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Climate Change Education in Teacher Preparation-Curricular and Pedagogical Approaches

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Climate change is a reality and existential threat not only to humanity but to the entire Planet Earth. Climate action is one of the SDGs (Goal 13) and target 13.3 of SDG 13 outlines and reiterates the role of education in awareness, building human and institutional capacity on climate change mitigation and scope for climate change education. Education plays a transformative role in not only realising the goals of ESD but also in mitigating the issues related to climate change. In this context, teacher education plays a pivotal role in empowering young people and citizens to take proactive role in mitigating climate change related issues at local and institutional levels and encouraging climate-responsive behaviour. This paper discusses the possibilities of positioning climate change education in teacher education programs and suggests various curricular and pedagogical approaches for the same.

Keywords: climate change education, teacher education program (TEP)

Climate change is one of the most pressing problems faced by not only humanity but the entire planet today. Global warming, caused by the emission of greenhouse gases, is accelerating climate change (IPCC, 2014). At the rate of ongoing emissions from human activities, it is projected that by the end of the 21st century, global temperatures will exceed by 1.5°C, which will have devastating and irreversible effects on all life forms on Earth (IPCC, 2021). Hardly any country is spared from the impact of climate change in the form of unpredictable weather patterns, rising sea levels, loss of biodiversity, shifts in vegetative zones and farming patterns, and the migration of animals, among other things. Not only is climate change impacting economies and livelihoods, but it is also affecting the vulnerable and impoverished populations the most (IPCC, 2014). Climate change is also exacerbating weather-induced health risks due to extreme hot and cold waves, an increase in infectious diseases, and water and food scarcity. According to the Global Climate Risk Index 2020 (Eckstein, 2020) India is the fifth most vulnerable country. Given that climate change is an existential threat, there is an urgent need to empower individuals "to acquire knowledge, skills, values, and attitudes," as enumerated in SDG Target 4.7 (UNESCO, 2017) Climate action is also one of the key themes of Education for Sustainable Development (ESD) for 2030 (UNESCO, 2017).

Climate Change Education

Education plays a transformative role in not only realising the goals of ESD but also in mitigating the issues related to climate change. Climate action is one of the SDGs (Goal 13) and target 13.3 of SDG 13 outlines and reiterates the role of education in awareness, building human and institutional capacity on climate change mitigation and scope for climate change education (UNESCO, 2017). However, according to the recent UNESCO report (2021), only half of the countries in the world have given importance to climate change in their curriculum. The climate urgency calls for integrating climate-focussed curriculum and evolve pedagogical approaches to address climate change in an interdisciplinary and transdisciplinary manner. Climate change can be addressed in three fundamental domains-carbon pricing, technological transfer/ innovation and behavioural change (Stern, 2007). In this context, education plays a critical role in both technological transfer and behaviour change in societies. An analysis of countries in the UN Framework Convention on Climate Change (UNESCO, 2022) shows that the domain of cognitive learning is given more importance than social, emotional or behavioural learning and enough attention is not given to socio-emotional skills and action-oriented competencies needed for sustainable development. Also, as per the 2021 UNESCO report only 40% of teachers are confident in teaching about climate change and only 35% are able to link climate change's impact on the local context. The abstract and complex nature of climate change poses a challenge to climate change curriculum. The transversal nature of climate change requires theoretical as well as action-oriented knowledge and due to the emerging field of inquiry, there are not any effective models for integrating climate change across various disciplines. This indicates the need for capacity building of teachers and teacher educators to integrate and address CC-related issues in the school curriculum.

Climate Change Education in India

As mandated by the Hon'ble Supreme Court of India (2003) Environmental Education (EE) is compulsory at all levels of education in India. At the school level, NCF 2005 recommended to integrate the EE across various subjects in an integrated manner following the infusion model. Hence at present the concepts related to climate change and environmental education are presented and addressed theoretically in subjects like Geography, Science, and Environmental studies. Environmental studies is also a compulsory paper at the undergraduate level. The recent policy in education NEP

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2020 also recommends to address climate change and mitigation in the school curriculum (11.8, NEP, 2020).

