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## Integrating Climate Change Education Into Teacher Education Curricula in Mongolia

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## Abstract

Teacher education plays a crucial role in preparing teachers to teach about climate change and its impacts on nature and society. This study analyzes the pre-service teacher education curricula at the Mongolian National University of Education (MNUE) to determine the current state of integrating climate change education (CCE) into teacher education in Mongolia. This study aims to identify CCE current practices, gaps, and challenges. Terms related to climate change and/or climate change education have been extracted from the learning objectives of the SDG 13 “Climate Action” according to United Nations Educational, Scientific and Cultural Organization and the extent of their occurrence in the syllabi of all courses offered by the MNUE’s undergraduate schools has been analyzed. The analysis has revealed that the terms only appeared in 24 courses, mostly professional education courses, and CCE is not emphasized in the curricula. According to the findings, CCE is found in only two course syllabi, and the extracted terms have not been directly incorporated into any of the five sections of those syllabi. However, the study has identified some good practices that can be built upon to enhance the integration of CCE into teacher education. The findings of the study provide a foundation for further research and development of strategies to mainstream CCE in the teacher education schedule.

*Keywords:* Climate change education, curriculum analysis, intended curricula, teacher education.

## Introduction

Mongolia is one of the most vulnerable countries to climate change worldwide due to its unique geographical location, encompassing various natural belts and a harsh continental climate. A significant portion of Mongolian life relies on climate and natural conditions, particularly for herders, who are inseparable from these conditions. Notably, around 90% of Mongolia’s territory belongs to arid and semi-arid zones, and the frequency of droughts has markedly increased (Ministry of Environment and Green Development [MEGD], 2014). Furthermore, approximately 77.8% of the total area has experienced desertification to varying degrees. These indicators underscore the urgency of raising awareness about the impacts of climate change and the imperative need for an environmentally friendly attitude and behavioral change through climate change education (CCE).

However, it is essential to recognize that CCE is a relatively new concept in Mongolia, marked by the absence of systematic policies and supporting documents. Existing national policies related to climate change, such as the National Climate Change Program, Green Action Plan, and 2030 Agenda for Sustainable Development, do not sufficiently promote CCE for both teachers and students. According to a UNESCO’s survey (UNESCO, 2021), nearly half (47%) of national curricula worldwide lacks references to climate change, a category that Mongolia falls under. National curricula in Mongolia across all school levels scarcely mention climate change, with only a few science subjects,

primarily biology and geography, addressing this topic. The key challenge in teaching and learning about climate change in schools is the dearth of CCE educational policies, curricula, and pedagogies, as well as teachers' ability to practice CCE. Focusing on the latter requires new developments in teacher education for CCE.

This study aims, therefore, to analyze the pre-service teacher education curricula at the MNUE to gauge the extent of CCE integration and provide recommendations to enhance the curriculum and pedagogy for more effective CCE inclusion. The MNUE is the largest university of education in Mongolia, training teachers at all levels from primary to upper secondary education. The significance of integrating CCE into teacher education is multifaceted. First, it empowers teachers with the required knowledge and skills to engage students in climate change mitigation and adaptation, laying the foundation for a more sustainable future. Second, this integration amplifies awareness about climate change on a broader scale. Informed teachers are more likely to discuss climate change with their peers, friends, and family, creating a ripple effect that builds an informed and engaged society. Last, CCE promotes interdisciplinary learning by intertwining science, social studies, and various subjects. It enables students to appreciate the interconnections between different disciplines and how they relate to real-world issues. In addition, Climate education must make sure that students understand concepts about the climate, but that this is reflected in actions (Ramos et al., 2024).

Climate change education for sustainable development is a nascent concept in Mongolia, and the country is in its initial stage of incorporating related concepts into its education system. Given that climate change is integral to themes of Education for Sustainable Development (ESD), it connects with nearly all ESD themes, such as renewable energy, biodiversity, disaster risk reduction, sustainable consumption and production, poverty, peace, and international understanding. Therefore, we set the following research questions in this study to promote CCE in teacher education for sustainable development.

