its ambitious emissions reduction goals. Climate change education is also urgently needed because of the time delay between decisions that may worsen climate change (e.g. increases in CO₂ emissions) and when their full environmental and societal impacts such as droughts, floods, hunger due to crop failure or climate induced migration are felt. As a result, it would benefit society if a due emphasis could be given to the evidences gathered from scientific projections in decision-making, and more efforts could be employed in addressing the roots of the problem. Effective education could accelerate climate change mitigation by transferring scientific knowledge across societal sectors and building social will or pressure to shape climate policy (Ledley et al., 2017).

But even though climate change education is important, it is not as widely practised as it should or could be. Table 1 outlines some of the problems seen in pursuing climate change education.

Table 1 - Some of the problems that hinder the pursuit of climate change education

Problem	Impact
Complexity & scale	Climate change relates to a variety of atmospheric, meteorological, social and economic factors which makes it a complex issue. The scale of climate change causes and impacts can be seen as overwhelming and individual acts can be rationalised as being inconsequential.
Lack of training and professional development opportunities	Not all teaching staff have the training or feel qualified to engage on climate change teaching
Limited teaching resources	The restricted availability of specific teaching resources which may clearly communicate on climate change in some countries
Curriculum constraints	Lack of flexible time-tables to allow discussions on climate change; inflexible and politically biased state curricula
Competing themes	Climate change needs to compete with a variety of themes which are equally important
Limited institutional support	In many cases climate change is on the one hand perceived as important, but institutional support to it is limited, which inhibits progress
Scepticism and controversy	Lack of interest to tackle the topic; fear of being controversial

Source: author

In order to address these problems and further efforts in respect of information, communication, training and education on climate change, the International Climate Change Information and Research Programme (ICCIRP)* was created by the Hamburg University of Applied Sciences in 2008. Since its creation, ICCIRP has involved over one million people on its on-line climate conferences, and thousands of scientists have attended the symposia it regularly organises.

The critical role of climate change education has been also recognized in a number of international agreements, such as:

- Article 6 of the UN Framework Convention on Climate Change
- Article 12 of the Paris Agreement, the Sustainable Development Goals (SDGs) which have on specific goal on climate change (SDG 13, Climate Action).
- The Lima Ministerial Declaration on Education and Awareness-Raising: Ministers and heads of delegations attending the UN Climate Change Conference 2014 - COP20 - (1-12 December 2014, Lima, Peru) adopted The Lima Ministerial Declaration on Education and Awareness-raising. This Declaration calls on governments to include climate change into school curricula, and to include climate awareness into national development and climate change plans. Marcin Korolec, President of COP 19/CMP 9 and at the time Secretary of State, Ministry of the Environment, Poland, said that "this declaration is an important step towards bringing education back into the spotlight where it belongs".

- Article 27 (j) of the Sendai Framework for Disaster Risk Reduction 2015-2030 asks for accredited formal qualifications for capacity development and professionalisation of the disaster risk reduction sector (UNISDR, 2016, p.18)
- The Aichi-Nagoya Declaration on Education for Sustainable Development (EDS)
- Article 6 of the UN Framework Convention on Climate Change (UNESCO, 2017)

(*) Details at: <https://www.haw-hamburg.de/en/ftz-nk/programmes/iccirp/>.

In addition, the Paris Committee on Capacity-building was formed by the UNFCCC in 2015 to addresses current and emerging gaps and needs in implementing the Paris agreement by analysing climate capacity-building issues and making policy recommendations to support countries in enhancing climate action. For the years 2017 to 2019, its focus area is capacity-building activities for the implementation of nationally-determined contributions in the context of the Paris Agreement (UNCCC, 2019).

Some Case Studies

There have been various studies on climate change, and on education, but very few have tackled climate change education in an integrated way. Based on the perceived need to address this research gap and the paucity of first-hand information on the obstacles which hinder developments in this field, a survey was performed, with a view to selecting some case studies from universities where climate change education is being pursued. These are herewith presented.

Evidences of the increasing significance of climate change education was seen by the launch of the UN Alliance on Climate Change Education, Training and Public Awareness (Læssøe and Mochizuki, 2015). Climate change, as a topic, has also been included in the U.S. National Science Standards such as the 2012 Framework for K-12 Science Education (National Research Council, 2012) and Next Generation Science Standards 2013 (NGSS, 2013).