In a National consultative meet organised by the Centre for Environmental Education Ahmedabad in 2021, most of the school teachers expressed that Climate Change Education (CCE) needs to be incorporated into the school curriculum as a separate subject. Teachers also expressed that most of the time environmental awareness activities involve slogan poster competitions, tree plantation, Eco club activities, cleanliness drives like Swatch Bharat Abhiyan, etc. Teachers expressed the lack of resources and training to enhance knowledge about CCE (2021). One strong recommendation which emerged out of this national consultative meet is to incorporate CCE in pre-service teacher training and continuing professional development for in-service teachers.

Positioning Climate Change Education in Teacher Education-Curricular and Pedagogical Approaches

Though the urgency to address CC through education is recommended and reiterated by many national and international policies, there is no clear-cut direction of the scope and pedagogy for Climate Change Education (CCE) so far. Given the importance of transforming the educational institutions, GAP Priority Action Area 2 ("Transforming learning & training environments: Integrate sustainability principles into education & training settings"') calls for 'promoting whole-institution approaches to ESD in schools and all other learning and training settings'" (UNESCO, 2014b: 18). At present there is limited focus on target 13.3 (education for climate action) in policies and curriculum frameworks in India. Though NEP 2020 recommends the inclusion of climate change in higher education (11.8, NEP, 2020) there is no action plan so far for integrating climate change education in the teacher education program. Once the policy and curriculum frameworks at national and state level mandate CCE, the curriculum and pedagogy can address the climate change related issues in an organic manner. This also calls for a coherent policy for TEPs. As the ITEP (Integrated Teacher Education Program) is being envisioned by NEP 2020 to be offered by multidisciplinary higher education institutions, there is a lot of scope for integrating CCE in inter and transdisciplinary manner through value-added courses, Skill enhancement courses (SAC) as proposed by NEP 2020 in higher education. A Review of research indicates that there have been three models for main streaming ESD in teacher education (Leicht, 2018)-(i) the Collaborative Resource Development and Adaptation model; (ii) the Action Research model; and (iii) the Whole-of-System model. In the CRDA model ESD can take place through the provision of curriculum and pedagogical resources and adequate training in the use of these resources (Ferreira, Ryan, & Tilbury, 2006). Action Research Model engages educators as key agents of change through the process of action research. Whole of the system model seeks to introduce new curriculum and pedagogy and ensure change takes place in a multi-faced manner in the whole system (Henderson & Hillbury, 2004). As NEP 2020 aims to promote interdisciplinary and multi-disciplinary approaches in higher education, TEPs positioned in multi-disciplinary institutions offer a lot of scope for integrating climate change.

The following section discusses some curricular and pedagogical approaches for integrating CCE in TEPs.

Transformative and Experiential Pedagogy: CCE is about developing skills and competencies in not only understanding climate change but also empowering and motivating learners to be the change agents in mitigating climate change effects to some extent and contributing to a sustainable future. The pedagogical approaches needed to achieve this end should be learner-centred, action-oriented and transformative. This approach is grounded in the cultural-historical learning theory (Vygotsky, 1987) which provides insights into expansive learning and change and psychological aspects of transformative learning through the process of conscientization (Freire, 1970). This point of view highlights how engaging with and resolving contradictions in existing knowledge is a reflexive and expansive learning process and how change happens as participants uncover and resolve contradictions in their worlds. The learners' prior knowledge as well as their experiences in the social context are the starting points for stimulating learning processes in which the learners construct their own knowledge base. In action-oriented learning, learners are engaged in action and reflect on their experiences (Kolbe, 1984).