**Research Question 1:** To what extent is CCE currently integrated into the pre-service teacher education curricula at the MNUE?

**Research Question 2:** What are the key gaps and challenges in the existing teacher education curricula at the MNUE that hinder the effective integration of CCE?

**Research Question 3:** How can the key gaps and challenges be addressed to improve CCE integration?

## Literature Review

Climate change stands as a profound threat to humanity, exerting its influence on where people can live, their ability to grow food, maintain infrastructure, and preserve health (UNESCO, 2016). The sixth assessment report by the Intergovernmental Panel on Climate Change (IPCC) underscores the unequivocal human impact on the climate system, recent surges in anthropogenic greenhouse gas emissions, and the far-reaching consequences of recent climate change on human and natural systems (Intergovernmental Panel on Climate Change [IPCC], 2021). The United Nation's 2030 Agenda for Sustainable Development has responded by introducing a specific sustainable development goal (SDG) on climate action – SDG 13, recognizing the interconnectedness of the climate

crisis with global challenges such as gender inequality and ethics.

CCE and public awareness are essential for informed decision-making, enhancing community capacity for climate adaptation and mitigation, and empowering individuals to embrace sustainable lifestyles (UNESCO, 2017). As the adage goes, “Changing minds, not the climate”, it is imperative that educators acquire the required knowledge, skills, values, and attitudes to promote sustainable development.

The Paris Agreement (United Nations, 2015) underscores the pivotal role of education, training, and public awareness. Target 13.3 of SDG 13 outlines and reiterates the role of education in raising awareness and building human and institutional capacity for climate change mitigation, as well as the scope of climate change education (UNESCO, 2017b). While numerous studies have focused on integrating sustainable development goals into curricula (Fiel’ardh et al., 2023), a recent UNESCO report (UNESCO, 2021) indicates that only half of the countries worldwide prioritize climate change education in their educational curricula.

Teachers play a central role in the dissemination of CCE ideas to schools, families, and communities, as well as in raising public awareness. Their knowledge, skills, and attitudes regarding climate change are indispensable for informing the younger generation and facilitating whole-school approaches to climate action (UNESCO, 2016). Consequently, learners’ contributions to climate change mitigation and achieving climate-friendly schools are closely tied to the capacity of teachers, their pedagogical content, and teaching methods.

Recent research has revealed low climate change knowledge among the general population (Carvalho, 2011; Leiserowitz, 2011; McCaffrey, 2008). Even among university students enrolled in science-related courses, misunderstandings can persist after instruction (Lambert, 2011). This underscores the challenging and contentious nature of the climate change discourse (Dawson & Carson, 2013).

Teachers are primarily responsible for imparting accurate information and raising awareness on climate change, so particular emphasis should be placed on pre-service teachers at university education faculties. To engage in CCE effectively and responsibly, teachers must bolster their preparedness regarding climate change issues. They should possess interdisciplinary teaching capabilities, a strong knowledge base, and a commitment to keeping abreast of developments in the field, fostering skills and critical thinking for problem-solving.

Many researchers (Leal Filho & Hemstock, 2019) have identified challenges for teachers in CCE, including the incorporation of a subject perceived as controversial into the curriculum, a lack of personal knowledge about the human causes of climate change, and the guidance of students on climate change actions. Integrating CCE into teacher education curricula is crucial for several reasons. First and foremost, teachers equipped with CCE knowledge and skills are better positioned to prepare students to understand and address the global challenges posed by climate change (UNESCO, 2017b). CCE not only fosters environmental awareness but also encourages sustainable behaviors among students. This is vital for cultivating a generation that values sustainability and understands its importance for a sustainable future (Stevenson, 2013).