In Canada, the province of Newfoundland and Labrador addressed the importance of education in its Climate Change Action Plan in 2005. The document promises continued support and funding to the Newfoundland and Labrador Climate Change Education Centre, which work focuses on educating the public about greenhouse gas emission reduction measures and encouraging actions to reduce personal emissions (Nazir et al., 2009).

A further example of action comes from China. The Chinese government highlights the importance of education as one of the necessary approaches to handle climate change in a variety of government policy documents. For instance, the document “China’s Scientific and Technological Actions on Climate Change and Policies”, in addition to various others, include recommendations on specific education initiatives to be integrated in schools, universities and research institutes (Yi, J and Wu, P., 2009).

In Denmark and Australia, matters related climate change are explicitly incorporated in the Danish Education for Sustainable Development strategy and the Australian National Education for Sustainable Development policy, respectively (Breiting et al., 2009; Chambers, 2009). Denmark followed the recommendation of the European Commission to implement climate change topics in the formal national education through its integration to Education for Sustainable Development (Milér et al., 2012). In Brazil, the Sustainable Schools Programme, which is included in the National Plan on Climate Change (2008) calls upon the Ministry of Education to introduce climate change into the curricula and learning materials (Valentin et al., 2015).

In the Pacific- African, Caribbean and Pacific (P-ACP) grouping, key national policies on climate change adaptation (CCA) and disaster risk management (DRM) / disaster risk reduction (DRR) have been surveyed (Table 1) with regard to policy support at national level for climate change education.

Table 1: policy support for climate change education in the P-ACP region

Country	Key Policy	Awareness Raising	Non-formal training	Strengthen capacity (general)	Education (formal assumed)
Cook Island	Cook Islands Joint National Action Plan for DRM & CCA	✓		✓	
Fiji	Fiji National CC Policy 2012 & National DRM Plan 1995, National Disaster Management Act 1998; Climate Change Adaptation and Disaster Risk Reduction Strategies 2013.	✓	✓	✓	✓
FSM	Joint State Action Plan for CC & DRM and 2 nd National Communications report to the UNFCCC			✓	✓
Kiribati	Kiribati Joint Implementation Plan for CC and DRM 2014 -2023	✓		✓	✓
Nauru	Republic of Nauru Framework for Climate Change Adaptation and Disaster Risk Reduction 2015			✓	✓

Niue	Niue's Joint Action Plan for DRM & CCA			✓	✓
Palau	Palau Climate Change Policy: For Climate & Disaster Resilient Low Emissions Development 2015			✓	✓
PNG	The National Development Strategic Plan (DSP) (2010-2030)			✓	✓
RMI	RMI Joint Action Plan for CCA & DRM; Vision 2018 (2003-2018); National Climate Change Policy Framework 2011; Ministry of Education Strategic Plan (2013-2016)			✓	✓
Samoa	Samoa National Action Plan for DRM 2011-2016	✓	✓	✓	✓
Solomon Islands	National Development Strategy 2011-2020; Solomon Islands Climate Change Policy (2012); Solomon Islands National Disaster Risk Reduction Policy (NDRRP, 2010)	✓	✓	✓	✓
Timor Leste	National Adaptation Programme of Action (NAPA, 2010) on Climate Change Adaptation National Disaster Risk Management Policy 2008	✓	✓	✓	
Tonga	Tonga National Climate Change Policy and Joint National Action Plan for CCA & DRM 2010-2015			✓	✓

Tuvalu	Tuvalu National Strategic Action Plan for CCA & DRM 2012 -2016	✓	✓	✓	✓
Vanuatu	Vanuatu Climate Change and Disaster Risk Reduction Policy 2016 - 2030	✓	✓	✓	

Integration of climate change issues at universities: some examples

Many countries are at present working on improving the efficiency of their education systems towards a climate literate society (Milér et al., 2012). Higher education institutions are considered to have a critical role in preparing society to adapt to the impacts of climate change, and to help local communities to create, test, and disseminate knowledge about regional climate projections and adaptation strategies (Dyer and Andrews, 2014). This is especially important in the regions where leaders and media have created confusion among the public about environmental issues such as climate change (Hess and Collins, 2018). Some recent publications such as “Universities and Climate Change: Introducing Climate Change to University Programmes” (Leal Filho 2010) and “Climate Change Research at Universities: Addressing the Mitigation and Adaptation Challenges” (Leal Filho 2017), have attempted to raise awareness about the role played by universities in the climate change debate, and have documented and promoted many concrete experiences and case studies which have shown how this can be done in practice.