Transformative learning aims to empower learners to question and change their ways of seeing and thinking about the world, in order to further develop their understanding of it (Mezirow, 2000; Slavich & Zimbardo, 2012). A step further is the concept of "transgressive learning" (Lotz-Sisitka et al., 2015) which enumerates that learning in ESD has to overcome the status quo and empower the learner for critical thinking and the co-creation of new knowledge. This kind of experiential learning can be provided by engaging pre-service teachers in various inter-disciplinary and inter-departmental projects. Real life community projects, service learning, internships, action research, workshops and collaborations with other organisations working in the area of environment and climate change.

Developing Pedagogical Content Knowledge: As pre-service teachers have different disciplinary backgrounds, their content knowledge and pedagogical skills in addressing climate change concepts need to be strengthened. The TEPs need to focus on strengthening the theoretical understanding of climate change and climate science in pre-service teachers. This can be done in two ways: one is by offering optional or specialisation papers in climate change as it is done in many universities abroad and the other way is to contextualise in the general education or education perspective courses as well as in pedagogy courses. Review of literature shows that three main approaches have been used to mainstream ESD in teacher education. In '*Competency frameworks*', generic skills are competencies identified which provide a scaffold for teacher education programs and it is expected that by the end of their training, pre-service teachers will be equipped with these generic skill sets. The outcome of this approach could be simplistic, mechanized, and de professionalisation of teaching (Inman & Champain, 1996) ensure strategic addressing of ESD (Cutter-Mackenzie, 2003). The 'Content frameworks' are based on the premise that a variety of competencies needs content in TEP and as prescriptive topics for every education course are not possible, environmental education scholars have suggested essential content in learning for sustainability for pre-service teacher education. '*Pedagogical frameworks*' proposes a paradigm shift required for ESD to transform both education and people which needs pedagogical approaches that differ substantially from traditional teaching styles (Robottom, 1987) and employ critical pedagogy approaches (Tilbury, Podger, & Reid, 2004). Pedagogical frameworks can be used to integrate CCE into teacher education.

Competency-based Approach: The pedagogy of climate change needs to be action-oriented and reflective the emancipatory approach in ESD has identified key competencies needed for learners to become citizens to promote sustainability . Accordingly, the GAP highlights learning outcomes that stimulate learning and promote core competencies, such as 'critical and systemic thinking, collaborative decision-making, and taking responsibility for present and future generations' (UNESCO, 2014b: 12). "Using *pedagogical approaches based on experiential learning help in development of competencies vital for promoting sustainable developmen*t" (UNESCO, 2014b: 12). Teacher Education programs can adopt competency-based approach and the following listed key competencies as enumerated in UNESCO documents can form basis for climate change education.

Table 1

ESD Competencies

- *"Systems Thinking Competency:* the ability to recognize and understand relationships, to analyse complex systems, to perceive the ways in which systems are embedded within different domains and different scales, and to deal with uncertainty;
- *Anticipatory Competency:* the ability to understand and evaluate multiple futures possible, probable and desirable and to create one's visions for the future, to apply the precautionary principle, to assess the consequences of actions, and deal with risks and changes;
- *Normative Competency:* the ability to understand and reflect on the norms and values that underlie one's actions and to negotiate sustainability values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions;
- *Strategic Competency:* the ability to collectively develop and implement innovative actions that further sustainability at the local level and further afield;
- *Collaboration Competency:* the ability to learn from others; understand and respect the needs, perspectives and actions of others (empathy); understand, relate to and be sensitive to others (empathic leadership), deal with conflicts in a group; and facilitate collaborative and participatory problem-solving;
- *Critical Thinking Competency:* the ability to question norms, practices, and opinions; reflect on own one's values, perceptions, and actions; and take a position in the sustainability discourse;
- *Integrated Problem-solving Competency:* the overarching ability to apply different problem-solving frameworks to complex sustainability problems and develop a viable, inclusive, and equitable solution"

Note. (Source- Issues and trends in Education for Sustainable Development ,UNESCO 2018)

The curriculum and pedagogy of climate change education can centre around these competencies. Not only climate change education but the entire course of TEP can focus on developing and promoting these core competencies. Inter-disciplinary projects, action research, case studies, etc can be used to develop the above-mentioned competencies.