Integrating CCE into teacher education promotes critical thinking and

problem-solving skills by engaging future educators in understanding and addressing complex environmental issues. CCE offers an interdisciplinary approach to learning. It connects science, social studies, and other subjects within the teacher education curricula, providing a holistic understanding of climate change from various perspectives (Heimlich & Ardoin, 2008). Moreover, CCE empowers future teachers to integrate climate change topics into their teaching methods, enabling them to educate students effectively and inspire them to take informed actions against climate change (Reid, 2019). By incorporating CCE into teacher education, civic engagement among future educators is also encouraged. They learn about their roles and responsibilities in educating students about climate change at local, national, and global levels. Understanding climate change is not only about science; it also encompasses cultural and ethical dimensions. Integrating CCE into teacher education fosters empathy, cultural sensitivity, and a comprehensive understanding of the broader implications of climate change among future educators and their students (Jickling & Wals, 2019). Many teachers are not sufficiently prepared with the knowledge and strategies needed to engage students in addressing the climate crisis. This underscores the importance of enhancing climate change education within teacher training programs (Beach, 2023).

An effective approach involves integrating the climate change curriculum into existing curricula, rather than treating it as a separate subject. This approach aligns with the concept of education for empowerment, characterized by its participatory, affective, multicultural, dialogical, democratic, investigative, interdisciplinary, and activist nature (Organisation for Economic Co-operation and Development [OECD], 2018). It underscores the need for key competencies, encompassing cognitive, practical, creative skills, and psychosocial resources.

The challenges in integrating CCE into teacher education are highlighted, echoing issues observed in Education for Sustainable Development programs. These challenges include the absence of standard guidelines due to university autonomy, difficulties aligning CCE courses with teacher education schedules, uneven coverage based on educator interests, and limited compulsory courses with few electives (Fujii, 2023).

Teachers are unprepared for the integration of action and content knowledge that characterize climate change education – particularly in science (Heimlich & Ardoin, 2008), where subject knowledge tends to be more factual (Oversby, 2015). Several authors have conducted studies examining the Pedagogical Content Knowledge (PCK) of pre-service teachers in climate change education (Favier et al., 2021). These studies have also explored the interdisciplinary nature of climate change education, highlighting the challenges and opportunities it presents for teacher preparation and curriculum integration.

The integration of climate change education into teacher preparation necessitates a comprehensive and collaborative approach. Collaborations between environmental experts and teacher educators have proven effective in enhancing the relevance and quality of climate change education (Johnson et al., 2018). Professional development opportunities tailored to climate change topics are vital for equipping teachers with the necessary knowledge and skills.

Curriculum integration stands out as a key strategy, ensuring that climate change

topics are seamlessly woven into existing teacher education curricula. CCE should be understood as a cross-cutting curriculum element and widely integrated not only in science subjects such as science and social science subjects but also in the humanities. To mainstream CCE in schools and teacher education institutions, CCE should be more firmly positioned in school education policy and curricula (Fujii, 2023).

## Methodology

The MNUE is one of the largest universities in Mongolia and has nine branch schools such as the School of Social Sciences and Humanities, the School of Mathematics and Natural Sciences, and the School of Physical Education. The university is a national teacher training institution, which has been playing a leading role in preparing teachers and professionals in the education sector and has 39 academic programs for preparing teachers. In other words, the university recommends over 39 kinds of teachers' professions, such as Mongolian language, history, mathematics, and biology. Undergraduate programs require students to earn at least 124 credit points (CPs) from general foundation courses, teacher education courses, and professional education courses.

**Table 1**

*Overview of Undergraduate Programs*

General foundation courses – 25 CPs	II. Teacher education courses – 21 CPs	III. Professional courses – 78 CPs
1. Compulsory courses – 21 CPs 2. Elective courses – 4 CPs	1. Compulsory courses – 17 CPs, including 3 CPs for teacher education practicum. 2. Elective courses – 4 CPs	1. Compulsory courses – 70 CPs, including 5 CPs for experiment teaching practicum and 5 CPs for teaching practicum. 2. Elective courses – 8 CPs

Only syllabi from the 2022 academic year have been considered, and the occurrence of terms related to climate change and/or climate change education – extracted from the learning objectives, suggested topics, and learning approaches of SDG 13 “Climate Action” – has been analyzed (UNESCO, 2017) (Table 1).