In practical terms, the integration of quality climate change learning into existing education systems requires reconsideration of existing approaches by developing a system that equips learners with the requisite skills, knowledge and attributes to deal with future challenges (Bangay and Blum, 2010).

Monroe et al. (2017) identified a number of effective climate change education strategies:

- development of programs focused on making climate change information personally relevant and meaningful for learners;
- engagement of learners into activities or educational interventions (e.g. debates, small group discussions, laboratory investigations, and simulations, field trips etc.);
- design of programs specifically to uncover and address misconceptions about climate change;
- engagement in designing and implementing projects to address some aspect of climate change, e.g. energy saving, emissions reduction, change of environmental behaviours (Monroe et al., 2017).

There are several ways to integrate climate change education into higher education. One of them is via **curriculum modifications**. Such modifications across a diverse range of disciplines could ensure professionals understand climate change, its impacts, and the best practices for responding to them

(Dyer and Andrews, 2014). Hess and Collins, 2018 identified three pathways toward a greater inclusion of climate science in the core curriculum:

- to have a single specified core course that explicitly requires education about climate change and taken by all students;
- to have a high volume of options of climate-related courses. Climate-change courses could be offered in multiple departments, thus increasing the proportion of courses that cover climate change in the general education curriculum;
- to have a menu of courses that would include climate-science or climate-change education for an environmental or sustainability studies programs

(Hess and Collins, 2018).

Naturally, there can be no prescription as to which approach is the best one. A decision about the most adequate method depends on the local context, available expertise and socio-economic settings.

In any case, experts note that climate education cannot only be limited to the STEM disciplines (science, technology, engineering, and math). It is critical to capacity building to focus on social and behavioural disciplines, including emerging inter-disciplinary fields, such as ecological psychology and ecological economics. Incorporating new learning objectives into a variety of programs is necessary to ensure that tomorrow's professionals have an understanding of the new climate reality that will impact their work (Dyer and Andrews, 2014).

Higher education institutions across the world have developed robust examples of integrating climate change into their curriculum. Even countries which have limited resources such as Belarus, can be active. In Belarus for instance, its universities integrated a new study course "Climate Change: Consequences, Mitigation, Adaptation", which has been developed under the UNDP-ENVSEC "Environment and Security" project framework. The four-unit study course applies innovative educational approaches to help students and young people to understand, address, mitigate, and adapt to the impacts of climate change (UNDP in Belarus, 2015).

Under the USAID Lowering Emissions in Asia's Forests (USAID LEAF), program participating universities integrated a regional climate change curriculum. It was created by USAID LEAF in close collaboration with 14 universities from six countries, as well as experts from the US Forest Service and from several American universities. The climate change curriculum consists of four modules: Basic Climate Change; Social and Environmental Soundness; Low Emission Land Use Planning; Carbon Measurement and Monitoring (USAID LEAF, 2016). For instance, at the Da Lat University, a leading research and technology institution in central Vietnam, 8,000 students are required to take an introductory climate change course. At Kasetsart University in Thailand, new undergraduate students take a general education course on climate change that integrates all four curriculum modules. The Vietnam Forestry University (VFU) has integrated the materials into existing courses,

including undergraduate courses on “Global Climate Change Impacts and Mitigation” and “Climate Change and Forestry” (USAID LEAF, 2015).

A number of European Universities have also set standalone graduate programmes on climate change. For instance, the University of Copenhagen offers a 2-year interdisciplinary MSc programme, that combines natural and social science approaches to the study of climate change, its causes and effects, and adaptation methods (University of Copenhagen, 2017). The Lund University offers a master program in Disaster Risk Management and Climate Change Adaptation with a strong focus on group work and interaction between students and teaching staff, supported by national and international institutions, such as UN agencies, the Red Cross/Red Crescent movement, NGOs, and national authorities (Lund University, 2017).