TEPs and Schools As Living Labs: The gap between 'learning to know' and 'learning to do' can be bridged to a large extent if the institutions become living labs and provide space for educators and students to operationalise some climate change solutions at the institutional level. This also falls under the whole institution approach. As living labs, the institutions should not only promote climate-responsive behaviour and involve the students in decision-making and policies at the institutional level for mitigating climate change and also give scope for promoting competencies discussed in the previous section. The local and community problems can also be discussed to innovate solutions.

Planning for Teaching Climate Change: In a school curriculum context, lesson planning usually centres on the cognitive approach to learning which is usually limited to knowing and recognizing concerns. However, ESD initiatives place more emphasis on socio-emotional dimensions and behavioural change practices. Co-engaged processes of coming to *recognize matters of concern*, that enable learners to *assess value* and *take action* towards transitioning to future sustainability, constitute a useful mediating progression for deliberative learning environments in ESD. These processes are commonly framed as competences for ESD (Schreiber & Siege, 2017) or as learning objectives for the SDGs (UNESCO, 2017).

SDG 13 (Climate action) has enumerated objectives in the cognitive, socio-emotional and behavioural domains. These objectives (Table 2) can serve as the focal point for the development of curriculum and resources. Pre-service teachers can integrate some of these objectives into their lesson plans and resources. These objectives can also serve as a point of reference for developing pedagogical content knowledge for both pre-service and in-service teacher education programs.

Promoting Research on CC in TEP: At present there is very little research on climate change education in the context of learning, models for main streaming climate change in school education and teacher education, pedagogy of climate change etc. In this context, TEI s need to explore and identify research areas especially action research and document best practises in educational settings which can be used to develop and promote participatory and transformative action-oriented pedagogies. Action research is one of the potential areas to involve both in-service and pre-service teachers in issues related to climate change. As CCE is transdisciplinary and transversal, it offers a lot of scope for interdisciplinary research, especially in areas like climate anxiety, climate justice, etc. NEP 2020 also emphasis interdisciplinary research as TEPs are to be located in multi-disciplinary institutions.

Institutional Collaborations: In order to create a diverse and cross-boundary learning environment for promoting global sustainability challenges (including the SDGs), educational institutions and educators should foster collaborations at the local, national, and international levels involving a range of societal actors, such as businesses, NGOs, public institutions and/or policy-makers. Such dialogues, collaborations, or projects empower students to learn about real-world challenges and from the expertise and experiences for building capacity as critical agents of change.

Promoting Citizen Science: Climate change offers a lot of scope for engagement in citizen science. Climate change and its impact on local communities can be explored and investigated by working with

local groups, NGOs, Scientists, and social scientists and the reports can be shared with larger groups working on solutions for mitigating climate change effects. This also gives opportunity to teachers and students to be part of the solution and develop ESD competencies.