**Table 2**

*Terms Related to CC and CCE From the Learning Objectives of SDG 13 “Climate Action”*

Learning objectives for SDG 13	Proposed topics for SDG 13	Examples of learning approaches and methods for SDG 13
Cognitive learning objectives: Greenhouse effect, natural phenomenon, climate change, emissions, human activities, global, national, local and individual level, prevention, mitigation and adaptation strategies, disaster risk reduction and response.	<ul style="list-style-type: none"> <li>- Climate change</li> <li>- Biodiversity</li> <li>- Sustainable production and consumption</li> <li>- Global justice</li> <li>- Disaster risk reduction</li> <li>- Poverty reduction</li> </ul>	<ul style="list-style-type: none"> <li>- Performing a role-play</li> <li>- Analyzing different climate change scenarios</li> <li>- Developing and running an action project or campaign</li> <li>- Developing a web page or blog</li> <li>- Developing climate-friendly biographies</li> </ul>
Socio-emotional learning objectives: Ecological, social, cultural, and economic consequences, prevention, mitigation and adaptation strategies, global climate, our worldview re-evaluation, everyday behaviors, from local to a global perspective, collaboration with others, climate protection.	<ul style="list-style-type: none"> <li>- Water</li> <li>- Energy</li> <li>- Climate change</li> <li>- Disaster and risk reduction</li> <li>- Loss of biodiversity</li> <li>- Food crises</li> <li>- Health risks</li> <li>- Social vulnerability and insecurity</li> <li>- Mitigation</li> <li>- Adaptation</li> </ul>	<ul style="list-style-type: none"> <li>- Undertaking a case study</li> <li>- Developing an enquiry-based Project</li> </ul>
Behavioral learning objectives: Climate-friendly economic activity, climate-protecting public policy, anticipation, estimation and assessment of impact, personal, local, and national decision, evaluation of their private life and job.		

Each course syllabus has five sections: goals, learning objectives, contents, methods, and evaluation. The analysis has identified the terms related to climate change and/or climate change education in 24 courses – 4 general foundation and 20 professional education courses (Table 3). The relevant courses have been classified into humanities, social sciences, and natural sciences) and have formed the basis for the further analysis.

**Table 3**  
*Selected Courses*

	General foundation courses	Professional education courses
Humanities courses	- Physical Education	- Art I - Art II - Drawing and Design I - Drawing and Design II - Integrated Methodology (Elementary)
Social sciences courses		- Mongolian Language I - Mongolian Language II - Russian Language I - Russian Language II
Natural sciences courses	- Informatics I - Informatics II - Natural Science (Elementary)	- Physics I - Physics II - Biology I - Biology II - Geography II - Climate Change Education - Chemistry I - Chemistry II - ESD in Geography - Natural Science (Educational Study) - Mathematics (Elementary)

These syllabi are the so-called intended curricula, which indicate the course objectives, the designed pedagogical content, and the expected learning outcomes that educational institutions and educators aim to provide to students. It is important to note that intended curricula are just one part of the broader curriculum framework.

The entire analysis has been carried out adopting the T-LAB software. It offers a unique combination of linguistic, statistical, and graphical tools applied to text analysis. In this study, the T-LAB has been used to explore the terms related to climate change and/or climate change education and to analyze the most important relations among them. The initial phase has entailed scrutinizing terms associated with climate change and/or climate change education across five sections of the syllabi: goals, learning objectives, contents, methods, and evaluation within the selected courses. Subsequently, our focus has been narrowed to dissecting solely the CCE within the entirety of the syllabi content.

## Results

To provide more comprehensive answers to the research questions, we have utilized the terms for learning objectives of SDG 13 to analyze both the goals and the learning objectives of the courses (Table 4). Additionally, we have used the terms for SDG 13 proposed topics for evaluating course contents and assessments, as well as examples of SDG 13 learning approaches and methods for analyzing course methods.