In the P-ACP region, the University of the South Pacific in partnership with the Pacific Community and national tertiary education providers were the first to offer a suit of technical, vocational education and training qualifications (TVET) in Climate Change Adaptation at levels 1 to 4 on the Pacific Qualifications Framework (Hausia Havea et al., 2019). This was part of a region-wide European Union funded initiative with all 15 P-ACP countries participating (the European Union Pacific Technical Vocational Education and Training in Climate Change Adaptation and Sustainable energy – EUPacTVET). For the P-ACP region, a vocational skill-sets and competencies approach worked since technical knowledge and skills are required to improve community resilience to climate change impacts. Additionally, Small Island States such as Tuvalu have around 30% of their employees working in jobs linked to climate change and disaster risk reduction, so climate change adaptation and “resilience” can be defined as an employment sector. These TVET qualifications were developed by all 15 P-ACP countries as equal partners and were regionally accredited (rather than on a national basis). The qualifications were then offered across the region at various tertiary education providers (for example, Fiji National University, Solomon Islands National University, Vanuatu Institute of Technology, etc) (Martin et al., 2017).

It is important to note that in all cases, it should be ensured that student learning outcomes are appropriate and allow them to seek solutions through well informed activities.

Another way of integrating climate change education to universities is by means of **research**. By providing cutting-edge scientific research, higher education contributes to climate adaptation by identifying the most pressing climate impacts at different levels. Research universities have also the opportunity to provide much needed research on solutions (Dyer and Andrews, 2014).

For instance, a number of South African universities are demonstrating transdisciplinary research and teaching, guided by the Global Change Grand Challenge National Research Plan (Valentin et al., 2015).

In 2008, the University of Victoria established the New Zealand Climate Change Research Institute (CCRI) to develop interdisciplinary research into all aspects of climate change. The Institute undertakes internationally significant climate change research that informs policy makers in New

Zealand and other countries, develops and delivers high quality, interdisciplinary taught courses to students and practitioners (Victoria University, 2017).

The Stanford School of Earth, Energy and Environmental Sciences and the Stanford Teacher Education Program launched a Climate Change Education Project in 2009. It aims to support teaching of scientifically accurate climate change curriculum in middle and high schools. The project documents in detail the full circle of curriculum development, teacher professional development, classroom implementation, analysis of student achievement data, and curriculum revision (Stanford School of Earth, Energy and Environmental Sciences, 2017).

The third way to integrate climate education is by building **collaborative partnerships**. The establishment of coordinated climate change education networks would help to integrate, and synergize these diverse efforts by conducting research on effective methods, sharing best practices and educational resources (Forrest and Feder, 2011). UNESCO recommends to seek collaboration and partnerships with ministries, civil society, communities, media, the private sector etc. In the specific case of African countries, the organization recommends to establish regional centres of excellence and regional climate change education network (Valentin et al., 2015).

Under the Asian University Network for Environment and Disaster Management (AUEDM) 18 universities from 13 countries have come together to share knowledge resources, advocate for policy change, and develop guidelines related to environment and disaster risk management. One of the objectives of AUEDM is to seek possibilities of mutual collaboration on field-based action research focusing on climate change adaptation (UNESCO, 2012).

In the P-ACP region, the Pacific Regional Federation of Resilience Professionals was formed as an industry association for resilience to achieve sustainable outcomes in skills development, education, training and employment for climate change adaptation and disaster risk reduction and to align closely with regional and national needs and priorities. It is also intended to administer an industry certification scheme for practitioners that sets the benchmark of quality for the Resilience (climate change adaptation CCA and disaster risk reduction /management (DRR/DRM)) sectors. To ensure the sustainability of the EU PacTVET project outcomes, this federation will host a Resilience Industry Skills Advisory Committee to facilitate reviews and updates of education and training curriculum and practices in resilience for the regionally accredited qualifications. (Hemstock et al., 2016 & 2017).

The next approach is **community engagement**. Colleges and universities have the opportunity to serve as 'hubs' on climate adaptation issues and support their communities preparing for growing climate change impacts (Dyer and Andrews, 2014). This role includes but is not limited to, conducting applied climate change research, assessment of current conditions and risks from severe weather events, translating science for lay audience and local decision makers, disseminating local-scaled climate information, providing technical support for multi-sector collaborative planning efforts, and evaluating the effectiveness of local adaptation actions (Gruber et al., 2017).