Table 2

Learning Objective for Climate Change Education

Cognitive learning Objectives	Socio-Emotional Objectives	Behavioural objectives
1. "The learner understands the greenhouse effect as a natural phenomenon caused by an insulating layer of greenhouse gases"	1. "The learner is able to explain ecosystem dynamics and the environmental, social, economic and ethical impact of climate Change";	1. "The learner is able to evaluate whether their private and job activities are climate friendly and - where not - to revise them";
2. "The learner understands current climate change as an anthropogenic phenomenon resulting from increased greenhouse gas emissions "	2. "The learner is able to encourage others to protect the climate";	2. "The learner is able to act in favour of people threatened by climate change";
3." The learner knows which human activities - on a global, national, local and individual level - contribute most to climate change"	3. "The learner is able to collaborate with others and to develop commonly agreed-upon strategies to deal with climate change";	3. "" The learner is able to anticipate, estimate and assess the impact of personal, local and national decisions or activities on other people and world regions";
4. "The learner knows about the main ecological, social, cultural and economic consequences of climate change locally, nationally and globally and understands how these can themselves become catalysing, reinforcing factors for climate change"	4. "The learner is able to understand their personal impact on the world's climate, from a local to a global perspective";	4. "The learner is able to promote climate-protecting public policies";
5. "The learner knows about prevention, mitigation and adaptation strategies at different levels (global to individual) and for different contexts and their connections with disaster response and disaster risk reduction"	5. "The learner is able to recognize that the protection of the global climate is an essential task for everyone and that we need to completely re-evaluate our worldview and everyday behaviours in light of this".	5. "The learner is able to support climate-friendly economic activities".

Note. (Source-Education for Sustainable Development Goals: Learning Objectives UNESCO 2017)

Capacity Building of Teachers and Educators: In order to transform education systems to be climate change responsive, it is essential to build the capacities of teachers. Building the capacities of educators and trainers is one of the five priority areas of GAP (UNESCO, 2014). As expressed in the National consultative meet organised by CEE and interaction with the in-service teachers and pre-service teachers, there is a need for capacity building workshops and training modules to empower teachers and teacher educators in the pedagogy of climate change. This can be done by offering a wide range of courses, capacity building workshops, online courses and consultative meetings and mentoring programs by the teacher education institutions.

Drawing from the Indian Knowledge Systems: Sometimes local problems need local solutions and indigenous knowledge systems often provide a wealth of knowledge, especially in the area of sustainability. NEP 2020 has also placed a lot of thrust on integrating Indian Knowledge systems in formal education at all levels. Environmental awareness and sustainability consciousness have always been part of our lifestyles and ancient Indian culture has promoted sustainable development and reverence for the environment both in spirit and practise. Climate change education can derive traditional wisdom and insights which are much needed for mitigating climate change related issues. Climate change curriculum development can gain a lot from Indigenous and Local Knowledge (ILK) to help build locally relevant, culturally sensitive and incremental knowledge (Priyadarshini & Abhilash, 2019) to address anthropogenic problems.

Summing up

Research indicates that teachers' knowledge of climate change is limited and scattered and that they have many misconceptions (Ratinen, 2016; Lombardi & Sinatra, 2013). Furthermore, integrating multidisciplinary climate change education into schools is challenging, as many teachers continue to view climate change in a limited manner and as part of the science curriculum. Climate change is an existential issue and evokes a lot of emotions like anxiety, and worry, which also need to be taken into account Also, teachers' negative attitudes and feelings, such as fear and uncertainty impact attitudes and capacity-building in the learners (Hermans, 2016; Ojala, 2015). As emotions have a significant impact on learning, they should be addressed in climate change education (Pihkala, 2017). Instead of fear and anxiety, climate change education should stimulate hope and compassion in people. The political character of climate change and other sustainability issues makes it crucial to draw from critical theories of psychology, sociology, and educational philosophy (Ojala, 2022). Positioning

the CCE in TEP needs to be based on the premises of a 'Holistic approach', 'Envisioning Change ', and 'Achieving transformation' (UNECE, 2013). Integrative thinking involves creating opportunities for sharing ideas and expressions from different disciplines and cultures and working with different perspectives, dilemmas, and tensions. Envisioning change involves learning from the past, inspiring engagement in the present, and exploring alternatives in the future. It involves critical assessment of the process of change in society and envisioning sustainable futures and, the use of natural, societal, and built environments as context and sources of learning. Active transformation is based on reflective practices and the willingness to challenge assumptions underlying unsustainable practices. Translating the notions of conscientization and self-actualization into the classroom means that the teaching and learning processes need to be significant for both the teacher and the learner.

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