**Table 4**  
*Occurrence and Frequency of Terms Related to CC and CCE*

Sections of syllabus	General foundation courses			Professional education courses		
	Terms	Freq	Courses	Terms	Freq	Courses
Goal				Climate change	1	CCE
				Human activities	2	CCE, ESD in Geography
CLO (Curriculum learning objective)				Climate change	2	CCE, ESD in Geography
				Human activities	1	ESD in Geography
Contents				Climate change	3	Geography II, ESD in Geography, CCE
				Poverty reduction	1	CCE
				Disaster risk management	2	ESD in Geography, CCE
	Water	3	Informatics I, Informatics II, Natural Science (Elementary)	Water	6	Biology I, Geography II, CCE, Chemistry I, Chemistry II, ESD in Geography,
					1	Drawing and Design I
	Energy	1	Natural Science (Elementary)	Energy	1	Natural Science (Educational Study)
				Food crises	1	ESD in Geography
				Adaptation	2	CCE, Geography II
				Mitigation	1	CCE

Continuation of Table 4

Methodology	Developing an enquiry-based project	2	Physical Education, Natural Science (Elementary)	Developing an enquiry-based project	3	Chemistry I, Chemistry II, Natural Science (Educational Study)
	Developing and running an action project or campaign	2	Natural Science (Elementary),	Developing and running an action project or campaign	2	Integrated methodology (Elementary)
						Mathematics (Elementary)
					1	Mongolian Language II
				Undertaking a case study		Chemistry II
Assessment		0			0	
Total		8			30	
Humanities courses		2				
Social sciences courses		1				
Natural sciences courses		35				
Total frequency of terms		38				

As a result of the text analysis, the term “climate change” has been identified within the goals of course “Climate Change Education” and the term “human activities” – as an integral component of the goals within the courses “Climate Change Education” and “ESD in Geography”. The frequency of the term “human activities” is two in each case. Other terms are not used in the goals of all courses.

Regarding learning objectives of the courses, the term “climate change” appears once within the courses “Climate Change Education” and “ESD in Geography”. Additionally, the term “human activities” has been identified exclusively within the course “ESD in Geography”.

We have conducted a comprehensive analysis of the terms within the contents of all course syllabi, identifying a total of 22 occurrences. We have found that certain terms, such as “climate change”, “poverty reduction”, “disaster risk management”, “water”, “energy”, “food crises”, “mitigation”, and “adaptation” are present. Subsequent research has revealed that these terms are encompassed within the courses “Climate Change Education”, “ESD in Geography”, “Geography II”, and “Natural Sciences (Elementary)”.

Course methods included “developing an enquiry-based project” and “developing and running an action project and campaign”. However, the terms such as “developing climate-friendly biography”, “developing a web page or blog”, and “analyzing different



Furthermore, the word frequencies have been analyzed, and a map has been generated. This process has determined that *nature*, *determine*, *method*, and *human* exhibit high frequency. Additionally, the analysis has revealed connections *between climate change education* and words such as *consequences*, *how*, and *human*.

As depicted in Figure 2, the concept “climate change education” is a response to human activity, and the imperative to mitigate impacts on the ecosystem is reflected in teacher training programs.