For instance, the Vietnam Forestry University has adapted climate change modules for a training program for provincial government officers titled “Green Growth and Climate Change Mitigation” and for training courses in Malaysia and Laos entitled, “Improving Forest Governance in Southeast Asia” (USAID LEAF, 2015). In the United States, the Cornell Institute for Climate Smart Solutions supports local farmers with decision tools for strategic adaptation to climate change and builds their capacity to cope with potential negative effects of climate change, and to take advantage of any opportunities that it might bring (Cornell Institute for Climate Smart Solutions, 2017). Also in the US, the Center for Climate Preparedness and Community Resilience of Antioch University in New England implements climate resilience at the local level through stakeholder capacity building, applied research, education and training provided to community leaders (Antioch University New England, 2017).

Community engagement can be also focused on **campus operations**. Campuses are often complex physical plant and infrastructure systems that include elements such as:

- a) buildings and operations such as , power generation, heating and cooling systems, storm water management
- b) transportation,
- c) waste management

In some campuses, elements such as forests and agriculture are also relevant. All these sectors are vulnerable to the risks posed by climate change (Dyer and Andrews, 2014). They also offer real opportunities via which universities may engage in environmental action. Indeed, many universities at present address these challenges as part of climate action strategies, blueprints or plans. For instance, the Climate Action Plan of the University of Saskatchewan, Canada includes energy awareness training, available to any department or unit on campus informing employees and students of expectations and goals for energy conservation and efficiency on campus. Furthermore, sustainability awareness is a part of new employee orientation through which new staff become aware of the university’s commitment to GHG reduction and the ways in which they can be involved (University of Saskatchewan, 2012).

It is important to note that climate change education has been shown to be more effective with a focus on concrete actions that can be taken by individual students (Alberta Council for Environmental Education, 2017). At the same time various studies suggest that many universities and colleges are still struggling to modify the general education curriculum and to ensure that all students are exposed to education about climate science and climate change. The reluctance to engage has many reasons, one of which can be the slow pace of change reflected in different priorities of professors and administrators for core curriculum reform (Hess and Collins, 2018). Another potential threat to the effective integration of climate change education might be differing views of roles and responsibilities in this process held by professors (McGinnis et al., 2016).

Lessons learned and conclusions

Education is central to efforts towards informing and raising awareness about climate change. But in order to yield the expected benefits, it requires a holistic and interdisciplinary approach, which recognizes the complexities of climate change and includes scientific, economic, political, ethical and cultural dimensions of expertise (UNESCO, 2011). Although higher education may contribute to climate change mitigation and adaptation in research, education, operational and community engagement activities areas, this potential has not yet been realised (Dyer and Andrews, 2014) partly by the reasons here outlined.

Some of the lessons which may be drawn from the literature and from the various examples and experiences listed on this paper, and some interventions which may lead to the further development of climate change education, are follows:

1. Climate change education should be equally pursued at school level and at universities, preferably in a more systematic way by means of formal policies and programmes, since these offer a sense of continuity, as opposed to being ad hoc and short-termed, as it is often the case with many of the current and past initiatives;
2. the existing international emphasis provided to climate change education by UNFCCC or the Paris Declaration, should be better used. This is particularly so if one considers the fact that over 100 countries have signed on to these documents, and are at least in principle committed to education on matters related to climate change;
3. climate change education can be planned and delivered flexibly. There is no prescription on fixed approaches or methods, much depends on the local context and reality;
4. much could be gained by combining climate change education with efforts in the field of education for sustainable development. After all, climate change is one of the major obstacles to sustainable development so that a combination of both education streams can have a far greater impact, than handling them in separate;
5. climate change education is not a prerogative of industrialised nations. On the contrary: education institutions in developing countries should actively engage and pursue initiatives to foster awareness and see local solutions

As far as universities are concerned, the plurality of options available means that climate considerations can be given to campus operations, teaching, research and in community relations. This, combined with an increase in teachers' confidence in teaching the political, social and economic side of climate change, may lead to changes and to a better motivation among students be more engaged towards addressing a problem which is global in nature, but whose impacts are felt at the local level.