**Figure 2**  
*Word Associations of Climate Change Education*

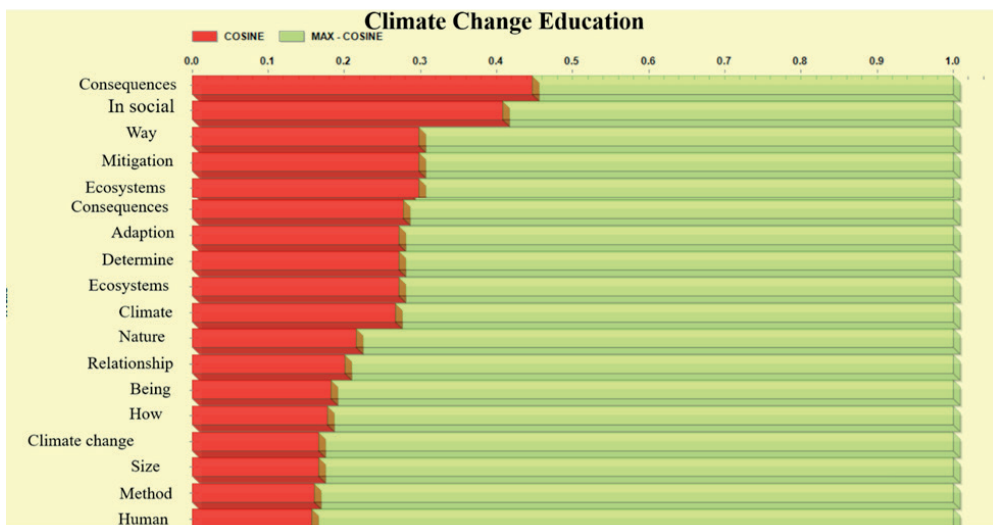
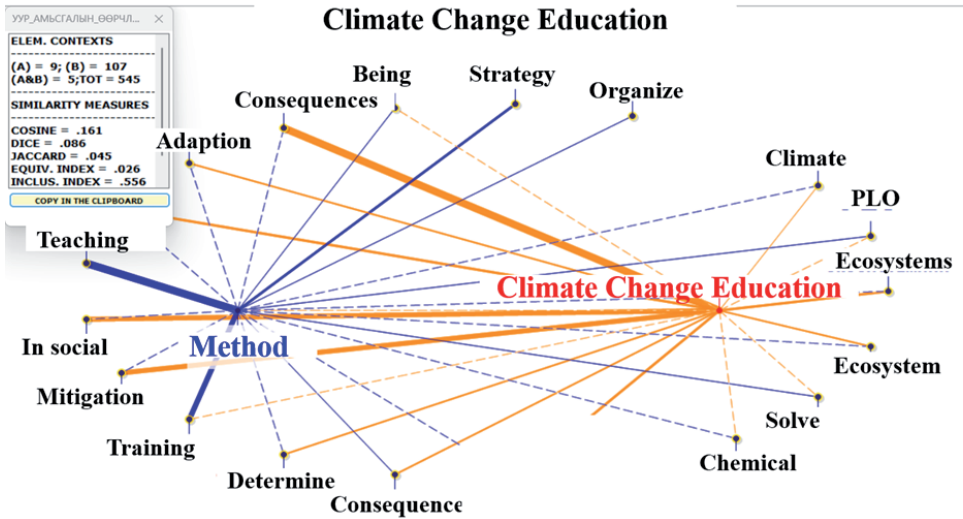


Figure 3 illustrates the interdependence between “Climate change education” and “Method”, which are associated with “Consequences”. Specifically, “Method” is directly linked to the terms “training” and “teaching”, while “Climate change education” is directly connected to “consequences”, “mitigation”, and “in social”. From this analysis it is evident that the “Methods” section of the syllabi of the courses incorporates content pertaining to climate change education and efforts to mitigate its consequences on nature and society.

**Figure 3**  
 Interdependence Between “Climate Change Education” and Method



## Discussion

The study has primarily focused on assessing the current level of integration of climate change education into pre-service teacher education in Mongolia. For this reason, an analysis of the curricula at the Mongolian National University of Education has been performed to identify climate change and/or climate change education-related terms.

Despite the methodological limitations and constraints arising from the limited selection of course syllabi, the Results section has uncovered a notable deficiency in the integration of extracted terms related to CC or CCE with the intended curriculum at the University. The findings suggest that Climate Change Education (CCE) remains in its infancy in Mongolia, marked by the absence of systematic policies and supporting documents, as well as limited knowledge and skills among teacher educators.

While ESD concepts are widely employed in the Mongolian educational sector and have been integrated into numerous curricula at secondary and higher education levels, the concept of CCE remains relatively contemporary, with variances in awareness and understanding. Several factors may contribute to the observed low level of integration between CCE themes and intended curricula at the University, and we have identified some of the most common reasons:

1. *Terminology Challenges:* The terminology associated with Climate Change Education has not been adequately formulated in the Mongolian language. This issue is compounded by scientists' use of various terms, contributing to a lack of standardization in the field.
2. *Limited Teacher Educators' Knowledge:* The research has indicated that teachers' knowledge about Climate Change Education is notably limited. This knowledge gap may hinder their ability to integrate CCE effectively into their courses.