References

Alberta Council for Environmental Education, 2017. What is Excellent Climate Change Education?
A guidebook based on peer-reviewed research and practitioner best practices. Available at:

[http://www.abcee.org/sites/abcee.org/files/3-%27What%20is%20Excellent%20Climate%20Change%20Education%20\(7%20Dec%202017\).pdf](http://www.abcee.org/sites/abcee.org/files/3-%27What%20is%20Excellent%20Climate%20Change%20Education%20(7%20Dec%202017).pdf)

American Chemical Society, 2016. Global Climate Change ACS Position Statement. Available at: <https://www.acs.org/content/acs/en/policy/publicpolicies/sustainability/globalclimatechange.html> [Accessed December 29, 2017].

Anderson, A., 2012. Climate Change Education for Mitigation and Adaptation. *Journal of Education for Sustainable Development*, 6, pp. 191–206. Available at: <http://dx.doi.org/10.1177/0973408212475199>

Antioch University New England, 2017. Our mission. Available at: <http://www.communityresilience-center.org/> [Accessed December 29, 2017].

Bangay, C., Blum, N., 2010. Education Responses to Climate Change and Quality: Two Parts of the Same Agenda? *International Journal of Educational Development*, 30, pp. 335–450. Available at: <http://discovery.ucl.ac.uk/1526915/1/Bangay2010Education359.pdf>

Breiting, S., Læssøe, J., Rolls, S., 2009. Climate Change and Sustainable Development: The Response from Education. Danish National Report. Danish School of Education, University of Aarhus, Copenhagen, Denmark. Available at: <http://www.hilaryinwood.ca/pdfs/researchb/ESD%20in%20Canada%202009.pdf>

Buliruarua, L.A., Hemstock, S.H., Jacot Des Combes, H., Kua, N., Martin, T., Satiki, V., & Manuella-Morris, T., 2015. P-ACP Training needs and gap analysis. Reports for Fiji, Cook Islands, the Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Timor Leste, Tonga, Tuvalu and Vanuatu. The Pacific Community and The University of The South Pacific. Suva, Fiji: EU PacTVET (FED/2014/347-438).

Chambers, D., 2009. Sustainable Development: The Response from Education - Australian country report. Melbourne Graduate School of Education, Australia. Available at: <http://www.hilaryinwood.ca/pdfs/researchb/ESD%20in%20Canada%202009.pdf>

Cornell Institute for Climate Smart Solutions, 2017. Smart Solutions for a Changing Climate. Available at: <http://climateinstitute.cals.cornell.edu/> [Accessed December 29, 2017].

Dyer, G., Andrews, J., 2014. Higher Education's Role in Adapting to a Changing Climate. American College and University. Presidents' Climate Commitment, Boston, MA. Available at: http://secondnature.org/wp-content/uploads/Higher_Education_Role_Adapting_Changing_Climate.pdf

Education International, 2017. COP23: States must be more ambitious with regard to climate change education and training. Available at: <https://ei-ie.org/en/detail/15526/cop23-states-must-be-more-ambitious-with-regard-to-climate-change-education-and-training> [Accessed December 29, 2017].

Forrest, S., Feder, M.A., 2011. Climate Change Education: Goals, Audiences, and Strategies: A Workshop Summary. National Academics Press, Washington DC. Available at: <https://www.nap.edu/read/13224/chapter/2>

Gruber, J.S., Rhoades, J.L., Simpson, M., Stack, L., Yetka, L., Wood, R., 2017. Enhancing climate change adaptation: strategies for community engagement and university-community