3. *Lack of Pedagogical Preparedness:* Teachers may lack the necessary training and resources to understand how to teach climate change effectively. This can result in a disconnect between the knowledge available and the methods used to convey this information to students.

The culmination of these challenges underscores the imperative need for comprehensive efforts to bolster the integration of Climate Change Education into teacher education in Mongolia, rectify terminology disparities, enhance teacher educators' knowledge and training, and develop teacher training curricula that align with the evolving global understanding of climate change and its critical importance.

## Conclusions

This study has investigated the extent to which CCE-related themes and terms are incorporated into teacher training curricula. In this study, we have examined 24 courses, focusing on the collection of important CCE-related themes and terms as outlined in SDG 13, its learning objectives, proposed topics, and learning approaches and methods.

The findings of this study have illuminated a glaring deficiency in the integration of CCE-related terms within all courses offered by the MNUE's undergraduate schools. Only a handful of CCE-related terms have found their way into teacher training curricula. It is important to acknowledge that our analysis has, thus far, concentrated on the intended curriculum. To comprehensively assess the situation, further studies of both the implemented and achieved curricula will be conducted.

These findings underscore the pressing need for concerted efforts to strengthen the integration of CCE within teacher education in Mongolia. By addressing this deficiency, we can better equip our future educators with the knowledge, skills, and resources necessary to educate the next generation on the challenges and solutions associated with climate change. In doing so, we contribute not only to the global goal of mitigating climate change but also to the development of a more informed and environmentally conscious society.

Moving forward, it is imperative that teacher education institutions in Mongolia and around the world take proactive steps to bridge this gap, ensuring that climate change education becomes an integral and indispensable component of teacher training curricula.

## Recommendations

To enhance the methodology in both in-service and pre-service teacher training curricula, it is imperative to address certain key areas of improvement. As we have discussed above, in pre-service teachers, simply imparting knowledge is insufficient. To rectify this, we should focus on the steps outlined below.

1. **Develop Cross-Curricular Collaboration Modules:** Preparing and implementing cross-curricular collaboration modules is essential. These modules should eliminate rigid differentiation and promote a holistic understanding of CCE.
2. **Enhance Teacher Competency:** Address the limited knowledge application and competency of teachers regarding CCE. To achieve this, various approaches can be adopted:

- a) *Utilize the PBL-CCE Strategy:* Prepare and implement for cross-curricular collaboration modules, emphasizing the principles of Problem-Based Learning (PBL), particularly the 4P framework (Problem, Project, Place, Phenomenon). These modules should eliminate rigid differentiation and promote a holistic understanding of climate change education.
  - b) *Develop E-Content for Early Childhood Education:* Create e-content tailored to the interests and comprehension levels of early childhood learners. Platforms like the NASA Climate Kids app can serve as inspiration for developing engaging, age-appropriate content.
  - c) *Incorporate Socially-Oriented Courses:* Integrate socially-oriented courses and modules on CCE into the broader curriculum. These courses should extend beyond the realm of education to encompass various sectors, including industry, government, healthcare, and agriculture. A broad approach to climate change education, utilizing lifelong learning and non-formal education methodologies, is essential to reach all segments of society.
  - d) *Tailored Methodology for All Age Groups:* Recognize that the methodology for teaching CCE should be tailored to the specific needs and characteristics of learners across different age groups. Customized approaches can enhance the effectiveness of CCE delivery.
1. ***Revive Traditional Knowledge:*** Traditional knowledge, particularly among Mongolian nomads, plays a vital role in understanding and adapting to environmental changes. These traditions have historically involved weather prediction and observation of natural elements. In recent years, these practices have declined due to technological advancements. It is crucial to revive and integrate these traditional methods into education at all levels to foster a deep appreciation for nature and combat climate change.
  2. ***Promote Cognitive, Socio-Emotional, and Behavioral Training:*** Implement specialized training modules focused on cognitive, socio-emotional, and behavioral aspects. These modules should aim to empower young nomads and other community members to play an active role in preserving nature and reducing the impact of climate change. Incorporating Mongolian traditional methods into these modules is essential.

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