- partnerships. *Journal of Environmental Studies and Sciences*, 7, pp. 10–24. Available at: <https://doi.org/10.1007/s13412-015-0232-1>
- Hausia Havea, P, Siga, A, Rabuatoka, T, Tagivetaua Tamani, A, Devi, P, Senikula, R., Hemstock, S.L. and Jacot Des Combes, H., 2019. Using vocational education to support development solutions in the Pacific: An emphasis on climate change and health. *Applied Environmental Education & Communication*. ISSN 1533-0389
- Hemstock S.H., Jacot Des Combes H., Martin T., Vaike F.L., Maitava, K., Buliruarua L.-A., Satiki V., Kua N., Marawa T, (2017). A Case for Formal Education in the Technical, Vocational Education and Training (TVET) Sector for Climate Change Adaptation and Disaster Risk Reduction in the Pacific Islands Region. In: *Climate Change Adaptation in Pacific Countries: Fostering Resilience and Improving the Quality of Life*. Climate Change Management . Springer International Publishing, Berlin, pp. 309-324. ISBN 978-3-319-50093-5
- Hemstock, S.L., Buliruarua, L. A., Chan, E.Y.Y., Chan, G., Jacot Des Combes, H., Davey, P, Farrell, P., Griffiths, S., Hansen, H., Hatch, T., Holloway, A., Manuella-Morris, T., Martin, T., Renaud, F.G., Ronan, K., Ryan, B., Szarzynski, J., Shaw, D., Yasukawa, S., Yeung, T., Murray, V., 2016. Accredited qualifications for capacity development in disaster risk reduction and climate change adaptation. *Australasian Journal of Disaster and Trauma Studies*. 20 (1). 15-33.
- Hess, D.J., Collins, B.M., 2018. Climate change and higher education: Assessing factors that affect curriculum requirements. *Journal of Cleaner Production*, 170, pp. 1451–1458. Available at: <https://doi.org/10.1016/j.jclepro.2017.09.215>
- Hopkins, C., McKeown, R., 2010. Rethinking Climate Change Education. *Green Teacher*, 89, pp. 17–21. Available at: <https://www.humphreyfellowship.org/system/files/Rethinking%20Climate%20Change%20Education.pdf>
- Læssøe, J., Mochizuki, Y., 2015. Recent Trends in National Policy on Education for Sustainable Development and Climate Change Education. *Journal of Education for Sustainable Development*, 9, pp. 27–43. Available at: <http://dx.doi.org/10.1177/0973408215569112>
- Leal Filho, W. (2009) Communicating climate change: challenges ahead and action needed. *International Journal of Climate Change Strategies and Management*, 1 (1) pp.6-18 <https://doi.org/10.1108/17568690910934363>
- Leal Filho, Walter (Ed) (2010) *Universities and Climate Change: Introducing Climate Change to University Programmes*. Springer, Berlin.
- Leal Filho, Walter (Ed) (2017) *Climate Change Research at Universities: Addressing the Mitigation and Adaptation Challenges*. Springer, Berlin.
- Ledley, T.S., Rooney-Varga, J., Niepold, F., 2017. Addressing Climate Change Through Education. *Oxford Research Encyclopedia of Environmental Science*, pp. 1–40. Available at: <http://dx.doi.org/10.1093/acrefore/9780199389414.013.56>
- Lund University, 2017. Disaster Risk Management and Climate Change Adaptation - Master's Programme. Available at: <https://www.lunduniversity.lu.se/lubas/i-uoh-lu-TAKAK> [Accessed December 29, 2017].

- Martin, T., Hemstock, S.L., Jacot Des Combes, H. and Pierce, C. (2017) Capacity development and TVET: accredited qualifications for improving resilience of coastal communities: a Vanuatu case study. In: *Climate Change Impacts and Adaptation Strategies for Coastal Communities. Climate Change Management*. Springer International Publishing AG (Springer Nature), International, pp. 119-131. ISBN 978-3-319-70702-0
- McGinnis, J.R., McDonald, C., Hestness, E., Breslyn, W., 2016. An Investigation of Science Educators' View of Roles and Responsibilities for Climate Change Education. *Science Education International*, 27, pp. 179–192. Available at: <https://files.eric.ed.gov/fulltext/EJ1104645.pdf>
- Milér, T., Hollan, J., Válek, J., Sládek, P., 2012. Teachers' understanding of climate change. *Procedia - Social and Behavioral Sciences*, 69, pp. 1437–1442. Available at: <https://doi.org/10.1016/j.sbspro.2012.12.083>
- Monroe, M.C., Plate, R.R., Oxarart, A., Bowers, A., Chaves, W.A., 2017. Identifying effective climate change education strategies: a systematic review of the research. *Environmental Education Research*, pp. 1–22. Available at: <http://dx.doi.org/10.1080/13504622.2017.1360842>
- National Research Council, 2012. A Framework for K-12 Science Education. Practices, Crosscutting Concepts, and Core Ideas. Committee on a Conceptual Framework for New K-12 Science Education Standards.
- Nazir, J., Pedretti, E., Wallace, J., Montemurro, D., Inwood, H., 2009. Climate Change and Sustainable Development: The Response from Education - The Canadian Perspective. Centre for Science, Mathematics and Technology Education Ontario Institute for Studies in Education, University of Toronto. Available at: <http://www.hilaryinwood.ca/pdfs/researchb/ESD%20in%20Canada%202009.pdf>
- NGSS, 2013. Next Generation Science Standards. Available at: <https://www.nextgenscience.org/> [Accessed December 27, 2017].
- Oversby, J., 2015. Teachers' Learning about Climate Change Education. *Procedia - Social and Behavioral Sciences*, 167, pp. 23–27. Available at: <http://dx.doi.org/10.1016/j.sbspro.2014.12.637>
- Stanford School of Earth, Energy and Environmental Sciences, 2017. About the Climate Change Education Project. Available at: <https://pangea.stanford.edu/programs/outreach/climatechange/about-climate-change-education-project> [Accessed December 29, 2017].
- UNDP (2013). Climate Change and Pacific Island Countries. Asia Pacific Human Development Report. Background Papers Series 2012/07. United Nations Development programme. HDR-2013-APHDR-TBP-07.
- UNDP in Belarus, 2015. International Assistance Helps Belarus to Face Challenges and Explore New Opportunities of the Climate Change. Available at: <http://www.by.undp.org/content/belarus/en/home/presscenter/pressreleases/2015/12/08/international-assistance-helps-belarus-to-face-challenges-and-explore-new-opportunities-of-the-climate-change.html> [Accessed December 29, 2017].
- UNESCO, 2017. UNESCO at COP23. Climate Change Education. Available at: <http://unesdoc.unesco.org/images/0026/002600/260083e.pdf>
- UNESCO, 2012. Education Sector Responses to Climate Change. UNESCO Bangkok, Bangkok, Thailand. Available at: <http://unesdoc.unesco.org/images/0021/002153/215305e.pdf>

- UNESCO, 2011. Recommendations from the UNESCO Expert Meeting on Climate Change Education for Sustainable Development and Adaptation in Small Island Developing States. Available at:
<http://www.unesco.org/fileadmin/MULTIMEDIA/HQ/ED/pdf/2011Bahamasrecommendations.pdf>
- UNESCO, 2010. Climate Change Education for Sustainable Development. Paris, France. Available at: <http://unesdoc.unesco.org/images/0019/001901/190101E.pdf>
- UNFCCC, 2019. 8th Durban Forum on Capacity Building. Available at: <https://unfccc.int/8th-durban-forum>
- UNISDR, 2016. The science and technology road map to support the implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030. Retrieved from www.preventionweb.net/files/45270_unisdrscienceandtechnologyroadmap.pdf
- United Nations, 1992. United Nations Framework Convention on Climate Change.
- University of Copenhagen, 2017. Master of Science (MSc) in Climate Change. Available at: <http://studies.ku.dk/masters/climate-change/> [Accessed December 29, 2017].
- University of Saskatchewan, 2012. Climate Action Plan. Available at: http://sustainability.usask.ca/documents/UofS_Climate_Action_Plan_2012.pdf
- USAID LEAF, 2016. Climate Change Curriculum Development Brochure. Available at: <http://www.leafasia.org/library/climate-change-curriculum-development-brochure> [Accessed December 29, 2017].
- USAID LEAF, 2015. Universities in Asia-Pacific Implement Innovative Climate Change Curriculum. Available at: http://www.leafasia.org/sites/default/files/public/resources/USAID%20LEAF%20SS5-Climate%20Change%20Curriculum%20and%20Universities_0.pdf
- Valentin, B., Abreu, D., Ramirez, O., Bynoe, P., Ferguson, T., Simmons, D., Gokool-Ramdoos, S., Lotz-Sisitka, H., Mandikonza, C., Sweeney, D., Pritchard, M., 2015. Not just hot air. Putting Climate Change Education into Practice. UNESCO. Available at: <http://unesdoc.unesco.org/images/0023/002330/233083e.pdf>
- Victoria University, 2017. About the Climate Change Research Institute. Available at: <https://www.victoria.ac.nz/sgees/research-centres/ccri/about> [Accessed December 29, 2017].
- Yi, J, Wu, P., 2009. IALEI-project: Climate Change and Sustainable Development: The Response from Education. Report from China. School of Education, Beijing Normal University, China. Available at: <http://rce-denmark.dk/sites/default/files/2017-04/Climatechangeandeducation.pdf>